REPORT

ON

DEVELOPMENT OF DROUGHT PRONE AREAS

NATIONAL COMMITTEE

ON

THE DEVELOPMENT OF BACKWARD AREAS

PLANNING COMMISSION

GOVERNMENT OF INDIANEW DELHI

SEPTEMBER, 1981

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

1. INTRODUCTION

1. Apart from the size and the geographical spread of the drought prone areas, another important consideration why it is necessary to formulate and implement an appropriate development strategy for these areas is 'that they represent a major factor contributing to regional imbalances in development of the country.

[Para 1.5]

2. As compared to other areas, the drought prone tracts are more vulnerable to ecological degradation, leading to an increasing economic dependency and social deprivation.

[Para 1.7]

2. CRITERIA FOR DELINEATION OF DROUGHT PRONE AREAS

3. The water balance technique seems to be the logical approach for the objective of drought prone, area delineation. This approach takes into account precipitation, evapo-transpiration and soil moisture storage and attempts to arrive at a balance between wider income and water loss. The Committee is of the view that while this may be an ideal approach, it does not appear to be practical of this stage for delineation purposes owing to paucity of experimental data on evapo-transpiration, soil moisture over the semi- arid and tropical regions and evolution of appropriate area specific agro-climatic models. As the objective of this Committee is drought prone area amelioration for planning and implementation of programmes for this purpose this approach will be ideal, provided the basic data on the essentials can be developed. This will, how ever, take time. Our objective being to find means of increasing and stabilising productivity in the concerned area, it seems reasonable to follow, for our purposes a synoptic definition that a Block can be defined as drought affected if the pattern & quantum of rain-precipitation, during the main crop season of the area, makes the traditional cultivation of the main crop of the area hazardous in three years or more out of every 10 years.

[Paras 2.14 & 2.15]

4. Till the necessary data is collected, and a scientific assessment of drought prone Blocks is done, the present area brought under a drought prone area programme may continue to be handled under the special area programmes. It has been pointed out to the Committee during, its discussions with the States that even following the, criterion now prevalent on the basis of which present identification has been done, there are marginal areas of Blocks which need to be brought within the drought prone area programme. The Committee would recommend that any such cases should be examined on merit on the existing definition and brought within the programme if they qualify. At the same time keeping in view the recommendations of the National Commission on Agriculture that a periodic review of these areas is necessary because of the developments that are continuously taking place, it would only be reasonable to expect that those Blocks which have already come to a level of development which will put them outside the drought prone area category, should be removed from the programme.

[Para 2.16]

5. Whilst some new areas may qualify, some existing areas have to be deleted as non-qualifying. The Committee would, however, emphasise that a scientific delineation of areas is required if a scientific answer is to be found for the amelioration of the defect. [Para 2.17]

6. The list of the Districts and the Blocks in the State concerned which have been identified on the basis of the recommendations made by the National Commission on Agriculture and which have been taken up under the desert development programme, these may be looked into in case there has been any reorganisation of Districts or blocks.

[Para 2.21]

3. REVIEW OF PAST AND CURRENT PROGRAMMES

7. The present approach is mainly confined to development of agriculture and allied sectors with its major focus on restoration of the eco logical balance. But for an integrated development of any area, agricultural sector alone can not help to achieve the desired objectives. One of the major reasons for deterioration in eco logical balance in these areas is the excessive pressure of population on 'land. Without providing alternative sources of income, any attempt to promote optimum use of land and water can not succeed inspite of the improved dry land agricultural practices.

[Para 3.54]

8. Comprehensive planning aiming at abound development of the area has yet to be taken up. Even the basic survey of existing resources has not been completed and there has been lack of coordination between various agencies and programmes in the district for development.

[Para 3.54]

9. The present concept is supposed to be based on the watershed approach. It was how ever only during last two or three years of the programme that attempts are being made to try out this concept and that too in a few districts of Gujarat and Rajasthan. But in most other districts, sectoral officers considered DPAP and DDP only as a source, of additional funds and intensified their activities without any attempt for integrated watershed development. The fundamental objectives of restoring ecological balance had not thus been able to get the desired attention.

[Para 3.55 & 3.56]

10. Though in some .districts there was a mention of division of the, district into major and sub-watersheds in the master plan, the actual planning and implementation were not done on the basis of watershed approach. In most districts, the land and soil capability surveys, the resources inventory etc. have not been fully completed.

[Para 3.57]

11. In an integrated area development programme for the effective implementation of the approach, funding and expenditure should be controlled by the same agency. Unfortunately, however, this is not so. The programme for infrastructure development is substantially de pendent on outlays in the State Sector. The priorities of the State organisations controlling

such outlays meant for the entire State is, how ever, seldom in compatibility with the priorities of the drought prone area development administration.

[Para 3.61]

12. Conceptually, an area development programme cannot and should not be designed on the basis of a certain fixed sum of money being repeated every year. Moreover, infrastructure such as dairying, roads, electric transmission lines, have their impact over areas much larger than the blocks and even sometimes a district. The present system of funding leaves, therefore, much 'to be desired. [Para 3.63]

13. There is now sufficient technology avail able for increasing productivity in the drought prone areas of the country except in extremely difficult land and water situations. What is lacking, however, is an aggressive adaptive research and technological transfer programme through a proper extension machinery.

[Para 3.73]

4. STRATEGY OF DEVELOPMENT

14. A block should be the local area for assessing drought proneness. On the principles evolved by the Department of Meteorology for assessing recurrence of the period of high deficiency rainfall, an exercise should be done immediately to assess the position in the various blocks falling broadly in the region of the pre sent drought prone areas demarcated in country. This exercise will be more relevant to the objective the Committee is seeking than a broad classification by regions.

[Para 4.4]

15. Experience over the years has shown that every year some part of this vast country or the other is susceptible to drought. Where the drought is severe, relief measures are the obvious answer. The entire country cannot be drought proofed. In the chronically drought affected areas, the economy of the population can be, improved optimally with potential available in the environment to tide over the bad years.

[Para 4.5]

16. Till the delineation under the new criterion is done with the necessary field data, the present area delineated as chronically drought prone may continue to be dealt with under the special area programme.

[Para 4.6]

17. The problems of the desert areas are different in many ways from those in the semi-arid and dry sub-humid regions. An analysis of the situation shows a very complicated trend. Total cultivated area is much less than total areas available for cultivation. Animal wealth is under-exploited inspite of the fact that the tract can boast of the best Indian dual purpose breeds of cattle, and recognisable breed of sheep. The livestock economy is migratory in character, mainly due to lack of all the year around grazing and water facilities.

[Para 4.7]

18. In attempting the development of areas, the restoration of the ecological balance between the water, the soils, the, plants, the human and animal population should be a basic consideration and should underline the development strategy. It indicates the need for bringing about an appropriate land use pattern which will be conducive to attaining the necessary ecological balance.

[Para 4.8]

19. There is sufficient technology available for increasing productivity in drought prone areas of the country except in extremely difficult land and water situations. An aggressive adaptive research and technological transfer through proper extension machinery should be able to increase, productivity substantially.

[Para 4.11]

20. The aim and concept as outlined by the Committee in para 2.12 of Chapter 2 of its report on "Organisation of Administrative and Financial Structure for Backward Area Development", should be to improve the quality of life of the people in the backward areas. Policies and programmes should be conceptualised and designed, keeping this overall concept in view, and administrative, social and economic institutions adapted and adjusted towards this end.

[Para 4.14]

21. While a comprehensive frame will be the ultimate objective, the spread and the expectation will have to be adjusted to the present level of absorbable capacity of the population of new techniques and skills and the capacity of the administration and institutions to cover the field in the comprehensive manner required in a backward area. Under this approach, it should be borne in mind that the programmes, would have to be both area and beneficiary oriented. For beneficiary oriented programmes, "family" should be regarded as basic human unit for planning and development and for the area planning and development "Block" should be taken as the unit.

[Para 4.14]

22. The whole country has been covered by aerial photography in black and white and this is to be repeated at an interval of 5 to 10 years. The Survey of India gets the areas photographed and the photo interpretation techniques have been very well developed, where one can see many things. We can interpret the photographs in terms of geology, geomorphology, geohy-drology, land use, soils and forestry and they give us very specific information and detailed maps can be prepared covering all these aspects. Combining all the data and maps available with suitable ground level, we can prepare optimal land use and land capabality maps, which would provide the basic guidelines for planning for agricultural and other development. This technique can be used on a large scale, district-wise, region-wise and basin-wise to study in a scientific manner, our renewable resources for a proper land soil water management.

[Para 4.16]

23. The effect of drought is a lack of water balance which involves the soil structure, evapo- transpirdtion conditions of the various crops of the area and the rainfall pattern during the main rainfall season. This requires a much more de tailed analysis of the environmental

conditions for proper guidance on the types of crops and their varieties to be grown, proper land use in utilising pasture development, horticulture, plantations and forestry to make maximum use of the environmental conditions and land quality available. Utilising the macro guidance given by studies on the lines done by the CAZRI for districts in Rajasthan, the position will have to be refined for each block by suitably constituted inter-departmental groups, which will, after local check of the various parameters and the scientific knowledge then available, guide the extension workers in the types of land use that can be introduced, with profit.

[Para 4.17]

24. The CAZRI may train state level teams to carry out macro surveys in the drought prone areas as has been done by them in Rajasthan. These state-level teams must have the necessary technical expertise to further refine the macro studies and to give Recommendations at the block level for extension purposes. The Ministry of Agriculture may form a Working Group to develop this concept of a technical study team at the State level to perform this necessary function for drought prone area development. This working group may also go into the adaptive research work that will be necessary in each stage to refine the macro research conclusions on a location specific basis for the drought prone 'areas and identify the farms' and the groups that will do the necessary adaptive research.

[Para 4.18]

25. The States had been advised to form Land Use Boards which would undertake this work in the States. The Ministry of Agriculture is at present performing the functions of coordinating this work at the Central level. It was envisaged that a proper Land Use Board will be constituted at the Centre. The Committee places great reliance on a proper land use capability survey, particularly, in the drought prone areas, for maximising productivity of land under the hostile environment

[Para 4.19]

26. The basic sphere dominating the farm population is the possibility of drought and the famine, forcing it to produce as much as possible in a normal area not only for the home consumption but also as carry over for the next year when the food crops may fail. This fear complex leads to bad land use and anyhow does not satisfy the requirements for foodgrains. If the farm population is to be brought out of this fear complex, and persuaded to grow more valuable cash crops on that land, which is now possible by the technology available, or change over to pasture development and animal husbandry, there must be some guarantee that they will get their food requirements throughout the year at a reasonable price from nearby fair price shops. The country with its vast food distribution organisation is now in a position to give this guarantee provided the requirements are estimated in detail at the block level, adjusting requirements to the changes in cropping that have taken place and providing the necessary foodgrains through the season at nearby fair price shops. The Committee would specially draw attention to this support for a proper land, use strategy.

[Para 4.21]

27. There are lot of research findings available in the All India Coordinated Research Project for Dryland Agriculture. A continuous up dating of the technology has to be done in order to refine the field level advice to the extension organisation.

[Para 4.22]

28. Uni-disciplinary research now generally prevalent in the Agricultural Universities and Parallel Research being carried on in various institutions—Central and State—in various aspects of the sciences have to be brought together in a multi-disciplinary applied research programme in order to solve the specific problems of drought prone areas.

[Para 4.22]

29. A joint team of the ICAR and the World Bank had recommended the constitution of regional research centers on a multi-disciplinary basis by Agricultural Universities in the country to deal specifically with a multi-disciplinary approach to regional agricultural programmes including crop husbandry, animal husbandry, forestry, horticulture, and fisheries. The Committee will strongly recommend that this concept already enshrined in the reports of the Joint Committee be translated into effect by ICAR whether the World Bank is financing the same or not. Such multi-disciplinary regional research centres in each of many different regions of drought are vital to support the drought prone areas amelioration programme.

[Para 4.22]

30. Whereas a lot can still be done by tapping available surface and ground water resources in the drought prone districts, it has long ago been realised that amelioration of drought prone districts can only be carried out effectively by transfer of water from more richly endowed basins to the drought prone areas. In future planning, the, strategy will have to be to ensure that inter basin transfers are systematically developed and relief given to drought prone areas, particularly those which do not have much of natural precipitation.

[Para 4.25]

31. Crops give maximum return when the evapo-transpiration balance is maintained during the crucial periods of crop growth. In other periods, slight stress can be stood by the crops without serious damage. A little under-watering in the other period is not a serious constraint. On the other hand, the mentality of sufficiency of water leads to save productivity. Here there is a need for the laboratory to get close to the land in translating the principle of proper and economic water use.

[Para 4.26]

32. For making better use of available water in drought for crops to give maximum coverage in irrigation both by selection of crops needing lower water duty and by rigid control of water use in the irrigation systems by bringing into effect all aids for such controls like linking of canals and canal controls—if this method is followed, may be much more than 30 per cent of gross cropped area will receive attention. This should be the objective.

[Para 4.27]

33. Our first objective should be to ensure that each family in the area gets a reasonable firm base for his economy so that in serious droughts only marginal help will be needed for the family. Thereby also large scale migration of man and cattle can be prevented. There is, therefore, justification for bringing in the principle of social justice and equity in distribution

of water to the families. The Committee would recommend seriously such an approach to be followed, if necessary, with a legislative support.

[Para 4.29]

34. In middle India, it is generally noticed that in major irrigation schemes main canals pass through deep cuttings in several reaches and higher lands on both sides may be drought affected. It is desirable that where such situations exist, relief is given to the drought affected area by suitable lift irrigation projects.

[Para 4.30]

35. The Committee notices that generally minor irrigation schemes of surface reservoirs are not designed and constructed for commands less than in some States 200 acres and in some States 100 acres. This is due to the responsibility cast on various organisations for minor irrigation and their present capacity to survey and design the projects. In drought prone areas the precipitation has to be conserved on a watershed basis starting from highest available point for storage and gradually going down and trying to hold back as much as of the precipitation as possible within the watershed. This will require a system of designing small ponds and minor irrigation reservoirs for very small areas of command. The construction will be simple. An organisation will have to be given the responsibility for planning such water holdings structures on a watershed, basis in drought prone areas. The obvious organisation would be the soil conservation organisation suitably strengthened with the necessary expertise.

[Para 4.31]

36. Ground water exploitation and conjunctive use of ground and surface water will be an essential ingredient, in agricultural development of drought prone areas. In some of the arid and semi-arid areas the ground water is saline. In such especially difficult areas, a proper planning of conjunctive use, of saline and fresh water and suitable agronomic practices and selection of cultivars tolerating levels of salinity, will all have to be filled in to the programme. The objective is maximum use of whatever water is available. In this context, the large, scale experimentation by Haryana of utilising saline ground water in the canal system is worth looking into.

[Para 4.32]

37. The Committee recommends that immediately the present stage of use of the reservoirs in the various drought prone areas, the system of reclamation, and the cropping pattern may be investigated- quickly and at least within the next year a proper plan of maximining the use of such water drawn up.

[Para 4.34]

38. As a majority of the population in the drought prone areas depends on land based activities like crop-farming and animal husbandry, the core task for development will be to promote rational utilisation of land and available water. The research institutions working in agriculture and allied sectors have evolved considerable amount of technology for improving and stabilising the economy of watersheds in the drought prone areas. The major task now is its transfer, in a package, to the people residing in these watersheds.

[Para 4.35]

39. The Task Force on Rural Development as well as the National Commission on Agriculture has therefore rightly stressed that the strategy for development of drought prone areas has necessarily to be built mainly around animal husbandry. Animal Husbandry in conjunction with dairing is considered to offer a more stable base than crop farming for sustained income for the, rural households in these areas.

[Para 4.38]

40. Notwithstanding the land resource constraints, these areas do offer considerable scope for pasture and fodder development on the available areas if the latest technology for fodder crop and pasture development evolved at the Central Arid Zone Research Institute, Jodhpur, the Indian Fodder and Grasslands Research Institute, Jhansi, and other places is adopted appropriately. [Para 4.41]

41. The problem of employment has to be tackled by providing opportunities in the secondary and tertiary sectors. Unless the industries and service sectors absorb the unemployed and under employed, it will not be possible to reduce the pressure on land in the watershed area. These areas, however, have good potential to provide employment in the non-agricultural sector. Some of the drought prone districts have very good industrial resources like lime stone, bauxite and manganese. [Para 4.42]

42. For the development of industrial sector in the drought prone areas, the growth centre approach will have to be synchronised with the watershed approach so that a clear appreciation might emerge on the extent to which the plans for secondary and tertiary sectors are complementary and supplementary to the land based activities.

[Para 4.43]

43. In the context of development of drought prone areas, where new activities or functions are proposed, their location becomes extremely important because such location at appropriate places will start a chain reaction of development with far reaching effects. Therefore, an under standing of functional inter-relationships in space goes a long way towards the development of a drought prone area. Further, decentralisation and the actual location of functions need to be done with in the framework of a region encompassing both urban and rural sectors.

[Para 4.43]

44. In relation to the drought prone areas, separation of urban and rural areas spells harm from the point of view of the overall development of the region and its impact on the people. In the drought prone areas, a gradual urban rural continuem, should develop with the intensity of watershed approach combined with growth centre concept. The Committee has already dealt with this aspect in its report on Industrial Dispersal and on the development of village and cottage Industries.

[Para 4.43]

45. From many drought prone areas in the country there is seasonal out-migration of various types of labour to take advantage of the semi skilled labour opportunities available in the large scale industrial and construction development taking place in the country. There has

also been seasonal migration during the agricultural season like the sowing season and the harvesting season to the more agriculturally endowed areas to supplement the local labour in the crucial operations. In planning the development of a drought prone area, these out-migration opportunities should not be lost sight of.

[Para 4.44]

46. It has been noticed that intensive agricultural activities in many parts of the endowed areas has resulted in high wage employment to a large number of out-migrants from the poor agricultural areas. It may be necessary to assess these opportunities and utilise them instead of trying to keep back people in the drought prone areas under low wage employment schemes like the Employment Guarantee Scheme in Maharashtra.

[Para 4.44]

47. Many large projects like irrigation projects in the country are today suffering from lack of the right type of semi-skilled labour for completing their work on schedule. There is scope here for increasing the number of semi skilled labour who can get into these opportunities. The obvious places to look for such labour for upgrading their skills are the drought prone areas of the country. The Committee would emphasise that in planning labour for the people in the drought prone areas, the question of skill and wages should be kept clearly in mind. Whether within the area or by out-migration if the family can earn more and cross the poverty line, every step should be taken to see that the people are advised in the correct direction. Particularly, when moving large masses of labour to new opportunity centres, a good deal of State support in organisation and movement will be necessary.

[Para 4.44]

48. As development takes place alongwith the desired lines, many agricultural commodities for local processing and semi-processing will be available. Extraction of sunflower oil, milk processing, wool grading and preliminary processing are instances. The scope for such economic activity needs to be assessed in each area and processing units located, where feasible.

[Para 4.45]

49. The provision of drinking water supply is an important element in any programme of development in drought prone areas. These areas experience acute scarcity of drinking water, both for human population as well as livestock, because of low rainfall. In fact, no development of livestock is possible in potential areas without the facility of drinking water. Priority attention, therefore, needs to be given to locating sources of drinking water in those areas.

[Para 4.46]

50. Since there is paucity of local water re sources, water has to be inducted from outside the arid zone. The Rajasthan Canal Project is an instance of such an effort. This canal is de signed to irrigate areas along the western boundary of Rajasthan but the interior desert areas do not derive any benefit from it. The project should be recast to exclude unsuitable areas, where the cost of land leveling and development will be high and to construct life canals to take some water deeper into the desert with a view to bringing more areas under irrigation

and extending the benefit to a larger section of the community. A beginning has already been made in this direction.

[Para 4.47]

51. For maximising the utilisation of the scanty rainwater, suitable water conservation techniques like Khadnis, bandhis and alhandhis will have to be adopted on a larger scale.

[Para 4.48]

52. In the early stages of development of the canal command areas, there will be water to spare in the canals. This opportunity needs to be utilised. As water becomes available in an area, a large scale programme of tree plantation, raising of shelter belts and wind breaks and rejuvenation of vegetable cover will have to be undertaken. This programme will arrest wind erosion, sand blowing and sand casting on arable fields and also reduce the desiccating effect of hot winds on crops.

[Para 4.49]

53. The economy of the desert area should continue to be mainly animal husbandry oriented. The desert area has a natural endowment of several good breeds of cattle and sheep. A major thrust of the development programme has to be on 'the prevention, in a large measure, of the nomadism of the cattle breeders and sheep owners. An organised programme of livestock development will have stabilising influence.

[Para 4.50]

54. In canal command areas dairy development and milk chilling centres and milk pro ducts factories should be undertaken.

[Para 4.50]

55. In the arid areas the major emphasis has to be on sheep development. The good breeds of sheep available in this region can be further improved both for wool and mutton.

[Para 4.51]

56. Apart from improving the quality of sheep, wool shearing and grading centres have to be established and arrangements made for wool and meat marketing. Another dimension to this development is the possibility of creating more employment in the cottage industry by processing the wool locally. For this, adequate extension support will be necessary.

[Para 4.51]

57. Attention has therefore to be paid to large scale development of pastures, regulated grazing to prevent over use and creation of grass reserves and fodder banks for supply of hay in scarcity years. In canal command areas, the cropping pattern has to be adjusted to bring 30 per cent of the area under fodder crops in mixed farming.

[Para 4.52]

58. The cold desert in the country occurs in Ladakh valley in Jammu and Kashmir. The Lahaul Spiti Valleys and the Kinnaur region in Himachal Pradesh are also considered as cold

semi arid. The population in these areas is sparse. The extreme climatic conditions, lack of communication and the level of education make development of these areas a difficult task. All efforts made so far to develop these areas achieved little success. The Committee would, however, like to emphasise that the available information is not sufficient for formulating the strategy for development and indicating the feasibility of different programmes. In our view, many more investigations and more extensive research based on local environmental conditions—physical and socio economic are required before viable economic programme can be implemented effectively in these areas. This has to be given the top most priority.

[Paras 4.53 & 4.56]

5. WATERSHED APPROACH

59. For a complete watershed approach one has to bring soil conservation measures, water conservation and storage measures, dryland farming, animal husbandry, afforestation and minor irrigation as 'the minimum number of discipline under a coordinated approach. At present, the watershed approach in the DPAP is one of the many programmes that 'the district carries out under DPAP. It is taken as a separate programme by itself with a coordinated approach limited to few watersheds taken up under the programme. The Committee would, therefore, suggest that if the sub-plan approach that the Committee has recommended for all backward area development programmes in its report on 'Organisation of Administrative and Financial Structure for Backward Area Development' is now brought into effect in the DPAP district, 'this scattered handling of programmes, which should be brought together for maximum benefit, will not continue to affect growth.

[Para 5.3]

60. For planning a proper watershed apporach for any watershed the basic physical features like the physiography, land slope, nature and depth of the soil and the hydrological behaviour of the soils and the slopes in the watershed have first to be studied and analysed. Scientific allocation of the various parts of the land for the right type of vegetative cover, grass, trees or agricultural crops will depend on this initial analysis of the physical characters. The type of soil-conservation measures and moisture conservation measures can be planned on the basis of the physiographic data. The present land use and the hazards in soil and water deterioration that this leads to, have then to be studied in detail so that initially a programme of stopping the deterioration, with a follow up programme of rehabilitation of the areas that have deteriorated can be suitably designed.

[Para 5.5]

61. The watershed characteristics vary according to the permutations and combinations of the basic factors of land, slope, nature and depth of soil, precipitation and induction of water from outside. Thus, planning for two watersheds cannot be made on an identical pattern; a watershed management plan has to be highly location specific. It can therefore be carried out only by a technical group of experts who understand the variations of these factors in planning a watershed management programme. The planning cannot be left to lower levels of field workers. This group expertise should be available bale at the project level, supported by higher expertise in the line departments.

[Para 5.5]

62. Till a comprehensive attack on the problem can be made on a sub-plan basis in the DPAP districts, it is essential anyhow to ensure that the departmental schemes are suitably examined by the project authorities to ensure that they do not create the hazards and where such hazards exist due corrections me made in the project on a continuing basis.

[Para 5.6]

63. Normally a watershed management approach and plan would have been based on the rainfall precipitation within the watershed. All other aspects of planning like soil and water conservation, cropping, etc. would naturally follow this basic factor. On the other hand, as and when the master plans for minor irrigation, medium irrigation and major irrigation are carried out in the various districts it may so happen that the irrigation system will create complications in the plan already done and lead to substantial modifications in the watershed management programme. In order to avoid this, it is desirable to examine the watershed planning in a drought prone district against a master plan for irrigation and then work out a suitable plan of adjustment as the programmes of irrigation come into operation. This will have to be a continuous process of examination and adjustment.

[Para 5.7]

64. A monitoring of the soil and water loss from the watershed will be a correct measure of the extent of success that has been achieved in the planning and execution of a watershed management. Monitoring of both soil and water loss is easy in a watershed approach if the monitoring unit is located at a point at the outlet of the drainage system of the watershed. A time series of soil and water loss at this point will enable the monitoring authorities to estimate the effectiveness of the action. Where the monitoring shows no significant improvement as expected, the monitoring authority can work back to the minor watersheds within the watershed and identify the particular mini watershed which has to be dealt with in detail for better soil and moisture conservation. This action will have to be a continuous process of monitoring and improvement.

[Para 5.9]

65. If we have, to carry out large scale development on a watershed basis quickly, it may be desirable to handle large watersheds in the initial planning. On the other hand, a watershed management programme requires the cooperation of the villages. If too many villages are brought within the watersheds, it may be difficult to get the human cooperation that is necessary for effectiveness of the operation. Basing on these considerations, the Committee would recommend that generally in drought prone areas a watershed of the order of 5000 hectares would be a workable proposition. Of course, in specially difficult areas, the approach may have to be changed to different limits.

[Para 5.11]

66. Watersheds of smaller size have distinct advantage of involving a small number of villages within a resource unit that share the common historical, social and economic patterns. Selection of large watershed entailing large financial outlay for its development should be avoid ed because the larger the area of the water, the greater will be the heterogeneity in other water shed characteristics like soil, vegetation, slope, land use and socio-economic conditions. Hence, integrated planning will be complex for larger watersheds.

[Para 5.12]

67. As the funds for area development would naturally be limited, some priority in action will have to be brought in the planning. Where general deterioration has to be stopped and areas, rehabilitated, the programmes would generally be soil conservation and afforestation including pasture development. For this purpose, the watershed in the project area will have to be analysed for identifying mini watersheds falling under the following three classes:—

(i) substantial deterioration needing prompt action;

(ii) moderate deterioration where investments can be spread over a longer time; and

(iii) reasonably low deterioration areas which can be improved by mere human action in utilisation of the land and resources.

The large soil conservation programmes that the State undertakes every year should be worked out on above listed priority schedule.

[Para 5.14]

68. There should be an adequate mechanism at the State Headquarters and at field level for collection of data through field units or from concerned agencies. The need for the basic data should be fully recognised and their collection, analysis and interpretation should be considered as a pre-investment towards proper planning and implementation of watershed management programmes.

[Para 5.15]

69. The most logical step would appear to be to incorporate corrective measures in the existing land use system to make the present land use practices less vulnerable to erosion and degradation hazards. Simultaneously, alternative management practices should be introduced with demonstration of best practice slowly to encourage the beneficiaries to shoft gradually to the improved land use pattern. If the agro-Silvicultural practices or agro-horticultural practices can be made profitable while practicing mixed farming, it may be possible to achieve this gradual shift in land use pattern, and retiring the marginal and sub-marginal land from cultivation of common agricultural crops to productive and remunerative alternative uses.

[Para 5.16]

70. Some arrangements will need to be made in the planning cell for collecting representative base level data for typical areas representing dominant combindtion of practices such as bench terracing, afforestation, water harvesting system, pasture, etc.

[Para 5.17]

71. After the creation of the Department of Rural Development which handles the DPAP in the Ministry of Agriculture and Irrigation, the technical expertise rests in the Department of Agriculture whereas the responsibility for carrying out these programmes rests in the Department of Rural Development {now Ministry of Rural Reconstruction). There is therefore a need for bringing together the line hierarchies responsible for technical

development and technical planners comprehensively into the DPAP planning and implementation at all levels from the project upwards.

[Para 5.18]

72. At the project level, the project authorities must have directly under their control technical officers of sufficient capacity in water and soil management and afforestation.

[Para 5.19]

73. Super imposition of other capital facilities, which improve the logistic support and thereby economic conditions, should be taken care of at a much higher level, say the District Planning Cells and suitable coordination with corresponding organisations should be made at that level. At watershed level, too many line departments should not be brought together, as that would create confusion.

[Para 5.20]

6. ROLE OF AGRO-METEOROLOGY IN AGRICULTURE PLANNING

74. Reliability of occurrence of conditions suitable for sowing and identification of such specific periods are of considerable, importance to agriculture. In this .context, the water balance technique seems to be a dependable approach for the objective of drought prone area amelioration as it takes into account precipitation, evapo-transpiration and soil moisture storage and attempts to arrive at a balance between water income and water loss. However, owing to paucity of experimental data on evapo-transpiration and soil moisture over the semi-arid tropical regions of the country and evolution of appropriate area specific agro-climatic models, it is necessary to make a start with the preparation of a sowing rain commencement chart with available climatic data, primarily to, meet the needs of agricultural planning effectively and profitably. Such charts, in fact, have to be developed for different soil Zones of the country. Using long term rainfall data and making certain assumptions, this method aims at mapping out the most probable time by which summer monsoon rains in a region would build up enough soil moisture to commence sowing,

[Paras 6.4 & 6.5]

75. The new methodology for delineation of drought prone areas for a proper remedy to the situation would comprise:—

(i) Assessment of the duration of the cropping seasons for various soil zones of the country. For this purpose, determination initially of the commencement of Sowing Rains (CSR), utilising all available daily rainfall data and adopting a criterion (or criteria) that will contribute to the building of a moisture profile in the soil;

(ii) determination of dispersion of CSR;

(iii) compilation of inter-spell duration and total rainfall realisation during the spells;

(iv) determination of frequency distribution of inter-spell duration in various ranges;

(v) superimposition of map showing medium dates of CSR and interspell duration on soil maps;

(vi) identification of drought prone areas of varying magnitudes depending on soil depths, texture infiltration rates and water holding capacity; and

(vii) re-assessment of most profitable cropping pattern.

[Para 6.7]

76. The State Agricultural Universities, in collaboration with the Indian Meteorological Department and other concerned organisations, should take up analysis in hand immediately and prepare maps of drought .prone areas, delineated on the basis .of inter disciplinary exercises of superimposition of rainfall analysis of soil zones to provide the basis for drought proofing and modification of cropping patterns. The Committee would further recommend that such studies should be completed in respect of states having arid and semi-arid areas according to time bound programme. Discussions with the concerned people indicate that it should be possible to complete such, studies for different States substantially within a period of one year.

[Para 6.12]

7. SOIL AND WATER CONSERVATION

77. The Committee is quite aware that the economic conditions of the farmers in these areas is poor and free self-labour availability of the farmers is low. There are practical difficulties in mobilising self-labour for subsidised Working through extension methods under the Soil Conservation Acts. Ail these have resulted in the concept of integrated watershed management being rarely achieved, particularly when a large number of farmers are reluctant to join in the working. At the same time any soil conservation programme would be self-defeating unless the people, on whose lands these .are carried out, are not only involved in it effectively but have some stake in improving the land and maintaining it. The Committee has suggested certain measures in this regard in Chapter 4 of its report on "Development of Backward Hill Areas" and would like to reiterate the same here, namely:—

(i) that the existing practice of subsidising private works on farmers' lands should be continued;

(ii) if there are any works on the private lands like construction and renovation of risers, which would benefit not only the land on which they are located but also other lands belonging to other farmers, these should be treated as items of benefit to the community and financed to the extent of 100 per cent by the state; and

(iii) the existing practice of financing the soil conservation programme of community land on 100 per cent basis should continue.

[Para 7.12]

78. The Committee understands that there is some amount of confusion in the financing .of farm ponds. . Farm ponds may be of two kinds— (1) farm pond to be utilised by the land-holding itself, and (2) farm pond to be utilised on a joint basis by more than one holders. Where the farm pond is for the benefit of the holding itself, the expenditure has to be met by the farmer subject to such subsidies as are available in the State for the farm pond scheme for various levels of holding. For joint farm ponds, similarly the level of subsidies available in

the State for such joint enterprise will have to be followed. The subsidies vary from State to State.

[Para 7.13]

79. Soil and moisture conservation is a complex subject which calls for appreciation of role of other technical disciplines besides dominant involvement of a particular discipline. It is necessary to devise a cadre of soil conservation with the basic background such as forests, soil science, animal science or agriculture engineering. It is equally necessary to acquaint the policy makers, administrators and financiers with the role of soil conservation in the area of national and regional priorities of affecting various development programme of the country.

[Para 7.14]

8. DEVELOPMENT AND MANAGEMENT OF IRRIGATION

80. Even with the improvement of existing works and the completion of projects under construction, the bulk of the drought prone areas will continue to be dependent on rainfall. The Irrigation Commission has, therefore, rightly emphasised the need for investigations into further possibilities of increasing irrigation by both surface and groundwater. We fully endorse this view.

[Para 8.2]

81. The most striking feature of the drought prone areas is the absence of sizeable irrigation sources such as perennial rivers. Consequently, small works such as tanks, bhandars and dug- wells constitute the most important sources of irrigation; a large number of these works have at present structural and other deficiencies which need to be removed in order to improve their performance.

[Para 8.7]

82. In certain areas, where ground water level is low and irrigation from wells is precarious, attention may have to be given towards construction of percolation tanks and check dams on a watershed basis.

[Para 8.7]

83. It has long been realised that amelioration of drought prone districts can only be carried out effectively by transfer of water from more richly endowed basins to the drought prone areas. In future planning, the strategy will have to be to ensure that such inter basin transfers are systematically developed and relief given to drought prone areas, particularly those which do not have much of natural precipitation.

[Para 8.8]

84. The Committee strongly urge that necessary studies and investigations for formulation of a National Plan to transfer water from one system to another in order to utilise the surplus water to meet the needs of drought prone and deficit areas in the country should be given a very high priority. It is only when these plans are executed that the picture in the drought prone area would undergo a substantial change. Till then, the Nation would have to be

content with taking such other measures as are feasible for the development of draught prone areas keeping in mind the constraint that adequate water resources would not be available.

[Para 8.13]

85. The schemes of inter-basin transfer of river water would take a very long time to fructify, even if they are found technically feasible. In the meantime, it is local source of ground and surface water, to whatever extent. it is, available, which will have to be harnessed and reliance placed in the drought prone areas for bringing more area under irrigation. This underlines, among other things, the need for a quick and early completion of hydrological surveys in these areas. Recently, there has been a growing awareness on the part of the States to undertake these surveys. The Committee would strongly urge that this programme should be stepped up and both the Central Ground Water; Board and the State Ground Water organisations should complete the hydrological surveys of all the arid and semi-arid areas as per a time bound programme.

[Para 8.14]

86. Even With full exploitation of possible irrigation programmes in the drought prone district and with all transfers of water from other basins and may be possibly on a national basis, water will still remain a very valuable commodity for agriculture and human development. It is, therefore, necessary to ensure that available water is utilised to the maximum in improving the economics of the area. Here, there is a need for the laboratory to get close to the land in translating the principle of proper and economic water use.

[Para 8.15]

87. The necessity is for making better use of available water in drought prone areas to give maximum coverage in irrigation by selection of crops needing lower water duty and by rigid control of water used in the irrigation systems by bringing into effect all aids for such controls like linking of canals, canals control, land shaping, field channels, etc. The Committee would strongly urge that the objective in all sources of irrigation in the drought prone areas should be to get maximum return out of every unit of water.

[Para 8.16]

88. Where there is a serious constraint of water in irrigation system, there is need for much more equitable distribution of available water keeping in view the principle of social justice. The Government of Maharashtra found that for such equitable distribution of water, proper legislation should be introduced so that such irrigation system in particularly bad drought areas may automatically control the distribution under a legal process. [Para 8.17 & 8.18]

89. What is essential is that the limited water must be put to optimal use. This requires not only rationing of water but also banning the growing to such crops as require heavy irrigation like sugarcane, paddy, etc. The Committee would strongly urge that such an approach must be brought about if necessary with legislative support.

[Para 8.20]

90. Another aspect is that there must be concerted effort towards avoidance of water losses. The Committee would, therefore, urge that it should be enjoined on all concerned that

wherever an irrigation scheme of whichever type exists or is taken up utmost priority should be given to the introduction of optimum use of water practices. This also would go a long way in increasing the protection available to the farmers in these areas.

[Paras 8.21]

91. The Committee notices that generally minor irrigation schemes of surface reservoirs are not designed and constructed for commands less than in some States 200 acres and in some States 100 acres. This is due largely because of the responsibility of such works being cast on Irrigation Departments, which are not attuned to design and undertake small projects. In drought prone areas the precipitation has to be conserved on a watershed basis starting from the highest available point for storage and gradually going down and trying to hold back as much of the precipitation as possible within the watershed. This will require a system of designing small ponds and minor irrigation reservoirs for very small areas of command. An organisation will have to be given the responsibility for planning such water holding structures on a watershed basis in drought prone areas. The obvious organisation would be the soil conservation organisation suitably strengthened with the necessary expertise.

[Para 8.23]

92. In some of the arid and semi-arid areas the ground water is saline. In such specially difficult areas, a proper planning of conjunctive use of saline and fresh water and adoption of suitable agronomic practices and selection of cultivars tolerating some salinity, will have to be fitted into the programmes. The objective is maximum use of whatever water is available. In the context, the large scale experimentation by Haryana of utilising saline ground water in the canal system would be worth looking into.

[Para 8.24]

93. The present stage of use of the reservoirs in the various drought prone areas, the system of reclamation and the cropping pattern may be investigated quickly and, at least, within the next year a proper plan of maximising the use of such water drawn up.

[Para 8.26]

9. CROP PLANNING AND PRODUCTIVITY

94. Despite the technology being available and its economic feasibility established, still the farmers are not changing over to new pattern. The trouble is that every household is anxious to somehow produce sufficient food- grains of the varieties most prevalent in the area. This basic fear dominating the farm population is the possibility of drought and famine, forcing it to produce as much as he can do not only to meet his current consumption, but also, for a carry over for the next year when the food crops may fail. This fear complex leads to bad land use and anyhow it does not satisfy the requirement for foodgrains. If the farm population is to be brought out of this fear complex and persuaded to change the present pattern of land use, there must be some guarantee that they must get their food requirements throughout the year at a reasonable price and the type of food required by them from nearby fair price shop. The country with its vast distributing organisation should now be in a position to give this guarantee provided the requirements are estimated in detail at the block level, adjusting the requirements to the changes in cropping pattern that have taken place and providing the necesary foodgrains throughout the season at nearby fair price shops. This is the first essential and foremost support for a proper land use strategy.

[Para 9.6]

95. The topmost priority in the drought prone areas must be given to prepare optimal land use and land capability maps, which will provide the basic guidelines for planning for agricultural and other development. Once such maps are available, it would be necessary for the concerned planning and development authority in the area to draw plans to take up relevant developmental strategy for such lands as are found unfit for crop cultivation, or are in a position to give better return if diverted to uses other than crop farming. The Committee considers this as a very essential step not only for proper land use, and improving the productivity and economic conditions of the people living in these areas, but also in restoring the ecological balance which would go a long way in not only improving the conditions of the people in these areas but would also be in the larger national interests.

[Para 9.8]

96. Successful dry land agriculture requires a two pronged strategy. When the monsoon is normal, it should be used most effectively. Making the best of it involves a good deal of attention and work—the best varieties, the best practices, inter-cropping and so on. The second part of the strategy comes into operation the moment the weather turns aberrant. This approach must outline for each agro-ecological region the list of anticipatory measures and alternative' crop strategies that ought to be adopted when there is evidence of the incidence of drought. This kind of programme involves steps like :—

(a) Maximising production and altering crop patterns, when necessary, in irrigated areas;

(b) proper development and management of irrigation sources;

(c) mid season corrections in crop planning in un-irrigaied areas;

(d) introduction of crop life saving practices ; and

(e) building up of appropriate seed and fertiliser buffer to implement the drought cropping strategy.

[Para 9.12]

97. There are crops that could give farmers something in return for his effort even in un favourable years. These are fodder crops. Mixed cropping system comes into full play in this situation. If one crop fails, another comes to the rescue of the farmer. It is important to treat all practices as a package because it is the cumulative effect that enables a farmer to raise crops successfully in rainfed areas. It is needless to say that partial adoption of this package will not produce the desired result. This is the task which the State Agricultural Development Organisation in these areas must take up in right earnest and gear up the extension machinery as well as the input supply organisation towards this end. It requires a close and coordinated effort on the part of the various agencies involved in introducing this package approach and all have to work together as per a preconceived cropping programme, based on pro per land use pattern.

[Paras 9.13 & 9.14]

98. "Watershed based resource utilisation" involves the optimum use of the watershed precipitation for the improvement and stabilisation of agriculture on the watershed through

improved water, soil and crop management. More effective utilisation of water for the production of crops can be facilitated by one or more of the following means:—

(/) Directly by improving infiltration of rainfall into the soil and thus making more soil water available for plant use ;

(ii) through drainage, collection, storage and reutilisation of run off; or

(Hi) by water recovery from wells after deep percolation beyond the root profile.

[Para 9.18]

99. Many small farms and fragmented land parcels and often several different land uses—together compose a watershed, their presence must be accommodated within efficient water shed development and management techniques. In many situations, group action may be required to attain the desired objectives.

[Para 9.19]

100. Improve technology will relate to crops—variety fertility, management, land development, water conservation etc. In the end, millions of small, often illiterate farmers, who have little capital must learn to apply the tools of science to extract more food and ultimately a better quality of life from their hostile environment. Compromises must be found between short-term and long-term objectives. The challenge is great.

[Para 9.20]

101. Timely completion of all from operations before the rains is essential. The earlier the sowing is done, the longer the period the crop has to grow and mature. Hence, the tillage operations should be completed before the onset of rains. In an inter-cropping system it is necessary to till or harrow immediately after the harvest of one of the component crops, as otherwise weeds take over and the yield of longer duration component is drastically reduced.

[Para 9.29]

102. The various dry land research over the last six years have identified and/or fabricated several farming machinery. The costly implements could be supplied to farmers on hire service.

[Para 9.30]

103. During the last 6-7 years, scientists in different regions have evaluated all the important crops generally grown in the area for their relative efficiency of production. On the basis of data obtained efficient varieties/crops have been identified for different regions of the country and these are now available for use by the extension machinery. The experience has been that change-over to improved crop varieties is a basic requirement to enable the growers to benefit fully from yield based inputs, fertiliser, available moisture etc.

[Para 9.31]

104. The farmer will have to be prepared to sow as soon as the seeding rain occurs. This can only be done if the land has already been tilled after the previous harvest. It is some times suggested that this tillage should be done after the harvest at a time convenient to the farmer.

In drought prone areas, disturbing the top soil after the kharif harvest during periods of high temperature and high wind can lead to serious soil erosion. The tillage to be effective and, at the same time, not destructive will have to be done fust after the harvest so that the land settles down before the temperature and wind increases. Alternatively the tillage will have to be done at a time shortly before the expected seeding rain so that erosion effects are minimal.

[Para 9.33]

105. The most important contributor to the increased productivity of land in the drought prone areas is the utilisation of the land for a kharif crop wherever a kharif fallow, followed by a rabi programme, is the traditional practice. The analysis made by ICRISAT which we have reproduced gives the parameters for deciding which areas are suitable for a kharif sowing. The Committee would recommend that based on this analysis a kharif sowing shall be attempted at the seeding rain in all these areas in drought prone zones. [Para 9.35]

106. Special efforts should be made to enrich the organic matter content of drylands. All the organic wastes of plants, cattle dung etc. should be incorporated, into the soils as FYM or compost. The practice will improve the soil structure and their water holding capacities.

[Para 9.40]

107. Whilst various types of weed control have been experimented upon in the coordinated research programme, a proper cost benefit analysis has not yet been done which can enable the extension organisation to effectively introduce a chemical weed control programme. It is rather unfortunate that the cost benefit criterion has not yet entered the experimentation. There are a number of operational research programmes being carried out in many large areas in the country under strict technical control. It is necessary that these operational research programmes go into a proper analysis of the cost benefit that can be attributed to weed control in lands similar to those found in drought prone areas. Particularly, as vertisols (Black soils) and Alfisols (red soib) predominate, experimentation should now be done for these two types of soils in varying depth conditions immediately. The Committee would recommend an early examination of the weed control cost benefit as it has no doubt at all that in drought prone areas, with all good cultural practices, unless weed control is effectively done, substantial part of productivity will be lost.

[Paras 9.42 & 9.43]

108. Not only would consistent rainy season cropping often not be profitable, it would probably endanger the profitability of the more important post-rainy season crop. We, there fore, emphasise strongly the importance of breeding for high yield potential post-rainy season sorghums for these and similar regions.

[Para 9.50]

109. For extension and implementation purposes it is convenient to divide the system for farming into tow parts: (i) soil and water management technique; and (ii) cropping patterns and agronomic practice. Soil and water management designed to control run off to dispose of excess water and to minimise erosion frequently including direction of cultivation have to be planned and. implemented on a whole-watershed basis since guidance of water from plot to plot is cducial. On the other hand, cropping pattern decisions and agronomic practices should be adapted to the watershed topography, only if the benefit of such group action are sufficient.

[Para 9.53]

110. In actual field level experimentation, the farm pond has been found useful under vertisol conditions. The Committee will recommend that the present policy of supporting a farm pond system in the Vertisols in the low rainfall areas may continue. The actual cost per hectare of the system is not such that one should wait for the further field experience and hold back the national priorities. If necessary, adaptive research can be carried out on a sufficient sampling basis by State Department which may yet have some doubt on the subject.

[Para 9.58]

111. The cost of broadbed and furrow system is not very high considering the crop advantages that appear to arise from the package of practices. Time taken for primary tillage is a very important aspect in drought prone areas where the rainfall pattern is extremely variant and the moisture accumulation in the soil for seed bed persists only for very snort spells of time. It may, therefore, be worth considering by the extension organisations whether this additional expenditure should be undertaken or not. Anyhow there is definitely a case for adaptive research analysis in the medium and shallow vertisol areas.

[Para 9.60]

112. Research and experiments by themselves are not enough to decide on detailed advice on either the crop patterns or improved agricultural practices for various zones of the country with various types of soils and rainfall pattern under the low rain fall group. A lot of adaptive research will have to be done by the State Agricultural Departments in close association with, the ICAR research stations with the technical support of agricultural university, to evolve the most profitable or most fool proof crop or mixed crop system and improved practices which can be recommended in micro regions in the states under different soil conditions in drought prone areas. The Committee recommends that necessary adaptive research should be organised quickly in the blocks, particularly having black soils.

[Para 9.61]

113. Broad Bed and Furrows definitely have a benefit in the deep and medium Vertisols situation. Compared to the cost of land shop ping on this basis, the benefits are substantial. The broad bed and furrow system can be adopted in individual fields and need not necessarily be with adjustment of boundaries on a watershed basis. ICRISAT experimentation seems to prove that watershed based adoption of field boundaries to graded cultivation may result in only modest increase of gross returns. But this may not, be sufficient to motivate farmers to exchange land on a voluntary basis. They have also pointed out that whereas water control on a watershed basis is desirable for drainage and run-off and irrigation control, the existing field boundaries can be respected. From the practical angle, however, for selling this strategy to the farmers, more rational research oh the field under varying conditions is absolutely essential and the earlier it is undertaken it would be better.

[Para 9.62]

10. LIVESTOCK DEVELOPMENT

114. Arid areas are considered to be the best suited for sheep husbandry, which is already an important source of livelihood for a. large number of rural people. In semi arid areas the total live stock is pretty large. They are poor milkers hut good drought breeds. However,

these cattle and buffalo breeds require further improvement of their potential for production. Sub-humid arid areas also have sufficient livestock resources, but it is their proper use and management that would determine the success of the programme for their development. In humid arid areas the resource endowment is the best. The productivity of cattle is low and efforts are necessary to develop them through improved breeding and management practices.

[Paras 10.3, 10.4, 10.5 & 10.6]

115. Sheep as a specie is most suited for arid areas because of its close grazing habit and adaptability to the arid conditions. Expanding sheep population has, however, not only resulted in depletion of natural vegetation in their home tracts but also on their migratory routes. Because of their close and selective grazing nature and their ability to utilise many weeds and bushes and to travel long distances in search of forage and water, sheep have often been leveled as the creators of the desertic conditions. In reality, it is not the sheep but the man who owns the sheep who is to be blamed for mis-management of the grazing land which has resulted in the desertic conditions. Controlled and judicious grazing practices on the desert land could prevent soil from, erosion and the droppings collected on the fertile land over the years could eventually convert it to more fertile land.

[Paras 10.12, 10.13 & 10.16]

116. Improvement in production and quality of wool and body weight due to cross-breeding, provision of a better health cover and adequate supply of feed and fodder is expected to provide higher returns. However, no reliable data are available ort the economics of supplemental feeding of sheep during growing stages, breeding seasons, later part of gestation, lactation etc. In our opinion, it is necessary for the purposes of planning sheep development programmes to have detailed information on these aspects. We, therefore, recommend that the Indian Council of Agricultural Research (ICAR) and Agricultural Universities should initiate without delay studies in this direction.

[Para 10.17]

117. Crop husbandry in these areas with low total rainfall, is a gamble. All the farming communities, particularly small and marginal farmers, can better depend on sheep rearing as the main source of livelihood.

[Para 10.19]

118. Cross breeding of superior local flocks with exotic rams for better yield of mutton and wool will result in the production of bigger animals with higher body weight having proportionately higher nutritional requirements. Unless, therefore, a strong fodder base is created, the potentiality of the crossbred animals cannot be fully harvested.

[Para 10.19]

119. Having accepted a sheep rearing programme as an important part of drought prone area development, the Committee would recommend that detailed planning of the programme as is being done in the IDA districts on the basis of further experience so far gathered and a comprehensive attack on the programme in the district through a duly constituted extension unit with the relevant techno logy should be immediately brought into effect in all the drought prone area districts considered to be good for sheep breeding. There must be

continuous monitoring and improvement of the scheme so that full benefit from the programme accrues to the sheep rearers.

[Para 10.24]

120. Whilst performance in the IDA districts can be considered as better than in non-IDA districts, it has to be noted that the recommended level of flock per 100 hectares is 400. This has not been reached so far anywhere. The Committee recommends that the organisation for the technical management of these units and the technical support to the sheep rearer groups within the units should be improved to bring about the level of 400 sheep per unit within the next two years

[Para 10.27]

121. Village based flocks must have additional pastures. This is very relevant in drought prone areas. The Committee has already pointed out how l/3rd to half of the land holdings, whether small, medium or big, are left fallow every year in the poor rainfall areas because of inability to cultivate them in time. An extension programme should be launched to put some of these general fallow lands under a permanent pasture cover with suitable cultivation practices to maximise fodder production within the holding.

[Para 10.33]

122. In the desert areas we have to handle not only the village based flocks but also the flocks which are nomadic perennially and those nomadic for some months in the year.

[Para 10.34]

123. Nomadism is the problem mainly of the desert areas. If a large 2000 hectare plot is developed with groundwater where available or in a khadin' in a suitable location, the pasture under good management can easily support throughout the year a flock of 4 sheep a hectare or 8000 for the pasture.

[Para 10.35]

124. Considering the very large acreage that have been reserved for the base sheep breeding farms, the number of rams produced per year for distribution by the various farms seems to be strangely extremely limited. The Committee would request that an immediate study of the situation in these farms be made and the reasons why the available facilities have not resulted in much larger issue of rams for the field programme be investigated and the faults remedied quickly. Otherwise, the support for the large sheep breeding programme in the DPAP would never be forthcoming.

[Para 10.45]

125. While recommended breeds of sheep are now available for arid and semi-arid of the country, such breeds are not yet available for humid region. It is, therefore, suggested that sheep development in humid areas should be brought about mainly through selective breeding in local breeds and introduction of exotic breed must wait or be done in stages by using half-bred rams.

[Para 10.48]

126. In regard to sheep improvement programme of migratory flocks, it is essential to provide necessary facilities on the migratory routes like improved grazing, area availability of some conservative fodder, necessary inputs for sheep improvement like prophylactic vaccination and drenching, superior purebreeding rams, sheep shearing and wool and live animal marketing facilities. The sheep and wool extension centre should also have sufficient drinking water resources for human and animals. They may provide credit and banking facilities to the nomadic sheep farmers. The migration will be controlled by these centres through communication among different centres. [Para 10 51J

127. Majority of sheep under migration belongs to Marwari and Jaisalmeri breeds which are good carpet wool breeds. It may be desirable to improve the wool quality for manufacturing superior carpets. [Para 10.53]

128. The desert development report of the National Commission on Agriculture has emphasised the need for the development of pastures for sheep rearing. They have recommended that wherever irrigation schemes exist and particularly in areas commendable with lifts from the Rajasthan Canal System and by natural flows, substantial pasture development under irrigation conditions should now be taken up. The Committee would reiterate this recommendation and ask for rapid action.

[Para 10.55]

129. In the afforestation programmes that are now being taken up on a large scale, priority may be given to locating tree fodder units wherever possible and wherever sheep flocks are in a large number.

[Para 10.55]

130. One of the hazards which the sheep have to face is the lack of shade in summer. If tree fodder units can be spread over sufficiently large areas on a scattered basis, they will give sufficient shade for sheep flocks which are nomadic in summer and even for village flocks which has shade difficulty in summer.

[Para 10.55]

131. Although the importance of development of marketing facilities for wool and live animals and development of small scale wool based industry has been stressed earlier, it is further emphasised that such facilities must be organised both for the sedentarisetl and migratory flocks by the Government or the Cooperative Agencies as this will avoid profiteering by a number of intermediary agencies dealing with the marketing of live animals and wool.

[Para 10.56]

132. The, Central purchase of sheep from the cooperative and slaughtering them at a modern abattour necessarily means a follow up in the deep freezing carcass and marketing the meat in frozen condition. Obviously, in such a centralised location near the area of the sheep flocks there will not be any substantial market for fresh meat. The Committee will recommend that a well thought out programme should be developed for one such centre with a minimum economic level of sheep to be slaugh tered per day and a tie up made with large metropolitan consuming centres like Delhi, Calcutta, Madras and Bombay

[Para 10.57]

133. There will also have to be a well spread marketing organisation to push the sale of frozen meat to ordinary householders. In this context, the Committee would point out to the pioneering work done by the Fisheries De partment of Karnatakd in filleting of sea fish scopes for pasture and fodder development on the available areas if the latest technology for fodder crops and pasture development evolved at the Central Arid Zone Research Institute, Jodhpur, the Indian Fodder Grassland Research Institute, Jhansi and other places is adopted appropriately caught in Mangalore, transported in deep frozen conditions to a chain of retail centres in Banga lore for sale. By this and suitable promotion, substantial sqa fish consumption has been deve loped in Bangalore. Such a network of retail centres with link up to the main production centres will have to be planned for mutton on a similar basis in the pilot scheme.

[Para 10.57]

134. During migration, sheep from different areas mix up in the grazing zones and follow common migratory routes. Thus, one diseased flock may contaminate large areas of the grazing lands on its route causing serious threat to the other flocks grazing over those areas. As such, it is highly necessary to undertake routine prophy lactic measures against the commonly occurring diseases.

[Para 10.58]

135. Slaughter of goats for meat purposes should be increased so that the rate of growth of godt population may come down. The Com mittee has already indicated that in view of its habit it can cause damage to areas under afforestation. Suitable management systems should be, devised to exercise greater control over their movement and feeding habits.

[Para 10.63]

136. Breeding programme should be planned keeping in view the local agro-climatic conditions.

[Para 10.69]

137. Identification of breeds, both exotic and indigenous suitable for the area has to be done, to develop their productive capacity. Improved indigenous breeds from other areas with similar agro-climatic conditions should be utilised for upgrading of local, non-descript stock in the villages under dryland farming condi tions.

[Para 10.73]

138. Any programme for rapid improvement of cattle wealth and thereby the income from cattle would be most welcome addition to the poor economy of drought prone areas. Hence there is a need for rapid introduction of the crossbreeding programme. The Committee would, therefore, Strongly recommend that the basis of exotic cow farm, breeding bull farm and frozen semen banks should be brought up to great efficiency immediately so that an active cattle development can take place in drought prone areas.

[Para 10.74]

139. One of the reasons given for the slovs pace of spread of frozen semen technology is the lack of canisters for holding liquid nitrogen to keep the frozen semen straws in conditions

for insemination in the field. The Committee understands that the present demand far out-reaches available supplies in the country. The Ministry of Agriculture will have to take a close look at the present programme of demand and supplies and solve the problem satisfactorily. Otherwise, this single factor may be a serious deterrent to the rapid growth of animal husbandry in the drought prone areas.

[Para 10.75]

140. Murrah in Haryana and Mehsana and Surti in Gujarat are the high milk yielding breeds of buffaloes. These, breeds have attained not only all India importance but also inter national recognition as important milk breeds of baffdloes. The following approaches should be followed for improvement of these breeds. Firstly, their genetic potential for milk produc tion should be improved further through selec tive breeding in their native breeding tracts. Secondly, the sires of proven worth belonging to these breeds should be used for up-grading non-descript buffaloes in other areas through crossbreeding. Graded murrahs are considered suitable to and are being distributed in arid and semi-arid tracts of drought prone areas.

[Para 10.78]

141. The necessity for milk production en hancement being so great, all production poten tial should be actively exploited for obtaining the maximum possible use. This would re quire enlargement and strengthening of the existing programmes as also initiation of addi tional programmes. Carefully planned systematic breeding programmes including progeny testing of selected bulls should be undertaken for progressive genetic improvement of the stock.

[Para 10.80]

142. At present most of the veterinary hospitals are poorly equipped, do not have modem aids for arriving at prompt and correct diagnosis of diseases and lack facilities for undertaking surgical operations. Even drugs for treatment of common ailments are in short supply. These problems are more acute in the drought prone areas. The Committee would urge that where ver animal husbandry programmes is taken up; immediate steps should be taken to provide animal health cover.

[Para 10.81]

11. PASTURE DEVELOPMENT AND RANGE MANAGEMENT

143. Pasture development in drouhgt prone areas, apart from increasing fodder availability and thereby promoting development of animal husbandry, confers the benefit of providing grass cover on lands subject to wind and water erosion. Unles the livestock are fed adequately and with quality fodder to provide all the nutri ents in required proportions, their productive potential is not realised in the form of increased production of milk and other animal products. Adequate production and good quality of fodder and grass thus becomes a pre-requisite for the success of animal husbandry programme, so vital to the economy in these areas.

[Paras 11.1 & 11.3]

144. Notwithstanding the land resources constraint, these weas do offer considerabl scopes for pasture and fodder development on the available areas if the latest technology for fodder crops and pasture developmerit evolved at the Central Arid Zone Research Institute, Jodhpur,

the Indian Fodder Grassland Research Institute, Jhansi and other places is adopted appropriately.

[Para 11.8]

145. Another important problem in the implementation of pasture development was lack .of seeds of suitable grass species in adequate quantities. These were problems of adoption of these varieties. It is necessary to plan the pasture and fodder crops development properly and implement a package of technical recommendations within the watershed frame for the success of the programme.

[Para 11.12]

146. A conscious policy fixing annual targets in the various states for an existing grassland development and marginal land development is the answer. The identification and allocation of areas should be based on the regional expecta tions of development of types of domestic ani mals and their quality as have been postulated in the recommendations of the National Com mission on Agriculture.

[Para 11.15]

147. For planned grassland development leading to intensive fodder production, the area has to be kept out of the nomadic grazing by scrub animdls that goes on endlessly in all these lands. The nature of the soil in the grasslands thdt have been identified will enable the planners to decide which particular type of fencing will have to be used and what will be the minimum area of land that would be economically maintainable. This exercise will have to be done simultaneously by each state whilst identifying the grasslands.

[Para 11.17]

148. The programme of identification of grasslands and intensive development can generally be followed without much difficulty in areas reasonably away from the village sites. Where such lands are close to the village and in the areas demarcated as grazing lands with in the village boundary, the strategy of deve lopment will have to adapt itself to the people's need.

[Para 11.18]

149. There is a temptation for the, nomadic cattle and sheep breeders to drive their cattle 2nd sheep over sand-dunes stabilisation systems, under the garb of private rights. In the interest of the community's welfare, the Committee would recommend some legislative measures to ensure a complete fencing of all the land and ensuring and preventing direct grazing on such sand-dune stabilised areas. The grass will have to be harvested by manual labour and fed to the cattle and sheep.

[Para 11.19]

150. Naturally, grassland development cannot be taken up all over the area identified for such development. It is recommended that it would be desirable to take up the development work initially in areas where reasonable accessibility to water facilities are available so that the stabilisation of the grasses and fodder can be accomplished quickly so as to demonstrate the benefit from the new method to the people before they lose patience with the reservation.

[Para 11.20]

151. Both sheep and goat are part of the nomadic economy. The grasslands away from the village settlement that are developed either in the Government areas or reserve forest areas will have generally to be protected against indis criminate grazing. [Para 11.24]

152. In nomadic sheep rearing, the problem of improvement of the breed through artificial insemination or direct cover becomes difficult unless the flocks can be brought together to a fixed place during the breeding season. These large, grass reserves can be utilised as such centres for bringing together the sheep flocks of nomadic breeders at the time of breeding.

[Para 11.24]

153. When the' lambing takes place, the ewes and the lambs can also be kept in the settlement round the grass land with permission to Utilise grasses inside the reserve. Thus, active improvement of breed can be done. There is scope for this approach, particularity, in the States of Rajasthan, Gujarat, Haryana and Maharashtra where sheep breeding is even now sufficiently large. It can be usefully introduced in the Southern States to extend the flocks rapidly where mution breeds will be the order of the day.

[Para 11.24]

154. Once organised grasslands are developed throughout the country, it will happen that for maximisation of yield there should be periodical harvest of the crop. There may be excess supply in certain parts of the season when the nomadic flocks can find natural ranges. It should be general practice to harvest such surpluses and maintain reserve in the large grass lands of the country for utilisation during serious droughts in the areas surrounding. The necessary technology for hay making with necessary equipment should be part of the grass land development programme.

[Para 11.25]

155. Grassland development programme will have to be on a package basis, with a link up of Research, extension, infrastructure development, input supply and control.

[Para 11.26]

12. HORTICULTURE DEVELOPMENT

156. There is considerable scope for increasing horticultural crop production, particularly in Rajasthan in the large areas being served by the Bhakra and Rajasthan Canal Systems. Ganganagar District has already nearly 6,000 hectares under fruit, vegetables, etc. In fact, it has been established that wherever canal irrigation water and good quality wdter from other sources like wells and tubewells is available, almost all the fruits and vegetables for which climatic conditions are suitable can be grown. The extremely dry conditions enable the production of a fine quality of papaya without the undesirable latex odour in its pulp. [Para 12.3]

157. With irrigation resources, commercial seed production of vegetable crops, e.g. lady finger, cucurbits, tomato, potato, juteseeds, chillies, brinjal, peas, cumin, coriander, etc. can be taken. Large scale production of vege tables for fresh market and for preservation factories

also lias enormous scope. Gardening of vegetables like cauliflower, tomato, potato, carrots, onion, garlic, etc. can be, highly profitable. [Para 12.9]

158. Research work is in progress at the Central Arid Zone Research Institute, Jodhpur, and Haryana Agricultural University, Hissar, to further identify the types of cultivars within these fruit crops which can withstand salinity without detrimental effects on their productivity. The results of this research should be pursued further. Some of the vegetable crops like spinach, beat, cabbage, brinjal and some root crops are tolerant to salinity.

[Para 12.10]

159. In recent years, extensive, research has been carried out in Mexico, Israel, Australia and USA to increase horticultural production by efficient management of water sheds. In India, such work is in progress at the Central Arid Zone Research Institute, Jodhpur. Some of the indigenous plant types can be planted even without following this technique e.g. kair (capparis decidua), cordia myza, custard apple, etc. Their productivity, will, however, increase if due consideration is also given to watershed management.

[Para 12.12]

160. As in hot arid zone, the rainfall is not only very low but is confined to the period from July to September, with 9 to 21 rainy days out of 12 to 30 rainy days in the whole year. The fruit crops selected for cultivation in these regions must be such that their maximal growth period falls during the period of maxi mum water availability in the soil and low vapour pressure deficit in the atmosphere.

[Para 12.13]

161. While selecting cultivars of a particular fruit tree, care should be taken to choose the early ripening ones so that they make maxi mum use of We residual soil water from the monsoon rains.

[Para 12.13]

162. Among the vegetable crops, the hardiest types belong to the cucurbitaceous and selaraceous groups. Besides these, cowpea, gourd, early, cauliflower and okra are also sufficiently hardy. There is however, need to grow the drought hardy cultivars of these vegetable crops for rainfed production.

[Para 12.14]

163. In vegetable crops also, optimum production is possible by adopting techniques of moisture} conservation and run-off concentration.

[Para 12.19]

164. Considering the marginal nature of the land in many cases, and the non-availability of adequate moisture and the risk involved in successfully raising foodgrain crops, great importance should have to be placed on opportunities 'to diversify rural economies away from crop production, to the extent possible, into activities that are less dependent on the vagaries of rainfall. Horiculture is one of the excellent opportunities which could provide a greater income to the farmers in such lands which are not good for crop production. The

Committee would strongly urge that horticulture should be taken up as an integral part of the package approach to \the development in the drought prone and desert areas. All essential steps would have to be taken. Extension support is the first essential item. This would not, how ever, be enough by itself unless suitable varieties are identified seeds and cultivars provided when needed.

[Paras 12.24 & 12.25]

13. AFFORESTATION

165. At present, areas classified under permanent pastures, cultivable wastes, barren, un cultivated land and forests are overgrazed and denuded. Hence, not only the development but protection and management of the forest and plant cover also assume considerable importance. It is necessary to provide for the requirements of fuel and fodder so that the people are not tempted to cut trees indiscriminately and inhibit the process of afforestation. [Para 13.5]

166. The, programme of tree planting has to be taken up on areas in and around agricultural fields and other areas where wood lands cannot be created. Planting can be carried out (i) on and along bunds and risers, (ii) marginal or peripheral bunds, (Hi) field and property boundaries, (iv) village paths, (v) fore-shores of tanks, (vi) irrigation channels, (vii) institutions like schools, hospitals, panchayat bhavans, places of worship etc. (viii) banks of small streams and any other available place.

[Para 13.12]

167. It is necessary to educate the farmers about the importance of tree planting on farm land. As the first step towards farm forestry, the farmers can confine their activities to grow their own timber, fuel and fodder trees along field bunds and marginal land where cultivation is uneconomical and not possible but the soil allows it.

168. All over the drought prone areas of the country, the farmers leave a third to a half of their land fallow every year, whether big or small, because they cannot possibly cultivate the entire land. It has been recommended that they may put part of their land under permanent intensive pastures and take, a subsidiary occupation of Animal Husbandry. There is a case for putting part of the land under tree lands and plant trees.

[Para 13.16]

169. Suitable species of different regions of India as also the improved techniques of afforestation have, since been compiled in {the Forest Research Institute Publication entitled "Hand book of Afforestation Techniques". The selection of species suitable for a particular area would necessarily have to be governed by the following considerations:

(i) objective of planting, viz. fuel, small limber, fencing, bioaesthetic, erosion control, top feed production, etc. and

(ii) locality factors, viz. climatic, topographic and biotic parameters.

The, other criteria for selection of tree species are (a) farmer's preference, (b) deep root system, (c) light down, (d) bird repellent, (e) ease of establishment, (f) fast growth, (g) resistance to drought/forest/fire, (h) multiple use, coppicing, adaptability and compatibility

etc. The Committee would strongly recommend that this programme should be taken up as a massive programme and should be backed with full political support.

[Paras 13.17 & 13.18]

170. In every Indian village, traditionally a portion of the land was reserved for the village forest. This was common property to be managed by the village elders for the benefit of all the villagers. The first to be affected by the rush for forest material by the expanding population was the village forests. Except it the very interior areas, village forests are now bare earth wherever the land has not been encroached upon. Rehabilitation has to start here. Considering the magnitude of requirements, the village towards farm forestry, the farmers can confine their activities to grow their own timber, fuel and fodder trees along field bunds and marginal land where cultivation is uneconomical and not possible but the soil allows it

[Para 13.15]

171. Trees are planted close and regularly pruned into bush form so that leaves and twigs are maximised instead of timber. Some fuel- wood will be available annually in the pruning of the twigs. In the interest of social justice, it is suggested that the poorer landless families near the forests may be allowed half a hectare each of such land and helped to grow the fodder trees or Tassar culture or lac growing. The latter two will be beneficial mainly to the tribal who naturally do Tassar culture and lac culture now on forest trees. It is necessary, therefore, to divide the programme of degraded forests bet ween fuelwood plantations by the forest departments and trees for leaf formation for Tassar, Lac and fodder by the landless families allotted right on trees on land for the purpose.

[Para 13.29]

172. The fuelwood plantation in degraded forests is to be harvested after 15 years at the start because the land is of poor quality having lost all nutrients. But future cuts can be once in 10 years because the_ land would have re gained its fertility in the first rotation of 15 years. Thus a plantation of 4.2 million hectares per year less one million in farm forestry per year in a 15 year rotation will take 48 million hectares in the first round tapering off to 32 million hectares after 25 years from start. If part of the plantations can be irrigated, area required will go down further. Technology will surely find ways and means of increasing productivity meanwhile, to link demand with supply. For the leaf programme it is annual harvesting of leaves. It is suggested that a programme of 5 lakh hectares per year may be taken up in the next twenty years. This will over time help 20 million poor labour families near the forests to get a decent living.

[Para 13.30]

173. Everyday trees are not necessarily trees with only fuel value. Trees yielding many varieties of minor forest produce and trees giving fruits on which the tribal population live and. also earn some money by collection, are also being devastated. One of the main objectives of the tribal development programme is to ensure that these benefits are not lost to the tribal but augmented. So, in all these plantations it should be a rule that tree's giving minor forest produce like mahua, karanj, neem etc. and fruit trees like mango, tamarind, jack and others are suitably interspersed.

[Para 13.31]

174. Mainly large scale plantation of eucalyptus should be avoided because they upset the ecological balance of fauna and flora very badly.

[Para 13.31]

175. Intensive fodder development is necessary if the devastation of forest areas and plantations by all types of cattle is to be avoided.

[Para 13.32]

176. The following programmes are already in operation and have to be intensified on a proper judgment of the developmental need:-—

(i) When farmers keep good milch cattle or crossbred sheep or exotic pigs, they must be persuaded to put a part of their land under intensive fodder tree cultivation. This development is already taking place on a large scale in Gujarat. Punjab and Haryana and needs intensification in the other States.

(ii) In the Drought Prone Areas, it has been explained that a third to a half of the land and in desert areas much more is left uncultivated in each year because of the rainfall patter and pressure of time. . A part of the land can go under fuelwood and a part put under permanent fodder tree.

[Para 13.32]

177. During the Sixth Plan large scale deforestation will be going on in social forestry including village and panchayat lands and degraded forests. If the community interests can be sought and maintained by the forest department in these programmes it should not be difficult to introduce a temporary tongiyds cultivation programme in these areas without any fear of the lands going out of the control of the forest department.

[Para 13.33]

178 Tamil Nadu has initiated a program of growing fodder in all the areas of development where, the tree, cover has not yet shaded the forest lands. They also allow the village cattle nearby to graze these areas on payment of a very reasonable fee. It is suggested that if they can give preference to the poorer families owning sheep and cattle and particularly those, who have taken to improvement of their breeds, it may give substantial benefit to the poorer sections towards their economic improvement. Other States can also follow this very useful approach to fodder addition for the villages near 'the reserve forests and commercial forests.

[Para 13.34]

179. It is necessary to put through the basic concept of a National institute with sufficient capacity at once. A necessary start of our massive programme of social forestry will depend entirely on the speed at which we get this base laid and recruit the necessary order of staff.

[Para 13.35]

180. Forest Service has traditionally been one where all their staff at all levels have been trained to the job after selection to the service. There are hot enough training colleges at pre sent to train all those that have to be added to the staff in a crash programme. This problem of manpower requires immediate attention.

[Para 13.35]

14. SAND DUNES STABILISATION IN ARID AREAS

181. Stabilisation of sand dunes is the most important necessity in the hot arid zones primarily for checking the growth of desertic conditions and protecting productive agricultural lands in the neighbouring areas from the wrath of moving sands.

[Para 14.2]

182. Efforts in sand dunes stabilisation, if they have to be effective, have therefore to be carried out in the wider context of scientific management of the total land resources in the region.

[Para 14.8]

183. Vegetative cover is the only answer for stabilising of sand dunes.

[Para 14.11]

184. The first priority for sand dune stabilisation is obviously in areas surrounding villages, townships and fertile lands where the sand dunes are, threatening to engulf the area. The extent of sand dunes of]this nature will not be so substantial that a phased programme of sand dune stabilisation over the next ten years with state investment cannot answer the problem.

[Para 14.15]

185. On a priority basis a programme of action for stabilisation of sand dunes which may cause difficulties should be taken up on phased basis. The land use survey which is being carried out by CAZRI, will be able to identify' the priority sand dunes areas. These dunes, it is often found, are not on lands completely in the control of Government but also covers existing rydtwari tracts. The pattern is mixed. Sand dune stabilisation has to be done on a watershed basis. Any programme, therefore, will have to include both government and private lands.

[Para 14.15]

186. Sand dunes stabilisdtion gives large areas which can be usefully put under pastures or small timber and can be expected to give returns on a commercially viable basis. The Committee suggests that two types of approach would be useful. In taking up large scale programmes of such sand dune stabilisation on the principle now followed for afforestation of panchayat lands, sand dune stabilisation of areas, selected comprising both government and private lands, can be put under the sand dune stabilisation organisation which will do the entire investment and development of the area. The return from harvesting of the usufruct when it is ripe will go to the government from the government lands and on the private lands a sharing formula can be developed. It is suggested that a 50:50 sharing will be reasonable.

[Para 14.15]

187. If the community approach is not possible in any area because of factions, a master plan for sand dune stabilisation can be worked out with those who are willing to agree to do the necessary stabilisation work on their individual fields. If the lack of agreement by any of the farmers prevents work on his lands and if the work is absolutely essential to prevent

deterioration of the rest of the work, some statutory provisions can be made for compulsory execution and recovery of investment. The soil conservation act which already provides for such works can be invoked wherever available. The A.R.D.C. and now the proposed National Bank for Agriculture and Rural Development (NABARD) have suitable programmes of re financing which can be availed of for this purpose if an integrated large scale programme is taken up.

[Para 14.15]

188. As regards the Rajasthan Canal Area, all shifting dunes in command area must be stabilised by planting over with grass to prevent sand casting of arable land.

[Para 14.16]

189. Grazing of livestock on dunes should be restricted so as not to disturb the soil but people may be allowed to cut grass on payment of moderate fees.

[Para 14.16]

190. In the canal cultivated area suitable shelter belts and wind breaks should be established to minimise the effect of hot winds and reduce sand castings.

[Para 14.16]

191. Advantage should be taken of spare water in the early stages of development in command area for growing trees on a massive scale. This programme should receive the top most priority in the Rajasthan Canal Area.

192. Incidentally, it has come to the Committee's notice that a tree (Leuoacefia Leucuce-phala) popularly known as 'IPIL' in Philippines and SHEMOO in Thailand has got great poten tial not only as a supplying fodder and shelter but also fuelwood. This tree is prolific producer of leaves, flowers, pods, buds and twigs, all of which are relished by the cattle. The annual yield of dry fodder is 6 to 10 tonne per acre, depending on the quality of the soil and irrigation facility. Its leaves and tender buds can be used as vegetables, its seeds can be ground and the flour used for making bread. It gives a very good yield of fuelwood. The Committee would recommend that this specie may be tried in the Rajasthan Canal Area and in such other areas where underground water is known to exist.

[Paras 14.17 & 14.18]

15. SOLAR ENERGY & WIND POWER UTILISATION

193. The research in utilising solar energy and wind power for replacing the diminishing sources of energy is national issue. It will be noticed that quite a lot of research is now going on. Before the research can be applied in the field more proper cost—benefit studies will have to be done on location specific studies so that the 'technology can be suitably given to the people for adoption.' The Committee would therefore, recommend that in all these researches in development of equipment and in running of systems for utilisation of solar energy and wind power, the research should define clearly limitations of use of the equipment and the cost-benefit of the utilisation.

[Para 15.23]

194. The equipment so far designed for cooking and for providing hot water for family use is well within the means of a family with modest means in the rural areas. The Central Arid Zone Research Institute (CAZRI) will have to develop brochures explaining this and giving the cost-benefit data so that the extension workers can straight away adopt this programme in the rural areas.

[Para 15.25]

195. Hot water will be available during the day. In hill areas and in the desert areas also, it is a commodity most welcome during the day for bathing in winter. Of course, this facility will be used more by middle class and that too in the semi urban and urban areas. A suitable brochure may be developed by the CAZRI for this purpose also for utilisation by extension workers, [Para 15.26] 196. Use of solar energy can be suitably designed to provide for drying facilities. There may be many uses for such drying facilities in the rural economy. Where this will be useful will have to be studied and suitable brochures developed by CAZRI.

[Para 15.27]

197. Wind power is spasmodic and at pre sent will probably be economic, only in lifting water to a tank or a reservoir. Urban water supply schemes and minor irrigation schemes can possibly be designed utilising wind power. The parameters have yet to be developed. Whichever organisation is attending to this research, will have to develop suitable brochures giving the cost benefit and also explaining the limitations so that the extension organisations can see whether they are .adaptable for their local problems.

[Para 15.28]

16. STRATEGY FOR TRANSFER OF TECHNOLOGY

198. The major problem is the transfer of appropriate technology to the people in the specific watershed for promoting rational use of land, water and other natural resources. Effective transfer of appropriate technology for watershed development would involve the following activities:

(i) ascertaining the present level of technology in the related sectors;

(ii) identifying the type of technology needed and suited for the felt needs of the population of the watershed in general;

(iii) based on such feed-back, need for adoption or adaptation of available technology for improving the productivity of the Area and preventing the ecological deterioration;

(iv) testing the suitability of new specific technology in different agro-physical and climatic regions requiring a large number of adaptive field trials and operational research projects under different geographical and socio-economic conditions; and

(v) Strengthening the linkages between research and field personnel.

[Para 16.1 & 16.3]

199. It has to be noted that the development of appropriate technology for the drought prone areas requires an effective feed-back mechanism. The research has also to give priority to the

development of low cost technology. A careful analysis of the methods of agriculture, animal husbandry, etc. in these area might indicate that a few modifications in the existing practices could yield better results instead of introducing new innovations which may not only be costly but may also require lot of efforts before the farmer could be .persuaded to take them up.

[Para 16.5]

200. Uni-disciplinary research now generally prevalent in 'the Agricultural Universities and parallel research being carried on in various institutions'—Central and State—in various aspects of the sciences .has to be brought together in multi-disciplinary applied research programme in order to solve the specific problems of drought prone areas. The establishment of regional Research centres on a multi- disciplinary basis is essential.

[Para 16.5]

201. What are the important steps necessary for transferring appropriate technology to rural areas, particularly the drought prone areas. The obvious answer is the field extension and .farmers' 'training, supply of information, literature, audio-visual education, field demonstrations, etc. Training of extension workers would also be necessary.

[Para 16.8]

202. The most distinguishing characteristics of the new methodology is that the Village Level Workers and the Agricultural Extension Officers are utilised in an intensive time-bound management system under a fixed programme of training and visits to the farmers field regularly every fortnight. The training has a direct focus on specific agricultural practices and recommendations related directly to farm operations during a given fortnight.

[Para 16.10]

203. The new Agrl. Extension methodology aims at ensuring transfer of know-how available at 'the Agricultural Research Stations to the farmers fields through an effective time-bound management system. This is being achieved through a systematic schedule of training of Extension Workers, to equip them with the latest know-how. The transfer of technology from Extension Worker to the farmers is ensured through a fixed programme of visits every fort night. The methodology followed in the existing set up can be adopted in the DPAP areas also but what would be essential is that the extensions personnel working in these areas must be provided training in ail the disciplines for which the area has the best potential and sup port is called for.

[Para 16.12]

204. The technical capacity of the VLW in the programme is limited to agricultural development only. On the other hand in the watershed management approach which is basic in DPAP the main thrust is firstly in restoring ecological balance and then maximising soil and water conservation for increasing crop productivity. The technical expertise for doing this work has to be spelt out carefully.

[Para 16.13]

205. The planning and execution of the soil and water conservation programme for the Government and community lands should be done by a suitable organisation in the Project. This work obviously cannot be done under the present T&V programme. For this, the Commit tee suggests the following approach. Once priority watersheds have been identified in the Project area for watershed management, technical teams of (he soil and water conservation experts in the project technical group must prepare the soil and water conservation programme for the Government and community lands with such help as may be required from the higher technical echelons for the individual watersheds. This plan must be implemented in full in the first year of the watershed programme as without this protection to the higher reaches, the farmers programmes will not be fully productive.

[Para 16.14]

206. The soil conservation organisation in the District should be given the responsibility to get the work done on schedule. The funds should be provided by the DPAP.

[Para 16.14]

207. The technical team of the project helped by such higher level expertise as is necessary will have to decide for each watershed the particular pattern to be followed.

[Para 16.15]

208. The landshaping programme on the holdings of all the farmers participating should be completed in 'the off season before the start of the second cropping season. The technical support for this will have to come from the soil and water conservation experts in the project, helped by the VLWs who suitably trained in advance will follow the T&V method to get the programme implemented in time.

[Para 16.15]

209. Where a change of cropping is essential in any holding to prevent wrong use and consequential soil deterioration, the technical experts in the project should identify the holdings and the changes necessary. The VLWs should then be used in the T&V programme to get the changes done by persuasion.

[Para 16.17]

210. In the T&V method there is a back up by a Technical Group which trains the VLWs every fortnight during the cropping season for the programme to be put across in the field in the next fortnight. This back up technical group with a base experimental area is crucial for watershed programme.

[Para 16.17]

211. Besides the technical disciplines involved in the T&V, a soil and a water specialist will have to be included. It is preferable that this group is based at the project centre, for each DPAP project area.

[Para 16.17]

212. The Base area should be a suitable watershed of the same size as the watersheds chosen in the project and should be close to the project centre. In this watershed the technical

group will personally supervise all the aspects of the intended programme that they are going to introduce during the year in the project. The base will be a demonstration centre for the project and a training centre for the field personnel. Higher level technical experts in the district must visit these demonstration areas and correct mistakes and solve special area problems that may arise. Selection of such back up areas should be done carefully so that substantial people's backing in the watersheds is available and the farmers are prepared to experiment. Such watersheds should, get all the subsidies and help that demonstration centres get under the state plan so that this will be additional attraction for people's in a new venture with some risk.

[Para 16.17]

213. The technical team back stopping the watershed programme will have to decide for each watershed the present status of available technology suitable as a first step to improving the traditional cultivation practices and land use patterns by marginal changes to improve the productivity and prevent deterioration of the ecology.

[Para 16.19]

214. The most important stage in transfer of technology will be the testing of the suitability of specific technology in different agro-physical and climatic regions so that introduction of the most modern technology can be done in the location specific condition. This requires a large number of operational research projects follow up by adaptive field trials.

[Para 16.20]

215. It is necessary for the ICAR to expand the national demonstration concept to include a large number of national demonstrations of the latest technology for handling the watershed approach in drought prone areas.

[Para 16.20]

216. The ICAR may examine early how best the lab-to-land programme can be modified to suit the requirements of a watershed approach.

[Para 16.21]

217. Education of individual farmers about the right crop to grow on his field and the correct agronomic practices along with the minimum soil conservation and water conserva tion practices on his holding should be the main plank of the T&V programme in the initial stage.

[Para 16.22]

218. Operational research programmes in large watersheds should now be taken up by the ICAR in the various DPAP zones so that the technologists may refine and imporve upon the package approach to make it. location specific to the various DPAP zones in the country. The operational research project will be a necessary back up to the national demonstration programme.

[Para 16.23]

219. The Government of India provide assistance to the State Governments through the Centrally sponsored schemes to strengthen the efforts of the states in the transfer of appropriate technology to the rural areas. The Committee would strongly recommend that the assistance provided under this scheme should be available for extension support in the drought prone areas.

[Paras 16.24 & 16.25]

220. The central element in the strategy for development of the drought prone areas should be the process of improving the capacity of rural people to control their environment by motivating them to make maximum utilisation of their own capabilities and the local resources. For long term development of drought prone areas, the first attempt should be to create awareness and consciousness among the people of the efficacy of both short term and long term measures.

[Para 16.31]

221. At the, Planning stage priority should be given for the assessment of villager's needs and their priorities. The administration and techno logists might think that the people have destroyed the ecological balance by their short sightedness. But they should also realise that they are creating a disequilibrium in ignoring the problem of their survival and suggesting of long gestation plans.

[Para 16.33]

222. If people's participation has to be en listed, such interventions to which the villagers will rationally respond have to be identified, short gestation income generating programme without further deterioration of the ecology for the people in the watershed have to be started and only then the long term conservation or regenerative programmes can. be pushed ahead.

[Para 16.34]

223. There is need to discuss at the level of operations details of the micro-watershed plan with the residents of the watersheds to avoid any mutual conflicts and secure their active participation. This could be done either through general meetings of all the residents or through the local panchayat or watershed co operative, if it is formed.

[Para 16.35]

224. Under the watershed approach, every piece of land requires some special treatment whether it belongs to a big holder or small holder, though the big holders may not qualify for subsidy. The land of the big holders has to be treated not because they belong to power group, but because it is a technical necessity for the development of the water shed.

[Para 16.36]

225. We cannot think of excluding programmes for the landless in the watershed development programme— If the marginal or surplus lands are being distributed among the land less, the wareshed project should provide for the development of pastures or horticulture on these lands, with guaranteed employment in secondary and tertiary sectors during the waiting period. This should also be specifically pro vided as part of the plan to achieve a participatory process.

[Para 16.37]

226. The watershed budget should have adequate provision for the extension education programmes of the people of the area before the watershed programme is undertaken.

[Para 16.38]

227. The long term objective of development of the drought prone areas should formulate some plan for educating the children and youth of the area so that when they grow up they understand their responsibilities as a citizen for mitigating the effect of drought.

[Para 16.39]

17. NOMADS AND NOMADISM IN DESERT AREAS

228. Because of the severe sociological tensions created by nomads, whether pastoral nomads or artisan nomads or non-descript, there is a general cry that nomads should be sedentarised. At the same time, it is often argued that artisan nomads like gadoliya lohars are not amenable to sedenarisation. The Committee would take the view that nomadic communities will accept sedentarisation and modify their economy provided the society can give them a firm base for livelihood which is better than what they are earning today. The economic attraction will prevail in all human motivations.

[Para 17.20]

229. In the Chapter on "Livestock Development" the Commitee has already explained how gradually nomadic sheep breeders can be brought to a limited number of centres in the ranges for the breeding and lambing season without any serious difficulties to them. Gradually, when they come to such centres for nearly 8 months in the year, the sedentarisation will automatically follow. Therefore, their movement outside will then is limited to a few months in the year to exploit large grass ranges available. When the community is so gathered, all the advantages of a sedentarisation, a society should be given to them by the State.

[Para 17.21]

230. Today with communications expanding and established, artisan systems developing in reasonably approachable urban centres, many communities who use the artisan nomads may no longer find them necessary. Thus, over time this will be a dying race unless we now take steps to utilise the skills that are available in the artisans for the benefit of themselves and the society.

[Para 17.22]

231. Before the artisan nomads die out by sheer force of economics, it is desirable to bring together into groups under a village industry development project in a convenient area close to available markets under the strategy explained in the report of the Committee on "Village and Cottage Industries". Selection of centres and persuading nomadic groups to concentrate there will be in fructuous unless the necessary raw material supply, credit and marketing facilities are simultaneously imposed on the centre. Training them for greater skills is also a part of village industry development.

[Para 17.22]

18. ORGANISATIONAL AND FINANCIAL ARRANGEMENTS

232. The Committee has recommended in its report on "Organisation of Administrative and Financial Structure for Backward Area Development". What it considers to be appropriate organisational and financial arrangements for realising the full potential of the area and executing a comprehensive development programme embracing all activities—developmental, social services, infrastructure etc. The Committee would, therefore, reiterate that the recommendations made by it in its report on "Organisation of Administrative and Financial Structure of Backward Area Development" covering "planning processes and decentralisation" methodology of Central and State Plan allocations, organisational set up for plan implementation, personnel policies, financial and budgetary control etc. are eminently suited for the development of the drought prone areas and should be implemented as early as possible.

[Para 18.12 & 18.13]

233. There should be a District Planning and Coordination Cell under the Chairmanship of the Collector to work out a proper programme and secure the best development of resources particularly in respect of such schemes and programmes which cut across the boundaries of more than one I DP.

[Para 18.14]

234. An Integrated Project Level Authority consisting of two or three blocks should be set up by an executive order.

[Para 18.14]

235. The Block Development Officer, or his equivalent, would function as an Executive Officer under the IDPA and all beneficiary oriented programmes would be implemented by the Block Administration under the overall superintendence and direction of the IDP Authority.

[Para 18.14]

236. Apart from the high level Steering Committee which will guide implementation of all the programmes, a Coordination Cell has been suggested at the State headquarters not only to monitor the progress but also to ensure that the funds earmarked for the development of these areas are not diverted by the departmental heads to other areas.

[Para 18.14]

237. The Committee would strongly recommend that each State should have an inter disciplinary land authority/board for planning in major watersheds and giving guidance to the lower level organisation in the planning, execution and implementation of the programmes on micro watershed basis.

[Para 18.15]

238. The existing departments at the state level like agriculture, forest, horticulture, etc. are concerned with their sectoral activities. What is essential is an organisation at the state level

which can ensure preparation of intergrat-ed projects on watershed development, guide their implementation and monitor the progress with reference to the overall objectives.

[Para 18.15]

239. The Committee would strongly urge that as a counterpart of the Slate Board, the Central Government in the Ministry of Agriculture must also set up a National Land use Board/Authority.

[Para 18.16]

240. Expertise in various disciplines, which constitute the key component of planning and implementation of programmes on watershed approach are located in the Department of Agriculture and in the Department of Agricultural Education and Research under the Ministry of Agriculture. As it is essential that there is complete coordination and agreement between various disciplines which has to provide input to the development activities in drought prone areas, the Committee would strongly urge the constitution of a Standing Multi-Disciplinary Committee with its own secretariat to guide project preparation, supervise implementation and provide necessary technical and research sup port, etc.

[Para 18.17]

241. The present procedure is that at the request of the State Governments, the Central Government sends 'the Teams to assess the damage of that drought affected areas. The Committee would strongly recommend that a representative of the Division dealing with the drought area programme should invariably be included in the Central Team to assess the quantum of funds to be made available to the States and once schemes are sanctioned and approved whether for creation of permanent assets or for providing relief, these should be prepared and executed in consultation and under the supervision of the Integrated Development Project Authority.

[Para 18.18]

242. The authority in the project would be in a far better position to decide as to the type of works which should be undertaken immediately to provide relief to the affected people. It would use these funds not only for providing relief to the drought affected but also get part of their own programmes for the benefit of the area with the help of these funds. The Committee is of the view that if such a system could be streamlined and operationalised, there would be bitter utility for funds made available for drought relief, in such areas which have been identified as chronically drought affected.

[Para 18.18]

1. INTRODUCTION

The terms of reference of the National Committee on the Development of Backward Areas, inter-alta, require a review of the ongoing programmes concerning the development of backward areas and to recommend a suitable strategy or strategies for effectively tackling the problems of such areas.

1.2 Broadly speaking, drought prone areas which cover both arid and semi-arid areas can be divided into four categories, on the basis of annual rainfall as follows :—

Arid Districts with rainfall upto 375 mm (15 inches).

Ssmi-Arid Districts with rainfall from 375 mm to 750 mm (15-30 inches).

Sub-Humid Districts with rainfall ranging from 750 mm to 1125 mm (30-45 inches)

Humid Districts with rainfall above 1125 mm (above 45 inches).

1.3 Annexures I and II indicate the population, density and land use and irrigation in DPAP areas as identified at present by the Government of India.

1.4 In terms of geographical area and population, drought prone areas account for nearly 19% of the total area of the country and 12% of the population. In some States such as Rajasthan about 56 per cent of the total area and 33 per cent of the population fall in this category. Next to- Rajasthan comes Andhra Pradesh, where about 30 per cent of the geographical area, and 22 per cent of the population lies in drought prone areas. In Gujarat about 29 per cent of the geographical area and about 18 per cent of the population are situated in drought prone areas. In Karnataka, the corresponding figures are 25 per cent and 22 per cent. Excepting Kerala, Punjab and the States- of North-Eastern region, every State in India has one or more drought prone areas.

1.5 Apart from the size and the geographical spread of the drought prone areas, another im portant consideration why it is necessary to formulate and implement an appropriate deve lopment strategy for these areas is related to the fact that they represent a major factor con tributing to regional imbalances in development of the country. Their overall productivity has been and continues to be low. Every third year, about three million inhabitants of the arid zone take to migration along with their live stock. Judged by various economic indicators, these areas occupy a low position and are res ponsible for introducing a major source of instability in the national economy. This instability is partly reflected in the fluctuating levels of production of coarse grains which are widely cultivated in these areas. 1.6 A rising population and a decreasing land man ratio make it difficult to evolve and pursue a viable and economic land use policy. India, since the midfifties, has been making serious attempts to match its food resources with rising human consumption requirements. The per capita net availability of cereals has, however, been increasing only at a marginal rate from 360.5 grams per day in 1956 to 404.3 grams per day in 1976 and to 479.9 grams per day in 1979. Understandably enough, planners and policy framers in the initial stages, there fore, concentrated on measures (a) for in creasing productivity in the better endowed areas; and (b) harnessing available water resources to meet the food requirements of the country. As a result of this pre-occupation, scientific research also focussed its attention mainly to improving the genetic quality of foodgrains suited to irrigated areas where a massive investment, in creating infrastructural facilities, was being provided by Government. In the process1, however, large

tracts of not so well endowed land were neglected, their pro ductivity remained low, and due to wrong land use, the quality and fertility of the land continu ed to deteriorate. With every year these lands are gradually moving out of agricultural use loosing valuable top soils due to wind and water erosion due to bad cultivation practices. It is possible that over a period, if steps are not taken to stop the process, these tracts will become completely unfit to support human or animal population.

1.7 As compared to other areas, the drought prone tracts are more vulnerable to ecological degradation, leading to an increasing economic dependence and social deprivation. In the past the main emphasis was on saving the people from starvation through relief works and by creating some protective assets like irrigation tanks, or in some cases, canal systems like the Tungabhadra system in Rayalseema or Ganga- nagar canal system in Rajasthan. The whole approach was determined by the Famine Com mission Reports of 1880, 1898 & 1901. The approach adopted was in the main, in the nature of 'fire fighting' and 'Crisis Management'. Measures were to be taken to provide employment, gratuitous relief and soup kitchens for the destitute and children. Employment was to be provided mainly through works like construction of roads and irrigation tanks etc.

1.8 In a good year or a normal year, DPAP areas make a substantial contribution to agricultural production in the country and that the potential therefore is quite substantial. The relative contribution of selected DPAP districts to all India production varies from year to year. These areas make major contributions in groundnut, bajra and jowar, where these crops account for about one-fourth to one-third of the total national production. In rice, these districts account for about 12 per cent of all India production. In ragi, eight districts alone account for one-sixth of the national production. In maize, nine districts alone contribute one-tenth of national production. In cotton 13 districts account for about one-eighth of the total production. In the production of pulses, the contribution of the DPAP districts is sizeable. In gram, the contribution of 30 DPAP districts comes to about 20 per cent of the total production; same is true of Tur and other pulses. It is, therefore, obvious that fluctuations in yield in these areas affect the overall production at the all India level.

1.9 Apart from contribution to the grain economy, the DPAP areas are also major livestock tracts, providing the country's best drought and dual purpose breeds, like Tharparker, Sindhi, Rathi, Halikar, and Khillairi etc. No study has yet been done to determine the actual contribution made by these tracts, as in the case of crops, but considering the statistical evidence of numbers, the overall contribution cannot be small. The drought tracts alone contain about 60% of the total sheep population of the country. In terms of proteins and mutton-fat, this is a sizeable contribution.

1.10 It is, therefore, obvious that there is a strong case for looking at the drought prone areas as economic partners in progress, and not as a bottomless pool in which scarce finan cial resources are sunk year after year. Even before a policy is designed, odds must be weighed and variables identified.

1.11 A historical look at these areas is interesting. Penukonda in Anantapur district was the summer capital of the Vijayanagar Kingdom; today it is classified as almost an arid area. The place could not have been chosen as the summer capital unless it had at least a reasonable agricultural base. Bijapur district, served two mighty kingdoms, the Hoyasalas of Badami and Bahamanis of Deccan. Today, Bijapur is assessed as a very low production area in crop husbandry. Were these fireas as such four or five hundred years ago, or have they deteriorated since then and if the latter is correct, then one should look into the causes which

have created this situation. Rectification of the conditions becomes the first task, but only if a study of the past trends is made. This is certainly an interesting area of research. Historical research apart, these are the problems of the present to be faced.

1.12 The National Committee constituted four Working Groups on Rural Development, Tribal Sub-Plan, Industrial Development and on Organisational Structures. The Working Group on Rural Development was to review ongoing programmes in arid and semi-arid areas and to suggest measures for the develop ment of these areas. The Working Group consisted of senior and experienced adminis trators from a number of States as well as representatives of the concerned Ministries in the Government of India. The composition and terms of reference of this Working Group are given in Appendix I.

1.13 The Working Group had held several meetings and sent a detailed questionnaire to the State Governments (Appendix II).

1.14 A Seminar was held at Jaipur from 6th to 8th March, 1981 in which not only the repre sentatives of the concerned State Governments but also eminent academicians, representatives of research institutes, people's representatives etc. participated. The subjects covered by the Seminar included special issues relating to desert areas, planning and implementation of DPAP schemes, land and water management, resources development including infrastructure etc.

1.15 The National Committee has had discussions with the State Governments of Rajas- than, Maharashtra, Orissa, Uttar Pradesh, Punjab, Karnataka, Andhra Pradesh and Har- yana. The National Committee also commis sioned studies in one drought prone district each in Orissa, Madhya Pradesh, Tamik Nadu and Karnataka.

1.16 The response of the State Governments to the questionnaire has not been encouraging. However, enough data became available as a result of the papers presented in the Seminar and individual papers on the specified subjects. Lot of material also became available from the National Institute of Rural Development, Hyderabad. On the basis of the data available and considering the need to expedite the Com mittee's report, the National Committee decided to hold its meeting jointly with the Members of the Working Group with a view to finalise its approach and recommendations on the sub ject. The National Committee also felt that in view of the important nature of the subject, it would be desirable to submit a separate report on the development of drought prone areas to the Planning Commission for their consideration.

Annexure I
District -wise Population and Density

State/District	Total Population of District	Population in the DP Area	Population Density in the Project Area
(1)	(2)	(3)	(4)
Arid Area			
1. Gujarat			
1.1 Kutch	8.47	5.96	45
2. Haryana			
2.1 Mohindergarh	6.89	6.89	205
2.2 Rohtak	17.83	5.25	249
2.3 Bhiwani		3.52	123
3. Rajasthan			
3.1 Jaisalmer	1.67	1.67	6
3.2 Bikaner	5.73	5.73	22
3.3 Jodhpur	11.52	11.52	59
3.4 Banner	7.74	7.74	30
3.5 Churu	8.74	8.74	56
TOTAL for the region	68.59	67.02	
Semi Arid Area			
1. Andhra Pradesh			
1.1 Anantapur	21.10	21.14	116
1.2 Kurnool	19.76	19.76	112
1.3 Mahaboobnagar	19.26	15.31	133
1.4 Cuddaph	15.73	14.78	117
1.5 Prakasham	19.15	5.63	64
2. Gujarat			
2.1 Surendranagar	8.40	7.63	95
2.2 Banaskanlhah	12.54	5.39	80
2.3 Ahmedabad	29.07	4.28	103
2.4 Jamnagar	11.08	1.67	86
2.5 Amreli	8.44	3.17	107
2.6 Rajkot	16.17	2.34	96
2.7 Mehsona	10.86	1.52	100
2.8 Bhavnagar	13.99	0.90	101
3. Jammu & Kashmir			
3.1 Doda		3. 40	29
3.2 Udhampur		0.30	67
4. Karnataka			
4.1 Bijapur	19.85	12.50	107
4.2 Chilradurga	13.97	7.03	109
4.3 Gulbarga		5.03	101
4.4 Kolar	15.16	1.05	177
4.5 Dharwar	23.42	6.50	146
4.6 Tumkur	16.27	6.05	136
4.7 Raichur	14.16	3.34	91

State/District	Total Population of District	Population in the DP Area	Population Density in the Project Area
(1)	(2)	(3)	(4)
4.8 Chickmaglur	7.36	1.87	138
4.9 Bellary	11.22	2.40	101
5. Maharashtra			
5.1 Sholapur	22.04	15.54	111
5.2 Ahmednagar	22.69	10.88	170
5.3 Sangli	15.40	2.47	80
6. Rajasthan			
6.1 Nagaur	12.62	12.62	76
6.2 Jalore	6.68	6.68	64
6.3 Pali	9.70	9.70	82
6.4 Udaipur	12.88	2.49	102
6.5 Jhunjhunu	6.89	4.36	149
6.6 Ajmer	10.06	2.39	164
Total for the region	455.91	230.35	
Sub -Humid-Area			
1. Andhra Pradesh			
1.1 Chittcor	22.80	17.93	159
1.2 Nalgonda	18.06	2.29	85
2. Gujarat			
2.1 Panchmahals	18.44	13.71	208
3. Karnataka			
3.1 Belgaum		10.23	141
4. Madhya Pradesh			
4.1 Bstul	7.35	7.35	101
4.2 Jhabua	6.67	6.67	102
4.3 Dhar		5.64	105
4.4 Khargone	12.80	3.06	164
5. Maharashtra			
5.1 Nasik	23.69	11.94	154
5.2 Satara	17.27	5.54	128
6. Rajasthan			
6.1 Banswara	6.54	6.54	111
6.2 Dungarpur	3.02	3.02	139
7. Tamil Nadu			
7.1 Ramanathanpura	18.14	18-14	249
7.2 Dharmapuri	15.31	15-31	197
8. Uttar Pradesh			
8.1 Banda.	21.79	6.15	146
8.2 Hamirpur	9.85	7.88	139
8.3 Allahabad	29.33	6.88	227
8.4 Jalaun.	8.11	3.31	156
8.5 Varanasi	28.51	1.73	297
Total for the region :	267-68	143-03	
Humid Area			
1. Bihar			

State/District	Total Population of District	Population in the DP Area	Population Density in the Project Area
(1)	(2)	(3)	(4)
1.1 Palamau	8.9	8.9	360
1.2 Rohtas .			
1.3 Monghyr	27.4	7.9	273
1.4 Nawada .		8.9	248
2. Madhya Pradesh			
2.1 Sindhi		7.77	72
2.2 Shahdol	10.30	1.70	65
3. Maharashtra			
3.1 Poona	31.78	12.36	153
4. Orissa			
4.1 Kalahandi	11.64	2.10	98
4.2 B. Phulbani	6.22	7.47	98
5. Uttar Pradesh			
5.1 Mirzapur	15.39	15.39	174
6. West Bengal			
6.1 Purulia	16.02	16.02	256
6.2 Bankura		5.92	295
6.3 Midnapur			
Total for the region	126.48	97.43	
Development of Drought prone Areas, N.k. Jaiswal and N.V. Kolte, National Institute of Rural Development, Hyderabad, Page 90-93			

ANNEXURE II
Land Utilisation and Irrigation in DPAP Districts 1969-70.

District	Net Area sown as %age of Reporting Area	Area under Forests as %age of Reporting Area	Pasture land as %age of Reporting Area	Cropping Intensity (S-100)	Gross irrigate area as %age of gross area sown
(1)	(2)	(3)	(4)	(5)	(6)
Arid Region					
Kutch (Gujarat)	11	2	1.95	104	13
Mohindergarh (Haryana)	84	1	4.28	148	9
Barmer (Rajasthan)	16	1	7.20	101	4
Bifcaner (Rajasthan)	16	1	1.25	100	1
Churu (Rajasthan)	69	1	2.67	100	1
Jaisalmer (Rajasthan)	1	1	1.97	100	4
Jodhpur (Rajasthan)	45	1	5.01	101	3
Semi Arid Region					
Nagaur (Rajasthan)	66	1	4.57	101	2
Anantapur (Andhra Pradesh)	44	10	1.29	102	15
Cuddapah (Andhra Pradesh)	30	32	4.11	105	32
Kurnool (Andhra Pradesh)	57	20	0.25	110	13
Mahbubnagar (Andhra Pradesh)	54	16	3.64	103	11
Amreli (Gujarat)	75	4	7.09	102	7
Banaskantha (Gujarat)	64	12	5.89	112	13
Jamnagar (Gujarat)	57	7	7.37	106	9
Rajkot (Gujarat)	70	3	9.80	104	12
Surendranagar (Gujarat)	66	2	4.54	302	8
Doda (J. & K.)	13	52	1.92	116	12
Bijapur (Karnataka)	84	4	1.00	101	4
Chitradurga (Karnataka)	43	8	13.25	110	19
Dharwar (Karnataka)	85	8	1.76	108	48
Kolar (Karnataka) *	42	9	13.51	110	23
Ahmednagar (Maharashtra)	74	11	1.40	105	13
Sangli (Maharashtra)	74	6	2.15	103	10
Sholapur (Maharashtra)	82	2	2.78	103	10
Jalore (Rajasthan)	45	1	4.96	107	16
Pali (Rajasthan)	39	5	7.19	104	5
Sub Humid Region					
Chittoor (Andhra Pradesh)	30	30	3.07	114	39
Panchamahals (Gujarat)	54	23	5.04	110	3
Belgaum (Karnataka)	70	14	1.92	102	11
Betul (Madhya Pradesh)				175	42
Dhar (Madhya Pradesh)	59	9	10.18	109	5
Jhabua (Madhya Pradesh)	48	36	8.59	107	2
Nasik (Maharashtra)	56	22	1.80	107	12

District	Net Area sown as %age of Reporting Area	Area under Forests as %age of Reporting Area	Pasture land as %age of Reporting Area	Cropping Intensity (S-100)	Gross irrigate area as %age of gross area sown
(1)	(2)	(3)	(4)	(5)	(6)
Satara (Maharashtra)	66	14	0.70	107	14
Banswara (Rajasthan)	40	16	7.20	125	5
Dungarpur (Rajasthan)	31	18	11.62	126	9
Dharampuri (Tamilnadu)	42	33	1.21	112	15
Ramanathapuram (Tamil Nadu)	51	4	0.40	102	38
Allahabad (UP)	54	2	0.09	119	23
Banda (UP)	60	9	Neg.	116	15
Hamirpur (UP)	69	5	0.08	104	14
Jalaun (UP)	78	6	0.09	104	34
Varanasi (UP)	64	15	Neg.	133	37
Humid Region					
Monghyr (Bihar)	48	14	0.53	140	24
Nawada (Bihar)	59	12	0.90	132	65
Sahabad (Bihar)	66	17	Neg.	152	60
Palamau (Bihar)	20	48	0.74	123	23
Sidhi (Madhya Pradesh)	30	42	Neg	128	7
Poona (Maharashtra)	65	12	0.60	108	11
Boudh (Orissa)	18	45	2.27	121	16
Kalahandi (Orissa)	31	32	6.71	112	11
Mirzapur (UP)	30	36	0.33	119	20
Bankura (West Bengal)	53	20		106	
Midnapur (West Bengal)	68	11		109	
Purulia (West Bengal)	44	14	Neg.	107	27
All India Average	45	21	4.24	118	23

Source : Development of Drought-Prone Areas by N.K. Jaiswal and N.Y, Kojte, National Institute of Rural Development, Hyderabad, Pages 10M02.

2. CRITERIA FOR DELINEATION OF DROUGHT PRONE AREAS

Vagaries of monsoon rainfall in various parts of the country causes drought or floods in some areas almost every year. While occurrence of floods due to heavy rainfall or other factors is immediately visible, drought, which is a more insidious phenomenon develops over a time.

2.2 What is drought? There is no uniform definition. The definition varies with the area of interest. The expression "drought" tends to be used varyingly by persons belonging to different disciplines. To a meteorologist, drought represents the absence or severe deficiency of rainfall, to the agronomist, it is the absence of soil moisture and, to the hydrologist, it is the absence of water in the storage reser voirs. However, from the practical standpoint, drought may be regarded as a period of abnormal dry weather sufficiently prolonged leading to lack of water so as to cause hydrological imbalance in the affected areas.

2.3 Drought occurs when there is a serious imbalance between the soil moisture arid evapo- transpiration needs of an area. Several factors such as precipitation, temperature, wind velocity, sunshine, soil texture, soil moisture and antecedent rainfall inter-act to produce this situation. The key role is played by the rain fall and its crucial variable are its distribution, variability and its capacity to meet the evapo- transpiration needs.

2.4 Palmer (USA) defines drought as an interval of time generally of the order of months or a year in duration during which the actual moisture supply at a given place consistently falls short of the climatically expected supply. The US Weather Bureau defines drought as a period of dry weather of sufficient length and, severity to cause at least partial crop failure.

2.5 Although an important criterion, rainfall alone does not give a complete picture of be fatal to crops in one region might be sufficient for growth in another. Factors, besides rainfall that intensify or, mitigate the effects of droughts, are temperature, wind, evaporation, sunshine, character and conditions of soil, stage of crop development, etc. Thus, Thronthwaite (USA) defines drought as a condition in which the amount of water needed for transpiration and direct evaporation exceeds the amount available in the soil.

2.6 The India Meteorological Department has defined drought as a situation occurring in a meteorological sub-division in a year when the annual rainfall is less than 75 per cent of the normal. When the deficiency of rainfall is above 50 per cent of the normal it is termed as a 'severe drought'. This definition of drought does not take into account the distribution of rainfall so important from the point of view of agriculture.

2.7 Droughts may be broadly classified into three types: meteorological, hydrological and agricultural. Meteorological drought is a situation where there is significant decrease from climatologically expected and seasonally normal precipitation over a wide area. Meteorological droughts, if prolonged, will result in hydrological drought with marked depletion of surface water and consequent drying up of reservoirs, lakes, streams and rivers, cessation of spring flows and fall in ground water levels. This may necessitate curtailment of hydel power generation and affect industry as well as agriculture. Agricultural drought occurs when soil moisture and rainfall are inadequate during the growing season to support healthy crop growth to maturity and cause extreme moisture stress/and wilting. In the major crops of the area an agricultural drought may exist even when a meteorological drought may not, and vice versa. For example even if total rainfall exceeds the gross water requirements of the whole crop periods, if soil moisture is deficient during critical periods of growth, then is agricultural drought. Good rain during critical growth periods may result in high crop yields

even when the total for the season or year is low. The problem of defining drought in quantitative terms thus still remains unsolved.

2.8 Drought has to be defined from the objective we seek for the use of the water or as a measurement of water. When we talk of drought, we have necessarily to mean agricultural drought, because the economy is still largely agricultural and agriculture is the main stay of the rural economy. Drought relevant to other uses of water like industrial and urban, which are major problems in advanced countries like the USA, is not yet a problem in this country.

2.9 A number of attempts have been made in the past to define a drought affected area. In 1967, States were asked by the Ministry of Agriculture, in consultation with the Planning Commission, to demarcate chronically drought affected areas on the basis of total or almost total failure of crops in the relevant years once in three, five or 10 years and other "relevant data. When the Government of India decided in 1970-71 to start the Rural Works Programme in the drought prone areas of the country (later renamed Drought Prone Area Programme in 1973) with the basic objective of eliminating or reducing considerably the incidence of drought by restoring the ecological balance in these areas, an exercise for identification of drought prone areas was undertaken. The identification of these areas was entrusted to a Committee of Secretaries in the Government of India. The data collected in 1967 was available to this Committee of Secretaries. This Committee identified certain areas as chronically drought prone on the basis of following criteria:

(i) Incidence of rainfall over a period of time;

(ii) Extent of irrigated area in the district;

(iii) Environmental conditions like proximity to the irrigated tracts providing better employment;

(iv) Availability of other avenues of employment in the same area;

(v) Existence of schemes amenable to long term economic development and lastly;

(vi) Chronic liability of drought.

At that time, the Rural Works Programme was initiated in 23 Districts. Later, the Central Committee for Coordination for Rural Development and Employment in she Planning Commission considered the question of identifying additional Districts. The Committee appointed a Sub-Committee (Gidwani Committee) to recommend additional Districts and indicated that the selection should be based on certain objective criteria like incidence of rainfall over a period of time, extent of irrigated area in the District, chronic liability of drought, etc. The Committee felt that since the main objective of the rural works programme was to organise works for reducing gradually emergency scarcity relief with in some years, the programme had necessarily to be restricted to areas as are liable to chronic drought. While keeping in view the broad, criteria indicated by the Central Coordination Committee, the Sub-Committee also took into account the criteria of revenue remission and frequency of famine or scarcity. After considering its recommendations, the Government of India selected 54 Districts in 13 States along with continguous areas in another 18 districts for the drought prone areas programme. Broadly the areas were divided into three categories :—

(i) Seven Districts having extreme degree of aridity consisting of mainly Western Rajasthan and partly Haryana and Gujarat were covered in the 1st category.

(ii) Second category is represented by twenty districts semi-arid in character having annual rainfall between 15-30 inches.

(iii) Third category is of the areas being sub-moist.

2.10 On the basis of rainfall, districts range from arid to sub-humid rainfall zones.

1st Zone Districts with rainfall upto 375 mm (arid).

Ilnd Zone Districts with rainfall ranging from 375 to750 mm (Semi arid)

Illrd Zone Districts with rainfall ranginS from 750-1125 mm (Sub-humid areas)

lVth Zone rainfall above 1125 mm.

Annexure I indicates the names of Districts already selected and those recommended by the Sub-Committee.

2.11 The Irrigation Commission (1972) also studied the problem of drought prone areas and envisaged the following criteria generally adopted by the States for determining drought prone areas':

(i) meteorological data

(ii) revenue remission

(iii) frequency of famine and scarcity; and

(iv) availability of irrigation facilities.

However, it suggested the adoption of the sunshine, soil texture, soil moisture and "Drought is the result of an imbalance between the soil moisture and evapo-transpiration needs of an area over a fairly long period, so as to cause damage to standing crops and a reduction in crop yield. The basic characteristic of drought is a steady rise in temperature, in addition to the absence or the severe deficiency, of rainfall over a fairly long period. Several factors, such as precipitation, temperature, wind velocity, sunshine, soil texture, soil moisture and antecedent rainfall interact to produce this situation. However, the key-role is played by rainfall and the crucial variables are its distribution, its variability and its capacity to meet evapo-transpiration needs".

But it maintained that all the districts and talukas which comprised the drought zone were not equally vulnerable to crop failure. Protective irrigation to stabilise agriculture had been developed, or was being developed, in some districts or taluks and it considered that those districts which enjoyed a minimum percentage of irrigation should be excluded from the list of drought affected areas. According to it, the minimum criterion for identifying areas susceptible to drought is that the probability of critical rainfall shortage should be 20 per cent and that there should be an adverse water balance. Once the broad drought zone had been demarcated, it can be further examined from the point of view of availability of irrigation to identify those which required special attention. A list of the areas identified on the above basis by that Commission is given in Annexure II and III.

2.12 In October, 1971, the Planning Commission had also appointed a Task Force on Integrated Rural Development which submitted its report in June 1973 on Integrated Agricultural

Development in drovight prone areas. This Task Force also went into the question of the identification of drought prone areas and after considering the recommendations of the Irrigation Commission and other relevant factors was of the view that there were no compelling reasons for reopening the list of areas already identified at that time as drought prone in the Fourth Five Year Plan. An analysis of the areas identified by the Government of India in 1970-71 and the areas recommended by the Irrigation Commission however indicates that while some of the Districts of West Bengal, Bihar and Uttar Pradesh figured in the fist drawn up by the Government of India, these districts had been excluded by the Irrigation Commission.

2.13 The National Commission on Agriculture also went, into this question in its report submitted in 1976. This Commission was of the view that while the Irrigation Commission had seen the problem from a particular angle, that is water balance, which was relevant from the point of view of crop growth, the Central Coordination Committee and other Government Committees, on the other hand, had taken into consideration other factors including facilities in neighboring areas and opportunities for employment in addition to rainfall and irrigation. The National Commission on Agriculture was of the view that the various criteria are essential and it would not be proper to judge a particular area or a District as drought prone, unless all the factors had been duly considered. It further emphasised that the list of areas for DPAP need not be regarded as, rigid and final for all time to come. All the factors taken into consideration for selecting areas are continuously changing. There could be many developments which would obviate the necessity and remove the urgency of a special programme like DPAP. The possibility of development of local water resources and intra-basin transfer of surplus water has yet to be fully explored. Similarly, with the completion of certain irrigation projects in the drought prone area Districts, substantial areas could be brought under irrigation and some of the Districts which are under drought affected category now will not need special programme. These kinds of developments cannot be foreseen now with a reasonable degree of precision. What is needed, therefore, is to review from time to time the coverage of the special programme like DPAP in the light of future development and changes in the circumstances obtaining in specific areas.

2.14 The National Committee have gone in considerable detail into the various approaches so far advocated and also considered the scientific recommendation of the Irrigation Commission and concluded that the water balance technique seems to be the logical approach for the objective of drought prone area delineation. This approach takes into account precipitation, evapo-transpiration and soil moisture storage and attempts to arrive at a balance between water income and water loss. The Committee is of the view that while this may be an ideal approach, it does not appear to be practical at this stage for delineation purposes owing to paucity of experimental data on evapo-transpiration, soil moisture over the semi-arid and tropical regions and evolution of appropriate area specific agro-climatic models. As the objective of this Committee is drought prone area amelioration for planning and implementation of programmes for this purpose this approach will be ideal provided the basic data on the essentials can be developed. This will take time.

2.15 Our Committee is considering drought proneness as the fundamental backwardness which needs amelioration. The fact that certain parts of the areas may have irrigation and other opportunities, which are criteria taken into account at present, cannot affect the backwardness of the area where drought conditions persist. Our objective being to find means of increasing and stabilising productivity in the area with backwardness it seems reasonable to follow, for our purposes a synoptic definition that a Block can be defined as drought affected if the pattern & quantum of rain precipitation, during the main crop season of the area, makes

the traditional cultivation of the main crop of the area hazardous in three years or more out of every 10 years. This allows for the soil and wind factor which has been emphasised by the Irrigation Commission in its stress on evapo-transpiration.

2.16 In order to delineate an area as drought affected, on the- basis of the criterion above-mentioned, one needs location specific data about the major crops in the area, their evapo-transpiration rates and the soil moisture conditions and retentivity to work out the water balance for the major crops in the area. The pattern of rainfall in the location is also very relevant. Whereas the pattern of rainfall is generally available at the level of a Block, there has not been sufficient adaptive research yet in the country to work out the other parameters. If a scientifically accurate definition of drought proneness has to be introduced, it will be necessary first of all together these location specific data at the Block level. This is going to be a long drawn process. Meanwhile, it is not desirable to depart suddenly from whatever programmes have been developed for amelioration of drought prone areas that have already been defined. The Committee, therefore, recommends that till the necessary data is collected, and a scientific assessment of drought prone Blocks is done, the present area brought under a drought prone area programme may continue to be handled under the special area programme. It has been pointed out to the Committee during its discussions with the States that even following the criterion now prevalent on the basis of which present identification has been done, there are marginal areas of Blocks which need to be brought within the drought prone area programme. The Committee would recommend that any such cases should be examined on merit on the existing definition and brought within the programme if they qualify. At the same time keeping in view the recommendations of the National Commission on Agriculture that a periodic review of these areas is necessary because of the developments that are continuously taking place, it would only be reasonable to expect that those Blocks which have already come to a level of development which will put them outside the drought prone area category should be removed from the programme.

2.17 There may be an expectation that if the scientific definition now put forward by this Committee is accepted, many more areas in the country would, fall under the drought prone area programme. A preliminary exercise done in Maharashtra shows that this expectation may not really fructify. Whilst some new areas may qualify, some existing areas may have to be deleted as non-qualifying.

The Committee would, however, emphasise that a scientific delineation of areas is required if a scientific answer is to be found for the amelioration of the defect.

2.18 As in the case of semi-arid areas, the delineation of arid areas also demands a large number of meteorological observations than are available at present. However, from the trend of variation of rainfall and temperature amongst meteorological stations, the moisture parameters and observable arid region characteristics, a reasonable delineation, howsoever approximate, has been made. The area classified as hot arid in the three states of Rajasthan, Haryana and Gujarat are indicated in Annexure IV.

2.19 According to the criterion of moisture index several other arid areas could be distinguished in the country, namely, in Saurashtra and Kutch, Andhra Pradesh, Karnataka and Tamil Nadu. Except the areas in Saurashtra and Kutch which are somewhat contiguous with the region mentioned above, the rest are scattered and deserve only local attention. Moreover, these areas, though arid, have their peculiar problems, which are quite unlike those of the region delineated above, Thus, in the mainland of Kutch, the problem is, no doubt, one of aridity, but in the Rann of Kutch, the problems of both salinity and alkalinity predominate

which require large scale reclamation measures. On the coastal tracts of Gujarat and Saurashtra, the problem is similar, namely, a large scale reclamation of saline soils. Ferozeput district (Punjab) especially its southern part falls legitimately into the arid desert areas but since already under irrigation, the question of its consideration in this Report does not arise. Again, Beliary and its neighborhood constituting an arid area of Karnataka has the problem of a deep, impervious, alkaline and bad structured black soil. It does not, however, possess any of the desertic conditions attributed to the Rajasthan and neighboring arid areas.

2.20 Apart from hot arid areas, there are also cold desert areas in the country in Ladakh valley in Jammu and Kashmir, Lahaul and Spiti and Kinnaur region in Himachal Pradesh.

2.21 Annexure V gives the list of the Districts and the Blocks in the State concerned which have been identified on the basis of the recommendations made by the National Com mission on Agriculture and which have been taken up under the desert development programme. These may be looked into in case there has been any reorganisation of Districts or blocks.

ANNEXURE I

(Chapter 2) District selected by the Secretaries Committee in 1971 and those recommended by the Gidwani Committee

State	Districts already Selected	Districts now recommended	Areas Contiguous to the Selected District
1	2	3	4
1. Andhra Pradesh	1. Anantapur	1. Mehboobnagar	
	2. Kurnool		
	3. Cuddappah		
	4. Chittoor		
2. Assam			
3. Bihar		2. Monghyr	
		3. Palamau	
4. Gujraat	5. Panchmahals		Sami nand Harij taluks in Mohasna
	6. Kutch		Veramgam and Dhanduka taluks
	7. Jamanagar		in Ahmdabad and Gadada taluk in
	8. Rajkot		Bhavnagar district.
	9. Amereli		
	10. Banaskantha		
	11. Surendranagar		
5. Haryana	12. Mohindergarh		
6. Kerala			
7. Madhya Pradesh		4. Jhabua	
		5. Dhar	
8. Maharashtra	13. Sholapur	6. Nasik	
	14. Ahmednagar	7. Poona	
		8. Satara	
		9. Sangli	
9. Mysore	15. Bijapur	10. Kolar	Sholapur, Shahpur and Yadgir in dis>
	16. Chitradurga	11. Dharwar	trict Gulbarga, Lingsugaur and
		12. Belguam	Kustagi in district, Raichur, Hara-Panaspali & Hadgali distt. Bellary* Sira, Madhugir, Koratagiri, Pavaga da in Distt. Tumkur and Kadur in distt. Chickmagalur
10. Orissa		13. Kalahandi	
11 Rajasthan	17. Jaisalmer	14. Jodhpur	
	18. Barmer	15. Banswara	
	19. Pali	16. Naguar	
	20, Bikarter	17. Dungarpur	

State	Districts already Selected	Districts now recommended	Areas Contiguous to the Selected District
1	2	3	4
	21. Churu		
12. Tamil Nadu		18. Dharamapuri	
		19. Ramanthapuram	
13. Uttar Pradesh	23. Mirzapur	20. Banda	Trans Pelan areas in Maja tehsil & southern part of Bara Sub-tehsil in Krarchana tehsil of Allahabad district.
14. Delhi			

ANNEXURE II
Area Identified by the Irrigation Commission

State	District under DPAP and also identified by the Irrigation Commission.	District not identified by Irrigation Commission but already covered under DPAP	New District identified by Irrigation Commission
1	2	3	4
Andhra Pradesh	Anantapur, Kurnool, Cuddaph, Chittoor, Mahboobnagar.		Hyderabad, Nalgonda*
Bihar		Palamau, Monghyr, Gaya-cum-Sahabed	
Gujarat	Kutch, Jamnagar, Rajkot, Amereli, Banakantha, Surendra-nagar.	Panchmahals	Ahmedabad Mehsana*and/Me-dabad, Kaira, Broach, Bhav-nagar*
Haryana	Mahendragarh		Gurgaon Rohtak*
Jammu and Kashmir		Deda	
Karnataka	BijapuF, Chitradurga, Kokar, Dharwar.	Belgaum	Bangalore, Hassan, Gulbarga*, Raichur* Tumkur* Bellary*, Mysore, Mandya.
Madhya Pradesh	Jhabua, Dhar, Betul	Sidhi	Dewas, Ujjain, Khargaon* Khandwa Datia, Shajapur.
Maharashtra	Ahrnednagar, Sholapur, Nasik, Satara, Sangli.		Aurangabad, Bhir, Osmanabad.
Orissa		Kalahandi, Phulbani	
Rajasthan	Dungarpur, Jaisalmir, Banner, Bikaner, Jodhpur, Churu, Ban swara.	Pali, Jalore, Nagaur	Ajmer, Udaipur*
Tamil Nadu	Ramanthapuram, Dharmapuri		Salem, Coimbatore, Tiruchirap-pally, Madurai, Tirunelvel
Uttar Pradesh		Mirzapur, Banda Allahabad, Varanasi, Hamirpur, Jalaun.	
West Bengal		Purulia, Midnapur-cum-Bankura	
Total	34	20	33
*Parts of these districts covered under DPAP : as contiguous areas.			

ANNEXURE III
Droutht Prone Areas Programme (Project Area of DPAP)

State	*District*	*No. of blocks*	*Name of Blocks in the Distt.*
1	*2*	*3*	*4*
1. Andhra Pradesh	1. Anantapur	16	ChinnakotapaHi, Dharmavaram, Gcoty, Ksdini, EastKadiri West Kalayandrug, Kudair Hindupur, Medakasira, Penukonc'e' Rayadurg, Singanamala, Tadipatii, Uravakonda, Kambadur and Kanekal.
	2. Chittoor	15	Bangarvapalem, Chandragiri, Chinnagottigj llu, Chittcor Chaw-depalle, Gangadharanallore, Tarvetinagar, R.uppam Madan-pallo, Palamaper, Pulicherla, Purganur, Puttur, Tambalapalle and Vovapal.
	3. Cuddaph	11	Cuddapah, Jamalamadugu, Kamalapu ram, Kodur, Lakhiradd palli, Middanor Porumamilla, Proddatur Pulivendla, Rajamed and Rayachoti.
	4. Kurnool	13	Ado no, Alur, Atmakur, Banganapall Dhoney, Rcdummur Koillkuntla, Kurnunool, My Nagar (Allagadda) Nandyal Pattikonda, Yemmiganur and Nandikotkur,
	6. Mehboobnagar	13	Acchampet, Amangal, Atmakur, Bijnapalli, Gadwal, Jadcherla Kalwakurthy, Kaliapur, Makthal, Alampur (Manopad) Nagr-kurnool, Shadnagar and Wana Parthy.
	6. Prakasam	6	Kanigiri, Markapur, Ciddalur, Yerrangondcfpalem, Veligandla and Bestavaripet.
	7. Nalgonda	2	Dsverkonda and Chentapatti
	Sub-Total	76	
2. Bihar	8. Monghyr	8	Chakai, Hilsi, Jamui, Jadha, Khaira, Lakhimpur, Sikandra and Sone.
	9. Newadah	10	Akbarpur, Govindpur, Hisua, Kawakala, Narhat, Nawadah, Pakaribarawan, Rajauli, Sirdala and Warisaliganj.
	10. Palamau	25	Bilamith, Birwadih, Bishandi, Biandaria, Bhawanathpur, Bish. rampur, Crundwa, Caattapiir, Daltonganj, Dhurki, Garhwa, Garu, Hiriharganj, Hussainabad (Saidabad), Latshar, Lesligan, Mahuadanur, Mainigaon, Manatu, Manika, Nagaruntari Psnki, Pathnu, Piprakalan and Raoka (Dewandag).
	11. Rohtas (Sasaram)	14	Adhaura, Bhabua, Bhagwanpur, Chand, Chainpur, Chnari Durgaw Kudra, Rohas, Sasaram and Sheong.

State	*District*	*No. of blocks*	*Name of Blocks in the Distt.*
1	*2*	*3*	*4*
	Sub-Total	57	
3. Gujarat	12. Ahmdabad	2	Dhankhuka and Viramgam
	13. Amreli	4	Dhari, Khamba, Lathi and Rajla
	14. Banaskaniha	6	Deodar, Chandra, Radhanpur, Santalpui, Tharad, Vav.
	15. Bhavnagar	1	Gadhada
	16. Jamanagar	2	Kalyanpur, Okha
	17. Kutch	7	Abdasa, Anjar, Bhavhau.Bhuj, Lakhpat, Nakhatrana, Rapa
	18. Mehsana	2	Harij, Semi
	19. Panchamahals	7	Devgadh, Varia, Godhra, Jambughoda, Limkheda, Lunavada, Sanframpur, Shehra.
	20. Rajkot	2	Jasdan, Wankaner.
	21. Surendranagar	8	Chotila, Dasada, Dhangadhra, Halvad, Lakhlar, Limdi, Muli Sayala.
	21. Surendranagar	8	Chotila, Dasada, Dhangadhra, Halvad, Lakhlar, Limdi, Muli Sayala.
	Sub-Total	41	
4. Haryana	22 Bhiwani	6	Badhra, Bhiwani, Bond, Dadri Laharu, Toshan
	23 Mohindergarh	5	Ateli, Kanina, Mohindergarh, Nangal, Chowdhary, Narnaul
	24. Rohtak	2	Nahar and Salhawas,
	Sub-Total	13	
5. Jammu and Kashmir	25 Doda	8	Assar, Bhaderwah, Bhalessa, Doda, Kishtwar, Marwa, Paddar and Ramban
	26. Udhamur	5	Mahore, Chenani, Rasi, Pouni Udhampur.
	Sub-Total	13	
6. Karnataka	27. Bijapur	11	Badami, Bagalkot, B. Bagawadi, Bijapur, Bilgi, Hungund, Indi, Jamakhadni, Muddebihal, Mudhol, Sindigi.
	28. Bellary	2	Hadgalli Harpanahalii
	29. Belgum	5	Athani,Gokak, Rabibagh, Pamdurg, Saundatti
	30. Chitradurga	5	Challakcra Chitradnrga, Hosadurga Jagalur, Malakamura
	31. Chickmagalur	1	Kadur
	32. Dharwar	5	Haveri, Kundgol, Mudargi, Ranebannur, Ren.
	33. Gulbarga	3	Shahapur, Shoranur, Yadgir
	34. Kolar	8	Big-3palli,Bangavpet,Chinfamani, Gudibanda,Kolar, Mulbagal, Siddala-hattaw, Srinivaspur
	35. Raichur	2	Kushtagi, Lingsugur
	36. Tumkur	4	Koratgeri, Madhugiri, Pavageda, Sira
	Sub Total	46	
7. Madhya Pradesh	37. Betual	8	Amala, Betual, Bhinapur, Chicho),Ghodaongiri, Miitai, Prabha-tpatan,

State	*District*	*No. of blocks*	*Name of Blocks in the Distt.*
1	*2*	*3*	*4*
			Shahpur.
	38. Dhar	8	Bigh, Bakaner, Dahi, Gandhwani, Kukshi, Manwar, Nisarpur, Sardarpur.
	39. Jhabua	12	Aligajpur, Bhabra, Jhabua, Johat, Kathiwara, Maghnaga; Petlawad, Rama, Ranapur, Sandhwa, Thandla, Udaigarh
	40. Khargaon	4	B.irwani, Thikari, Pali, Rajpur
	41. Shahdol	2	B iohari, Jaisingnagar
	42. Sidhi	8	Chiirangi, Deosar, Kushmi, Majhauli, Rampur, Sihawal, Sidhi, Vaidheh
	SubTotal	42	
8. Maharashtra	43 Ahmednagar	13	Ahmednagar, Akola, Jamkhed, Karjat, Kopargaon, Newasa, Parner, Pathardi, Singamner, S'liogaon, Shrigonda, Shriram-pur, Rahuri.
	44. Nasik	6	Chandur, Malegaon, Nandgaon, Niphad, Sinnar, Yeola
	45. Pane	6	Biramati, Dhand, Haveli, Indapur, Porandhar, Si/ur
	46. Sangli	2	Atpadi, Jaih
	47. Satara	4	Khandala, Khatav, Man, Phaltar
	48. Sholapur	11	Akkalkot, Barsi, Karmala, Madha, Mangalwedha, Milshiras, Mohol, Pandharpar, Sangola, Sholapur South, Sholapur North.
	Sub Total	42	
9. Orissa	49. Kalhandi	11	Baden, Golmund, Kasinga, Komna, Lanjigarh, Madanpur, Rampur, Narla, Nawapara, Thyaamel, Rampur, Sinapali.
	50. PaulbanL	14	B .liguda, Chakapad, Daringibadi, G. Udaya, Harbhanga, Kant-tamaljKhajuripada, Kotaragarh, Naugaon, Phin'ngia, Phulbani, Raikia, Tikabad, Tumudibancha.
	Sub Total	25	
10. Rajasthan	51. Ajmer	2	Jawaja, Massauda
	52. Bmswara	8	Bigidore, Banswara, Bhukhiya, Garhi, Ghat, Kushalgarh, Pipalkhunl, Sujjangarh.
	53. B armor	8	Barmer, Baitu, Chohtan, Guralamani, Pachpadra, Sheo, Sundha-ri, Siwana.
	54. Bikaner	4	Bikaner, Kolayat, Loonkaransar, Nokha
	55. Churu	7	Dangargarh, Rajgarh, Ratangarh Tatanagar, Sardarshehr, Suja-ngarh, Taranagar.
	56. Dungarpur	5	Aspura, Bichiwa, Dungarpur, Sagwara, Simlawara
	57. Jaiselmer	3	Jaiselmer, Sam, Shenkra
	58. Jalore	7	Ahera, Bhinmal, Jalore, Jaswantpur, Raniwara, Sanchore, Sa-yala.
	31. Chickmagalur	1	Kadur

State	*District*	*No. of blocks*	*Name of Blocks in the Distt.*
1	*2*	*3*	*4*
	32. Dharwar	5	Haveri, Kundgol, Mudargi, Ranebannur, Ren.
	33. Gulbarga	3	Shahapur, Shoranur, Yadgir
	34. Kolar	8	Big-3palli,Bangavpet,Chinfamani, Gudibanda,Kolar, Mulbagal, Siddala-hattaw, Srinivaspur
	35. Raichur	2	Kushtagi, Lingsugur
	36. Tumkur	4	Koratgeri, Madhugiri, Pavageda, Sira
	Sub Total	46	
	59. Jodhpar	9	Bileswar, Bap, Bhoaplgarh, Bilara, Jodhpur, Luni, Oslan,Pha-lodi, Shergarh.
	60. Jhunjhunu	2	Chirawa, Jhunjhunu
	61. Nagaur	11	Dccdwana, Degama, Jayal, Kucharmn, Landhnu, Makran, Mundwa, Merta, Nagaur, Parbatsar, Riyan
	62. Pali	10	Bali, Desuri, Jaitaran, Karchi, Pali, Raipar, Rani-Station,Rohat, Sojat, Sumerpur.
	63. Udaipur	3	Bhim, Deogarh. Kherwara
	SubTotal	79	
11. Tamil Nadu	64. Dharampuri	16	Bargur, Dharmapuri, Harur, Hosur, Kaveripatinam, Kelamangalam, Krkhaagiri, Morappur, Nallampilli, Pallacode, Papp-iraddipatty, Ponnagaram, Sholagiri, Thalli, Uthangaraia, Vep-pan&patli.
	65. Rarmnathapuram	32	Arupukkottai, Bogalur, Devakotlai, Ilayangudi, Kaldaladi Kahyarkoil, Kalla!, Kamuthi, Kannangudi, Kariapatti, Man-rmdirai, Mmdapam, Mudukulathur, Narikudi, Pdramakudi-R ja palagam, Ramanathapuram R. S., Mangilam, S-3kk>ttai Sattur, Singarmpiranani, Sivaginge, Sivakasi, S ivillaiputiur, Ti nc'iuli, Tirupattur, Tiruppulanni, Tirppjvaram, Tiruvad-nai, Vembakoftai, Virudhunagar, Watrap.
	SubTotal	48	
12. Uttar Prdesh	66. Allahabad	8	Chaka, Jasra, Karchana, Koraon, Meja, Nanda, Sharkargarh Urwa.
	67. Banda	6	Karvi, Manikpur, Mau, Narani, Pahari, Ramnagar.
	68. Hamirpur	5	Charkhari, Mahoba, Maudha, Sarilla, Seumerpur.
	69. Jalaun	3	Dakore, Kadaura, Mchewa
	70. Mirzapur	15	Bibhini, Chatara, Chhonye, Chopan, Dudhi, Gohorwal, H'Jia.Lalginj, Pitchrakalan, Marihan, Mirzapar City, Myo-rapur, Nagava, Pahari, Rajgarh, Rovertsgangj.
	71. Varanasi	3	Chakia, Naugarh, Shahabganj
	Sub Total	40	

State	*District*	*No. of blocks*	*Name of Blocks in the Distt.*
1	*2*	*3*	*4*
13. West Bengal	72. Bankura	7	Chhadia, Ganghajalghati, Indpur, Khatra II, Mehjhia, Rani-bandh, Saltora.
	73. Midnapur	8	Binapur I, Binapur II, Gopiballavpur I, Gopiballaypur II, Jam-bani, Kharagiam, Nayagram, Sankrail.
	74. Parulia	20	Arsha, Bigmundi, Bilrampur, Barabazar, Bardwan, Hura, Jaipur, Jhalda I, Jhalada II, Kashipur, Mmbazar I, Manbazar II, Nsturia, Pata, Kuncha, Purulia-II, Raghanathpur-I, . Raghunathpar-II, Santuri.
	Sub Total	35	
	GRAND TOTAL	557	

ANNEXURE IV
State-wise District Tehsil and Area Delineated as arid

State	District/Tehsil	Area (Sq. km)
1	2	3
Rajasthan	1. Ganganagar	20,638
	2. Bikaner	27,369
	3. Jaisalmcr	38,834
	4. Banner	28,172
	5. Nagaur	17,644
	6. Churu	16,860
	7. Jhunjhunu .	5,928
	8. Jodhpur	22,644
	9. Sikar	7,749
	10. Jalore	10,564
	11. Pali	12,224
	Total	208,626
Harayana	Hissar	
	1. Dabwali	1,446
	2. Sirsa	2,825
	3. Fatehabad	2,385
	4. Hissar including Tohana	2,648
	5. Hansi*	2,089
	Bhiwani	11,393
	1. Bhiwani	1,982
	2. Loharu	581
	3. Dadri	1,448
	Rohtak	4,011
	1. Jahajjar	2,107
	Total	17,511
Gujarat .	Banaskanlha	
	1. Vav	1,701
	2. Tharad	1,358
	3. Deoar	1,012
	4. Kankrej	822
	5. Radhanpur	596
	6. Santalpur	1,352
		6,841
	Mehsana	
	1. Sami	1,510
	2. Harij	407
		1,917
	Total	8,758
	Rajasthan	208,626
	Haryana	17,511
	Gujarat	8,758
	GRAND TOTAL	234,895

* Includes Bawani Khera Tehsil now forming part of Bhiwani district

ANNEXURE V Area under Desert Development Programme		
State	District	Block
1. Jammu and Kashmir.	1. Leh	1. Leh 2. Derbak 3 Neyamd 4. Khalsi 5. Nebra
	2. Kargil	1. Kargil 2. Drass 3. Sanka 4. Shakr Chint 5. Zanskar
2. Himachal Pradesh	1. Lahaul Spiti	1. Spiti
3. Gujarat	1. Banaskantha	1. Vav 2. Tharad 3. Deoar 4. Kankrej 5. Radhanpur 6. Santalpur
	2. Mehsana	1. Semi 2. Harij
	3. Kutch	1. Abdasa 2. Nakhtrana 3. Lakhpat
4. Harayana	1. Hissar	1. Bahuna 2. Barwala 3. Dhiranwas 4. Fatehabad 5. Hissar 6. Hansi 7. Mundha 8. Narnaund 9. Raiia 10. Tohana
	2. Bhiwani	1. Badhra 2. Bawani Khera 3. Bhiwani 4. Bond 5. Dadri 6. Loharu 7. Tosham
	3. Rohtak	1. Nahar 2. Sahiawas 3. Deri 4. Jhajjar 5. Bahadurgarh
	4. Sirsa	1. Badagudha 2. Dabwali

		3. Rania 4. Sirsa
5. Rajasthan.	1. Ganganagar	1. Bhadra 2. Hanuman-garh 3. Karanpur 4. Mirzawala 5. Nohar 6. Padampur 7. Raisinghna-gar. 8. Sadulsharar 9. Suratgarh
	2. Bikaner	1. Bikaner 2. Kalayat 3. Loonkaransar 4. Nokha J
	3. Jaisalmer	1. Jaisalmer 2. Sam 3. Shankra
	4. Barmer	1. Baifu 2. Barmer 3. Chohatan 4. Guralamani 5. Pachpadra 6. Shoo 7. Sindhari 8. Siwana
	5. Nagaur	1. Doedwana 2. Degana 3. Jayal 4. Kuchaman 5. Ladnu 6. Makrana 7. Mundwa 8. Merta 9. Nagaur 10. Parbatsar 11. Riyan
	6. Churu	1. Dungargarh 2. Raigarh 3. Ratangarh 4. Ratannagar 5. Sardarshahar 6. Sujangarh 7. Taranagar
	7. Jhunjhunu	1. Alsisar 2. Buhana 3. Chirawa 4. Jhunjhunu 5. Khetri 6. Nawalgarh

		7. Surajgarh 8. Udaipurwati
	8. Jodhpur	1. Balesar 2. Bap 3. Bhopalgarh 4. Bilara 5. Jodhpur 6. Luni 7. Osian 8. Phalodia 9. Shergarh
	9. Sikar	1. Daniaram-garh 2. Dehad 3. Fatehpur 4. Khandela 5. Lachrnangarh 6. Neemkathana 7. Piprali 8. Srimadhopur.
	10. Jalore	1. Ahore 2. Bhimmel 3. Jalore 4. Jaswantpur 5. Raniwara 6. Sanchore 7. Sayala
	11. Pali	1. Bali 2. Desuri 3. Jaitaran 4. Kharchi 5. Pali 6. Raipur 7. Rani station 8. Rohat 9. Sojat 10. Sumerpur

3. REVIEW OF PAST AND CURRENT PROGRAMMES

The problems of periodic droughts and scarcity in the country have been receiving the attention of administrators and policy makers for the past hundred years. The Famine Commissions appointed by the British Government did suggest some measures like expansion of irrigation and railways, grant of loans _ etc. These measures were intended to provide immediate need to the distressed population and did not have the long term perspective for improving the conditions in the chronically drought affected areas. It was only after Independence that a long term view was taken of the problem for evolving a strategy for development of these areas.

3.2 There was no appropriate recognition of the problem of drought affected areas in the initial years of the planning era in India. Though, Rs. 15 crores was provided in the First Five Year Plan for assistance to the scarcity affected areas, there was no mention of these areas in the Second and Third Plan. The approach was essentially that of starting ad-hoc relief works to create employment for the affected population.

3.3 The First and Second Plans, however, emphasised that as over a considerable area agriculture depended largely upon rainfall, the problems of dry land farming had to be given more attention than before. Research on con servation of soil and moisture by reducing the rate of run off, control of evaporation through soil mulches etc., at Sholapur in Maharashtra and Bijapur in Karnataka and Rohtak in Haryana was found useful for ensuring a good crop in bad years also. It was stated that these dry farming practices could be widely spread among farmers and the difficulties experienced therein could be studied by extension staff and research workers. During the Second Five Year Plan, 45 dry farming projects were initiated covering an area of about 400 ha, each hi different States to demonstrate the benefits of dry farming practices in low and erratic rainfall areas.

3.4 It was only in 1961 that a slightly wider connotation was given to famine by bringing in the concept of chronically drought affected areas which covered not only those areas where famine was endemic but also certain other areas where rainfall was low, and the general geographical, climatic and agronomic conditions were such that any slightest unfavourable tilt in the natural balance would push these areas in the direction of famine. The Ministry of Food and Agriculture, Government of India, accordingly prepared an outline of a draft plan in 1961 for development of certain regions of Andhra Pradesh, Karnataka and Maharashtra which are subject to chronic droughts causing periodically wide spread distress to people.

3.5 It was, however, only after the very pro longed wide spread droughts of 1965-67 that there was a real awakening at the national level and the importance of evolving a long term strategy for development of drought prone areas was felt.

3.6 The concern at the deteriorating situa tion in drought affected areas and the mounting burden of expenditure on drought relief measures led to a rethinking on the problems of development of these areas. It was apparent that during scarcity conditions relief funds were often spent on improvised employment schemes which did not provide lasting benefits to the drought affected areas. It was realised that appropriate technologies had to be evolved and programmes put on the ground to improve and stabilise their economy. Without an all out effort in this direction the instability of produc tion in these areas would continue to hamper the growth of the economy of the country as a whole. The Fourth Plan, therefore, laid considerabale emphasis on research into improved dry farming technologies and application of

such technologies in dry farming areas. The plan also envisaged a programme of rural works and mentioned:—

"Apart from outlays included in the Plan, the Central Government annually provides about Rs. 25 crores from the budget as grant to famine affected areas. Over the Fourth Plan pariod nearly Rs. 100 crores are likely to be available from this source. The bulk of these amounts can be so deployed in the areas chronically affected by drought as to generate considerable employment related to pre-planned programmes of rural works. Individual schemes of rural works thus' drawn up should be integrated on the one hand with the general programmes of agricultural development in the areas concerned and on the other specific programmes of development for sub-marginal farmers and agricultural labourers. All these are aspects which require considerable attention and advance planning if the results obtained are to commensurate with the outlay both in terms of rural employment generated and the development achieved".

3.7 To achieve the above objectives, the Plan initiated the All India Coordinated Research Project for Dry Land Agriculture. Besides, it also initiated 24 pilot projects in 1970-71 for testing the applicability of a package of dryland practices with an outlay of Rs. 20 crores in the Centrally Sponsored Sector.

3.8 The Rural Works Programme was initiat ed during 1970-71 in 54 districts (along with some contiguous areas of another 18 districts) in 13 States which were identified as chronically affected by drought with the primary objectives of employment generation so as to mitigate the effects of drought. The emphasis in the pro gramme was on the construction of civil works of a permanent nature which would facilitate further development of the area. The pro gramme covered 600 lakhs or 12% of the population, and an area of 5.66 lakh sq. km. which constitutes about one-fifth of the total area of the country. Detailed guidelines were issued for the planning and implementation of this pro gramme. The intention was to generate employ ment in the rural sector and create productive assets of permanent value on which sustained development could take place. The schemes proposed were necessarily to be labour intensive in nature and were to be regarded as additive to the Plan, and the non-Plan schemes were to be integrated with other relevant development pro grammes in the district for ensuring full impact. Further more, the districts were expected to have another set of pre-planned schemes with well- defined priorities for execution in the event of occurrence of a famine while the above pro gramme was being implemented. The general order of priorities suggested was Medium and Minor irrigation projects, Soil conservation & afforestation; and Village and District roads. It was assumed that for every Rs. 1 crore of expenditure of programme, employment for 25-30,000 persons would be generated.

3.9 The Ru|al Works Programme was a Central Sector non-Plan scheme during 1970-71. But considering its developmental nature, the Planning Commission classified the scheme as a Plan scheme from April 1972 and an outlay of Rs. 70 crores was earmarked for the remaining two years of the Fourth Plan (1972-74). Annexure I gives the Statewise total outlay and expenditure on the Rural Works Programme during 1970-73. An analysis of the data pre sented in this annexure indicates that about 81% of the funds were spent in Haryana; follow ed by 71% in Andhra Pradesh while it ranged from 58% to 62% in Maharashtra, Karnataka and Tamil Nadu. Only 10% of the funds were, however, spent in Bihar. In terms of share of absolute expenditure on the Rural Works Pro gramme, it could be seen that Rajasthan and Karnataka accounted for 17% each and Maha rashtra 15% of the total expenditure incurred, while it was negligible in Bihar, Jammu & Kashmir, Madhya Pradesh, Orissa and West Bengal.

3.10 The table below present's sectoral out- j lays and expenditure on rural works programme by the end of 1972-73:—

(Rs. in lakhs)

Sector No.	Outlay for Fourth Plan	Expenditure for 1970-73	Percentage
1. Minor Irrigation	6016-09	2269-49	37-72
2. Soil Conservation	914-43	477-03	52-16
3. Afforestation	905-54	392-15	43-30
4. Roads	2836-31	1545-62	54-50
5. Others	580-80	104-67	18-02
Total	11255-17	4788-96	42-55 1

3.11 Out of the total expenditure of Rs. 47.89 crores of Rural Works Programme during 1970-73, it could be seen that medium/ minor irrigation claimed as much as 47% of the funds followed by road works (32%), soil conservation (10%) and afforestation (8%). Only two per cent of the total expenditure was incurred on creation of drinking water facilities and pasture development which were taken up only in Andhra Pradesh, Gujarat, Madhya Pra desh and Rajasthan.

3.12 Further, the allocation of sectoral out- 1 lays varied considerably at the district level also. The Report on Integrated Agricultural Develop ment in Drought Prone Areas (Task Force appointed by the Planning Commission) in June 1973 pointed out that the percentage of approv ed outlay varied between 10 to 97 per cent for minor irrigation, between less than 10 to 50 per cent for soil conservation and less than 10 to 44 per cent for afforestation. Again, the allocation for road works ranged from less than 10 to 75 per cent. The content of the Rural Works Programme thus varied even from dis trict to district.

3.13 As a part of the programme, soil conser- 1 vation measures were taken up in an area of 4.6 lakh ha. and 9,000 km. of roads were con- I structed. Afforestation programmes covered slightly less than one lakh ha. and irrigation was provided to 1.64 lakh ha. as against the target of five lakh ha. As stated earlier, the pro gramme aimed at creation of employment by launching labour intensive schemes.

3.14 The efficiency and the speed with which the Rural Works Programme was implemented during Fourth Plan, varied from State to State. As described earlier, the State Governments were asked to prepare Master Plans for each district indicating clearly the strategy of development. It was, however, reported by the Task. Force that none of the State Governments spelt out clearly the priorities in respect of the sectoral programme due to their pre-occupation with the execution of rural works to generate employment. In many areas, the Task Force observed, excessive priority was given to roads even though at the then stage of development, they could not be considered important for the mitigation of the effects of drought in those areas.

3.15 Though Master Plans were drawn up for some districts, these were nothing but the different sectoral schemes collated together. They were not drawn up by following sound planning procedures. The inventory of approved schemes was frequently revised and the schemes proposed earlier were dropped due to difficulties in execution. In view of the urgency of pro viding employment, all the schemes were designed to provide immediate employment, not always with a long term perspective. The State Govern ments were asked to go ahead with the imple mentation of the schemes generally following the basic priorities of the programme. However, this ad-hoc approach to the implementation of the programme did

not prove effective in mitigating the drought conditions. There was no monitor ing or supervision of relief expenditure with the consequent inadequacies in the appropriate utilisation of funds. As a result of deviation from the norms and yardsticks adopted at the time of formulation of schemes, a large number of schemes were left incomplete at the end of the Fourth Plan.

3.16 Following the Fourth Plan mid-term appraisal in 1971, the programme was reoriented from mainly employment generation to drought-proofing of the areas covered. It was' renamed as Drought Prone Areas Programme (DPAP) with effect from January 1973.

3.17 The programme in the initial stages was restricted to schemes of minor and medium irrigation, afforestation and soil conservation, roads and drinking water supply. It was later appreciated that the development of cattle and dairying as well as sheep was highly relevant to the land and water resources situation in most of the drought prone areas and pasture and animal husbandry development would be more effective in utilising the resource potential of the areas concerned. The expenditure incurred on the programme during the first few years brought out the fact that the emphasis on labour- intensive schemes had resulted in sanctioning of schemes by the States without regard to any long term strategy of development. Many low priority and non-productive assets were thus created through the relief employment pro gramme which did not lead to any increase in the overall productivity of the area. The State Governments were advised to reorient the pro gramme and it was found that most of the resources had already been committed. Tht shift in emphasis, although conceived during the Fourth Plan, could not be brought to bear on the contents of the programme during that plan.

3.18 The need for this programme was em phasised as follows in the Fifth Plan Document:—

"The need for a careful development strategy for drought-prone areas in the Fifth Plan arises from several considerations. Firstly, the drought-prone areas represent nearly 19% of the total area of the country and account for nearly 12% of the population. Secondly, the drought prone areas are a major factor contributing to regional imbalances in the country. Their overall productivity has been and continues to be low. Every third year, about three million inhabitants of the arid zone migrate with their livestock. Thirdly, these areas remain a continuing source of strain on the financial resources of the nation. At the India level, during the period 1969-70 to 1971-72, the expenditure on drought relief was nearly Rs. 420 crores. For 1972-73, the expenditure would be in the neighbourhood of Rs. 370 crores."

3.19 The DPAP differed from Rural Works Programme in many ways. The main objecti ves of this programme were (i) optimum utili sation of resources in the areas covered under the programme with emphasis on primary re source, viz., land, water, livestock and man power, and (ii) improvement of the living conditions of the rural poor who suffer most in terms of scarcity and drought in particular, and the community in general by creating direct and indirect wage employment and taking up short gestation programmes of development.

3.20 The main thrust of the programme was to be in the direction of restoration of ecolo gical balance between land, water, and vegetation, animal and human population.

3.21 The main objective of the programme now rs integrated development of the area affected. It aims at providing the optimum utili sation of land, water and livestock resources, stabilisation of the income of weaker sections of the society, and minimisation of the impact of drought on agricultural production and the in come of rural people. The programme lays

special emphasis on the uplift of Scheduled Castes, Scheduled Tribes, Small and Marginal Farmers, Agricultural Labourers and other weaker sections of the rural community who have been neglected so far in the developmental process. The basic objectives of programme are ',—

(i) Reducing the severity of the impact of drought,

(ii) Stabilising the income of the people, particularly weaker sections of the society; and

(iii) Restoration of ecological balance.

3.22 Some of the important components of the programme are :—

0) Development and management of water resources;

(ii) Soil and moisture conservation measures;

(iii) Afforestation, with special emphasis on social forestry and farm forestry;

(iv) Development of pasture lands and range management in conjunction with development of sheep husbandry;

(v) Livestock development and dairy development;

(vi) Restructuring of cropping pattern and changes in agronomic practices; and

(vii) Development of subsidiary occupations.

3.23 The programme covers 74 selected districts in 13 States wholly or partly identified as chronically drought prone districts by the Government of India. The programme is in operation in 557 Community Development Blocks out of 5011 Community Development Blocks in the country. The total area of these drought prone districts is 585,000 sq. kms. with a population of 600 lakhs. The programme, thus, covers about 12% of the, total pouplation (1971 Census) and about 19% of the total area of the country.

3.24 The Fifth Plan envisaged an investment of Rs. 336.94 crores for the programme. The actual utilisation till the end of 1978-79 amount ed to Rs. 269 crores. The programme is being continued during the Sixth Plan. Presently allocations to projects are made on the basis of Rs. 15 lakhs per annum per Block. This allocation is shared equally between the Centre and the State Governments., The Central allocation for the various State Governments for 1980-81 is indicated below:—

(Rs. in lakhs)

S. Name of State No.	No. of districts	No. of Blocks	Allocation
1. Andhra Pradesh	7	76	570.00
2. Bihar .	4	57	427.50
3. Gujarat.	10	41	307.50
4. Hiryana	3	13	97.50
5. Jammu & Kashmir	2	13	97.50
6. Karnataka	10	46	345.00
7. Madhya Pradesh .	6	42	315.00

8. Maharashtra .	6	42	315.00
9. Orissa .	2	25	187.50
10. Rajasthan	13	79	592.50
11. Tamil Nadu .	2	48	360.00
12. Utiar Pradesh	6	40	375.00
13. West Bengal	6	35	262.50
Total	74	557	4222.50

3.25 The programme has also been helped by aid from international agencies. The World Bank has extended a loan of US $ 35 million for the programme in 6 districts viz., Anantapur (Andhra Pradesh), Bijapur (Karnataka), Ahmednagar and Sholapur (Maharashtra), Jodhpur and Nagaur (Rajasthan). West Germany has extended an aid of Rs. 19.5 million for parts of Bankura district of West Bengal.

The EEC has also extended aid for the projects in the districts of Jalaun, Hamirpur and Mirza-pur in Uttar Pradesh amounting to US $ 10.0 million which will continue till 31st March, 1983.

3.26 Small Farmers are allowed subsidy upto 25% and Marginal Farmers and Agricultural Labourers upto 33 1/3% on their investment cost in various programmes. On land development, soil and water conservation works the subsidy rate is 25% of the total cost to all farmers. The cost of fishing nets is also subsidised upto 25%. Subsidy upto 25% of cost is also provided to small and marginal farmers. For mulberry cultivation under farm forestry, the cost of planting material is borne by the Government. In case of group/community projects the rate of subsidy is 50% on the cost attributable to small/marginal farmers.

3.27 In order to encourage the Cooperative Credit Institutions for increasing their advances to the weaker sections, the agencies provide risk fund at 6% of the additional investment each year on short term and medium term loans to the primary cooperative societies/central co-operative banks and 2% on long term loans to Land Development Banks. As subsidies from the project funds are paid in kind through the financing institutions, and are linked with loans the identified participants are also encouraged to become members of cooperatives. For this purpose, interest free loan for the purpose of four shares upto Rs. 40 is given by the DPAP Agencies to the Small/Marginal Farmers and agricultural labourers. Similarly, medium term loan upto Rs. 10 lakhs is given by the Agencies to Central Cooperative Banks in the Project Area where the Bank is not able to advance loans from its own resources to meet the condi tions of non-overdue cover.

3.28 For infrastructure development under various development heads, 100% of cost is borne by Government with the exception of Mandies for which assistance at the rate of Rs. 3 lakhs per Mandi is provided under the programme. The rest is to be taken on loan.

3.29 The apex organisation is the Drought Prone Areas Programme Division in the Ministry of Rural Reconstruction, Government of India. This Division oversees programme plannmg and implementation throughout the country. At the State level, planum!, monitor ing and evalution cells have been set up At the project level, in most regions, Drought Prone Areas Development Agencies have been esta blished as Societies registered under the Socie ties Registration Act. The Collector of the District is normally the Chairman and all the district level officers of the implementing departments and some non-officials aje members of the Agencies. The Agencies have the responsibility of planning, coordinating and implement-ing the project. In the field, the schemes are implemented by the existing Go vernment depart-

ments who continue to function under their respective Heads of Departments. If the existing staff is not adequate to implement the additional activities contemplated under the programme, additional staff is sanctioned.

3.30 It has been reported that the set up is not uniform in all the States. While District Development Agencies for the programme have been set up in majority of the States under the Societies Registration Act, 1860, in Tamil Nadu, a Rural Development Corporation was set up in one district Dharampuri while Madhya Pradesh continued to implement the programme through the office of the District Collector. In contiguous districts in some States where the coverage of the programme was restricted to a few blocks, the administration of the programme in such districts was taken over by neighbouring districts which had a sizeable area under the programme. In Maharashtra also only two districts; namely, Ahmednagar and Sholapur which were part of the project assisted by the International Development Association, district agencies were set up. With the introduction of the IRD programme, a Rural Development Agency has been set up and the drought prone areas programme in the concerned district has been merged with it.

3.31 Till March 1981, an outlay of Rs. 578.36 crores was earmarked for the programme against which a sum of Rs. 448.48 crores upto 31-10-1980 was reported as expenditure by the participating State Governments which constitute about 77.5 per cent of the outlay mentioned above. As per the information supplied by the Ministry of Rural Reconstruction, over 33.05 crores mandays of employment was generated through various activities taken up under the programme since inception upto end of March, 1979. The actual figures regarding number of beneficiaries belonging to small and marginal farmers and agricultural labourers covered under the programme during Fourth Plan period is not readily available. However, it has been estimated that 25.51 lakh small/ marginal farmers/agricultural labourers received benefits under the programme during the period April 1974 to March 1979.

3.32 A statement showing the sector-wise expenditure under DPAP during Fourth Plan from 1974-75 to 31st August, 1980 and physical achievements under major heads upto September 1980 are given in Annexures II and III.

3.33 An analysis of the performance of the programme during 1974-78 (Development of Drought Prone Areas — National Institute of Rural Development, 1980) indicates that none of the States could achieve the full targets. The highest utilisation of funds was reported by Madhya Pradesh (91%), followed by Tamil Nadu (83%), Gujarat (80%) and Karnataka (79%), Harayana and Jamu & Kashmir report ed lowest expenditure of 59% each. Taking into account the shares of the respective States in terms of absolute expenditure (percentage of expenditure to the total all India expenditure), we find that the highest expenditure was in curred in Rajasthan (14.6%), followed by Gujarat (12.9%), Andhra Pradesh and Karna taka (11.7%) each, Uttar Pradesh (10.0%), Madhya Pradesh (9.5%) and Maharashtra (8.3%). The rest of the States together accounted for 21.3% of the total expenditure incurred.

3.34 The performance under different sectors in terms of financial expenditure and area-wise outlays and expenditure are given in the table below:—

Sectorwise outlay and expenditure (1974-78)				
Sector	Outlay sanctioned during 1974-78	Expenditure incurred during 1974—78	Percentage of expenditure to the total outlay in each sector	Percentage share of each sector in total expenditure All India
Agriculture	4010-25	2797.32	69-8	14.8

Irrigation (minor and medium irrigation).	12794.45	9146.65	72.0	48.5
Afforestation and pasture development	2873.34	2511.44	87.4	13.3
Aniimlhurbandry	3758.68	2481.74	66.0	13.1
Horticulture	196.13	145.41	74.1	0.8
Fisheries	293.03	186.85	63.3	1.0
Drinking Water Supply	369.10	233.01	63.1	1.2
Credit management	261.07	162.93	62.4	0.9
Others	1442.97	1232.28	85.3	6.4
Total	25909.13	18897.63	72.9	1000

3.35 The following table shows outlays and expenditure on different Drought Prone Area Programmes for different category of drought affected areas during 1974-78.

(Rs. in lakh)

Area	Out lay	Percent outlay to total outlay	Expenditure	Percent expenditure e to outlay	Percent expenditure in the area to total expenditure in coutary (total of column 4).
(1)	(2)	(3)	(4)	(5)	(6)
Arid	2511.83	10.8	1777.96	70.8	10.5
Semi-arid	9525.26	41.1	6334.48	66.5	37.6
Sub-humid	6947.50	30.0	5557.89	80.0	33.0
Humid	4171.94	18.1	3193.93	76.5	18.9
Total	23156.53	100.0	16864.26	72.8	100.0

3.36 Nearly half the total expenditure (48.5%) incurred under DPAP during the Fifth Plan (1974-78) was under irrigation (42.4% on minor irrigation and 6.1% on medium irriga tion). The agriculture sector comprising soil conservation and crop husbandry programmes claimed nearly 15 percent of the total investment. Thus, as much as 63 per cent of the total investment was made on irrigation and agriculture. Afforestation/pasture development and animal husbandry were other important sectors each claiming about 13 per cent of the total exenditure incurred.

3.37 In terms of percentage to the respective sectoral outlays, the afforestation and pasture sector led with an expenditure of 87 per cent. Horticulture, irrigation and agriculture had ex penditure ranging from 70 to 74 per cent. The area-wise analysis of outlays and expenditures reveals some interesting facts. Out of total out lay of about Rs. 232 crores, the highest outlay (41 per cent) was allocated to semi-arid areas. Sub-humid areas came next in terms of the funds allocated (30%) and arid areas were allocated only 11 per cent of the outlays.

3.38 As much as 80 per cent of the outlays was spent in sub-humid areas and about 67 percent in semi-arid areas.

3.39 The study conducted by the National Institute of Rural Development (published November 1980) to which we have referred earlier has observed as follows about the achievement in different sectors :—

"The achievements of DPAP against it's long-term objective have to be judged with reference to the integrated effort made for the development of watersheds which could help in restoration of ecological balance. Though this aspect was emphasised by the Government of

India as well as the State and district authorities in their plan documents, somehow it did not find its due place in the reporting system. Some evaluation studies as well as discussions with the Project Directors/Collectors of different DPAP districts in India who came to attend workshops at the NIRD reveal that though soil conservation activities were planned in most of the DPAP districts on Watershed basis, the implementation planning for other sectors was not done according to the concept of watershed. The activities were scattered all over the DPAP areas of the district in order to spend the amount allotted to the schemes."

"The analysis of gains from DPAP from thel point of financial expenditure, physical achievements and creation of employment opportunities indicates that performance under this programme was quite good in most States of the country. But if we consider the objectives with which this programme was launched we have to review its performance from different angle. It was emphasised that in DPAP, the planning and implementa-on will be done strictly on watershed basis because this programme was essentially perceived as an area development programme. The beneficiary oriented activities were added only to help the weaker sections in improving their income. The major objective to DPAP was to make such intervention in the selected watershed as would help in long-term restoration of ecological balance. To achieve this objective, the concept of integrated area development was linked to the water-shed approach. As stated earlier, it was only during the last two years of the programme that attempts were being made to try out this concept in a few districts of Gujarat and Rajasthan. But in most other district sectoral officers considered DPAP only as a source of additional funds and intensified their activities without any attempt for integrated watershed development. Therefore, even after five years of working of this programme no tangible improvement in the direction of ecological balance was achieved. The master plans for different DPAP districts formulated at the time of inception of this programme were the compilation of shopping lists prepared by different sectors. Though in some districts there was a mention of division of the district into major and sub-watersheds in the master plans, the actual implementation planning was not done on the basis of watershed approach. In most districts, the land and soil capability surveys, resource inventory etc., were completed. Above all the reporting system of DPAP emphasised achievements of physical targets and more particularly, expenditure of the allotted amounts to the different sectors. Therefore, each sector initiated as many activities as possible to spend the allotted funds. These activities were quite independent of the concept of development of specific watersheds".

3.40 It was originally envisaged that the DPAP plans should be dovetailed into the normal district plans and resources from DPAP and normal funds should be integrated in order to achieve the overall objectives of long term development of the district. But somehow this did not happen in most of the districts/ The DPAP activities were chalked out quite independent of the normal activities.

3.41 Some other problems mentioned by the NIRD for the slow progress in certain projects are:—

(i) Lack of cement and delay in acquisition of land for irrigation works.

(ii) Inadequate organisational base to guide and assist the rural people.

(iii) Paucity of credit facilities and financial assistance.

(iv) Lack of credit worthiness of farmers due to several reasons.

(v) Insufficient technical assistance; and

(vi) Absence of local entrepreneurship in local people to take advantage of the programmes by entering into gainful occupations.

Desert Development Programme

3.42 Apart from the sporadic attempts made by some of the former Rulers of Princely States to find ad-hoc solution to the pressing problems in isolated areas, there is no evidence of any organised and systematic attempt having been made before Independence to tackle the problems of the desert in a comprehensive way.

3.43 In 1951-52, the need to conserve and improve the resources of the desert region of Rajashan was recognised and an ad-hoc Committee of experts was appointed by the Union Government to investigate and report on this problem. A Desert Afforestation Centre was set up at Jodhpur in pursuance of the recommendations of this Committee. Sub sequently, the scope of work at this station was enlarged by the inclusion of soil conser vation programmes, and it was renamed in 1957 as the Desert Afforestation and Soil Conser vation Station. The station "is required to conduct researches, basic as well as applied, in land use covering forestry, crop husbandry and grassland development so that the problem of wind erosion and resulting increase in desert conditions could be controlled.

3.44 About this time, an Arid Zone Project was started under the auspices of the United Natrons Educational Scientific and Cultural Organisation (UNESCO) to initiate and intensify research on problems of arid zones in different parts of the world- Under this project, UNESCO Adviser, an expert from Australia, was invited to render advice on the ways and means of identifying and overcoming the nro-blems of desert areas in this country. The Expert suggested a broad based programme of research and surveys covering basic resources fundamental problems of soil water plant atmosphere relationships, control of pests regulated grazing of pastures, development of animal husbandry and arable crop raising and socio-economic problems. In pursuance of these suggestions, the Desert Afforestation and Soil Conservation Station was further reorganised in 1959 as the Central Arid Zone Research Institute.

3.45 In 1960, the State Land Utilisation Committee appointed by the Government of Rajasthan made its recommendations on the development of desert and semi-desert areas of Rajasthan. Subsequently in 1964, the Government of India set up a Working Group under the Chairmanship of Shri M. K. Kidwai, which examined the problems of desert development and recommended a number of pilot projects tor improvement of selected desert areas This Committee felt that ultimately it would probably be necessary to set up a Desert Development doard to keep a watch over the formulation and implementation of schemes for the development of desert areas. In June, 1966 a Desert Development Board was accordingly constituted with the Secretary, Ministry of Agriculture, as its Chairman to ensure a more rapid development of the arid region. Nominees of the States of Rajasthan, Gujarat and Haryana and representatives of the Planning Commission and Ministries of Finance, Agriculture, Irrigation & Power, Health & Family Planning, Communications, Education and Social Welfare and four non-officials were made members of the Board.

3.46 The Board was reconstituted in October 1971 with Minister of State in the Ministry of Agriculture as its Chairman and the Secretary, Department of Agriculture as its Vice-Chairman, thereby raising status of the Board. The Ministries of Health & Familv Planning, Irrigation & Power, Communications education and Social Welfare were not represented on this Board as the programmes covered only the agricultural development. The member-ship

of the Board, however, included representatives of the Planning Commission Ministry of Fmance, Department of Agriculture and the State Governments of Rajasthan, Haryana and Gujarat. In addition, four non-official members including two Members of Parliament and two representatives of the local Panchayat were included

3.47 On the basis of the recommendations of the Board, an integrated programme of pilot project for desert development involving a total outlay of Rs. 10 crores was proposed for inclu sion in the Fourth Five Year Plan. This pro gramme covered items like pasture development, minor irrigation and sou conservation. As against this, a very limited programme costing in all Rs. 2 crores was actually provided in the Fourth Plan.

3.48 The above programme was confined to four desert districts. The districts selected were Mohindergarh in Haryana, Banaskantha in Gujarat, Banner and Jaisalmer in Rajasthan. A statement indicating the details of the schemes sanctioned in various districts is given in Annexure IV. It will be seen that a variety of activities have been taken up. These included minor irrigation, development of pastures, soil conservation, afforestation etc.

3.49 In January, 1972, the Desert Develop ment Board appointed a Committee of Experts to evaluate the work done in the pilot projects. These projects were also visited by the National Commission on Agriculture. The Desert Development Board has also been reviewing the programmes from time to time. The main findings, emerging from these studies and re views are summarised below :—

(i) One of the programmes taken up under the pilot projects is that of deep tube-wells in certain areas (i.e. Banaskantha District of Gujarat). The water of these tubewells has a salinity of nearly 3500 parts per million out of which 2500 parts is sodium chloride. Though this water is reported to be acceptable as drinking water for both human beings and cattle, it has to be seen whether this will be suitable for continuous irrigation on the already saline sub-soil in the area.

(ii) Another scheme taken up under the Desert Development Programme is that of adundis (percolating tanks). This involves construction of bund across a natural water drainage in a village for facilitating storing of rain water. This water helps in leaching down the salinity in the top soil, and makes possible a good wheat crop in the rabi season. Below the bund, gradually the sub-soil gets good water and land improves sub stantially. This type of activity in some of the areas such as Banaskantha district of Gujarat has been found to be highly promising.

(iii) Under the pilot projects for desert development, schemes of afforestation with Propois Julifloria have been taken up. This plant is reputed to be suited for saline areas. So far, these plantations have usually done well in the upper slopes but the plants have had stunted growth in the valleys where salts have accumulated. The problem of keeping salt away from the growing plants will have to be tackled.

(iv) In Barmer district, the work has not been taken up in a concentrated area. Various schemes, such as rehabilitation of degraded forests, development of grasslands and pastures, have been spread out all over the district. Thus the very purpose of initiating a pilot project in a compact area has been by and large defeated.

3.50 In September, 1972 the Desert Development Board reviewed the existing programmes and recommended the approach for the Fifth Five Year Plan. It was felt that most of the schemes like development of minor irrigation, soil conservation, afforestation etc. are such as

are common features of a State Agricultural Development Programme. Consequently, the Board felt that there was no particular advantage in taking up such activities as a part of the Central Sector programme. There were, however, some special problems which can be taken up in the Central Sector. Accordingly, the Board recommended that, in the Fifth Plan, action may be taken to concentrate on programme of shelter belts and avenue plantation in the desert areas. There may also be pilot projects for resettlement of nomads. Finally, the Board suggested taking up of special studies in regard to sand dunes, meteorological conditions etc. These programmes merged with DPAP during the Fifth Plan.

3.51 The National Commission on Agriculture made a detailed review of the problems and needs of the arid areas and submitted an interim report on Desert Development in March, 1974. It stated "the problems of the desert area are different from those in the semi-arid and dry sub-humid regions and even the southern arid zone. In order to improve the conditions of the desert economy, a different set of measures are necessary. We have considered the problems of development of the Indian desert in our Interim Report on Desert Development. In that Report, we have drawn attention to the urgent need to arrest the rapid deterioration of the desert area and have recommended a 15 year comprehensive and integrated programme for its improvements and economic development so that much of the hardship arising there out of drought and aridity can be mitigated permanently and lasting socio-economic improvements can be brought about in this under-developed region". (NCA Report Part XIII, page 130).

3.52 Based on the recommendations of the National Commission on Agriculture, a desert development programme was launched in 1977-78. The programme covered the hot arid desert for developmental activities, and the decision making power concerning all sectors responsible for development work in the district. While a District Development Agency has been created, it mostly passes the funds on to various departmental agencies. There is no effective delegation of powers, whether financial or administrative, nor is there any control or coordination among the implementing agencies.

3.60 Key to the stabilising and develop ment of basic infrastructure supporting ail the various economic activities like roads, elecri- fication, drinking water, marketing and proces sing facilities leave much to be desired. For instance, till 1977-78, no scheme of infrastructure except rural electrification was included in the programme. Again in 1977-78, drinking water and rural roads were included in the programme. The drinking water supply was again excluded.

3.61 The approach would appear to be an integrated one in name onhy. In an integrated area development programme for the effective implementation of the approach, funding and expenditure should be controlled by the same agency. Unfortunately, however, this is not so. The programme is substantially dependent on the outlays in the State Sector. The priorities of the State organisations controlling such outlays meant for the entire State js, however, seldom in compatibility with the priority of the Drought Prone Area Development administration.

3.62 From 1978-79, the Planning Commis sion introduced a new concept in funding the DPAP as also the DDP. Earlier in the Fifth Plan, each district was given an outlay of roughly Rs. 4 crores (Rs. 6 crores for the IDA assisted districts) but variations were permitted having regard to the requirements of the districts which varied greatly in area and population problems etc. There was some flexibility in outlays and these were generally linked to needs. However, from 1978-79, the Planning Commis sion introduced the system of allocating a sum of Rs. 15 lakhs per block, irrespective of the size of the block, population and other

problems faced. Jaisalmer, for instance, is the largest district in terms of area in the country and almost totally lacking in basic infrastructure. It has only 3 blocks and, therefore, became entitled to only 45 lakhs per annum against about Rs. 1 crore that was being utilised in this district earlier. The present arrangement thus introduces much rigidity, ignores felt needs and requirements, and also has the disadvantage of pegging development in terms of availability of funds for development at the level of 1978-79. Whereas in most other schemes, annual plan outlays get an incremental increase of about 15 to 20 per cent each year compared to the previous year, the outlays under DPAP and DDP remain stationary. Assuming an average 1.0% inflation per year as in the recent past, the availability of funds for these programmes will keep on decreasing in real terms and at "the end of 5 years would be reduced to half.

3.63 Even conceptually, an area development programme cannot and should not be designed on the basis of a certain fixed sum of money being repeated every year. Moreover, infrastructure such as dairying, roads, electric transmission lines, have their impact over areas much larger than a block and even sometimes a district. The present system of funding, therefore, leaves much to be desired.

Dry Land Research Programmes

3.64 During the last 25 years or so, certain amount of attention has been paid towards research work connected with dryland farming. One of the main areas of research has been the breeding of drought resistant and drought escaping varieties. Breeding for drought resistance was also included as an item in the wheat breeding programme initiated several decades ago.

3.65 While the research on an ad-hoc basis was being conducted earlier also, the Fourth Plan witnessed the initiation of an All India Coordinated Research Project in dryland farming. This project is being operated presently at 15 main centres and 9 sub-centres. Besides these centres, a special centre has been set up at the IARI New Delhi. The office of the Project Coordinator is located at Hyderabad.

3.66 The pattern of the all India coordinated research project during the Fourth Plan had also envisaged a programme for research into improved dry farming technology, and for testing the efficiency of the new technology for dry farming through pilot projects. Twenty four pilot projects for application of a package of new technology being taken up in dry farming areas were sanctioned during the Fourth Plan as a Central Sector programme. Unfortunately, due to a variety of reasons e.g., delay in the issue of sanctions both by the Government of India and State Governments, appointment of project officers etc., there was considerable delay in the pilot projects getting off the ground. Out of a total provision of Rs. 4.83 crores during the period 1970-71 to 1972-73, the actual expenditure was only Rs. 2.73 crores. A detailed review of the Centrally Sponsored Scheme was undertaken by the Planning Com mission on 28th January. 1972 and it was envisaged that immediate action should be taken to ensure a close tie up between research and extension activities. The Ministry of Agriculture also constituted a Study Team in December 1972, to review the progress of these pilot projects. Considerable progress has since been made in both these projects and important research findings are now available.

3.67 The International Crop Research Institute for Arid and Semi-Arid tropical areas located at Hyderabad has also done a good deal of pioneering work, both in black and red soils. This institute was set up with a special franchise to undertake research and development in Jawar, Bajra, Chickpea and pigeonpea which are the major crops in our semi-arid areas.

Groundnut was added later on. The main thrust of this institute is to carry out research on proper land use and water use, alongwith development of varieties of crops mentioned above which are best adapted to semi-arid conditions. This Institute has, within a short period, done systematic work in applied research into land use and water use in both black and red soils.

3.68 The Central Arid Zone Research Institute, Jodhpur (CAZRI) traces back its origin to 1952 when the Government of India established a Desert Afforestation Research Station at Jodhpur to carry out forest research work and forestry extension including erection of shelter belts and afforestation of sand, dunes and denuded areas unfit for cultivation of crops. In 1959, the Station was reorganised as Central Institute and has since been functioning as a focal point of research of agricultural problems of the arid zones.

3.69 The CAZRI has developed a number of technologies for the reclamation and main tenance of the desert's natural resources. It has made positive recommendations in regard to crop production technology, moisture conserva tion, wind erosion control, arid zone forestry, arid horticulture, grassland and pastures, live stock productivity, plant protection, etc. to men tion only the important ones.

3.70 By now, with the combined knowledge gained by the All India Coordinated Research Project for Dryland Agriculture, International Crop Research Institute for Semi-Arid Tropics and the Central Arid Zone Research Institute, Hyderabad, substantial technical support is available for reasonably aggressive field pro grammes in the drought prone areas of the country. One could say with confidence that there is now sufficient technology available for increasing productivity in the drought prone areas of the country except in extremely difficult land and water situations. What is lacking, however, is an aggressive adaptive research and technological transfer programme through a proper developmental and extension set up.

ANNEXURE I

State-wise total Financial Outlays and Expenditure under Rural Work Programme 1970-73.

State	Total.outlay for Fourth Plan	Total Expenditure for 1970-73	Percentage expenditure to respective outlay	Percentage of expenditure to the total expenditure.
1. Andhra Pradesh	899.42	639.51	71.10	13.35
2. Bihar	592.66	58.27	9.83	1.21
3. Gujarat	1570.62	535.44	34.09	11.18
4. Haryana	344.00	277.62	80.77	5.79
5. Jamrau and Kashmir	218.93	37.87	17.29	0.79
6. Madhya Pradesh	798.50	521.07	15.27	2.54
7. Maharashtra	1273.76	735.40	58.19	15.35
8. Mysore	1310.95	794.17	60.57	16.58
9. Orissa	389.98	130.17	33.37	2.71
10. Rajasthan	1962.94	797.52	40.62	16.65
11. Tamil Nadu	400.95	247.07	61.62	5.15
12. Uttar Pradesh	1097.56	339.69	30.94	7.09
13. West Bengal	404.85	73.66	18.19	1.53
Total	11255.17	4788.96	42.54	

ANNEXURE II

Drought Prone areas Programme

Statement showing the sector-wise expenditure under DPAP during Sixth Plan from 1974-75 to list August 1980.

	Sixth plan Expn.	Expenditure during						Total since inception upto August, 1980
		1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	
1. Agriculture	643.00	532.80	475.64	854.53	934.35	1346.51	1382.00	6578.32
2. Irrigation	5107.00	1467.54	120.32	2903.39	3055.40	2999.81	2260.00	20045.46
3. Afforestation and Pasture	640.00	397.48	467.93	753.93	892.56	978.51	1023.00	5447.80
4. Animal Husbandry	—	161.95	303.42	717.98	1298.39	1375.88	1243.00	5267.54
5. Horticulture	—	16.36	30.48	43.61	54.17	77.44	69.00	303.52
6. Fisheries	—	35.23	50.70	57.98	61.92	100.23	79.00	374.58
7. Drinking Water Supply	260.00	75.47	47.01	53.46	57.07	—	—	493.01
8. Sericulture	—	—	—	—	—	—	200 00	232.73
9. Cooperation	—	—	—	—	—	—	79 00	93.81
10. Project Management	173.37	13.55	70.54	164.19	168.64	218.74	104.00	1069.67
11. Others	2493.63	4.80	275.34	456.95	242.57	919.80	556 00	4944.43
Total	9227.00	2685.26	3441.74	6005.46	6785.17	8016.92	7075.00	44830.86

ANNEXURE III

DROUGHT PRONE AREAS PROGRAMME

Key Indicators of Physical Achievements of Major Activities

Programme/ Unit/ Sector	Achievement from1.4.1974 to 1977-78 (Fifth Plan period).	1978-79	1979-80	Cumulative achievement since1-4-1974 to 31-3-1980	1980-81 (upto September 1980)
I. Agriculture					
Area treated under soil conservation (00 hectare)	9528	29297	1717	14242	677
II. Irrigation					
Irrigation potential created (hect).	194406	56261	50069	300736	13755
III. Forestry and Pasture Development	212936	98714	300659	612319	4C094
IV. Animal					

Husbandry					
Distribution of Milch Animals (Nos.).	37246	24947	17403	79596	2521
V. Organisation of Milk Producers Ccop.	1777	1548	2768	6093	43
VI. Organisation of Sheep Coop. Societies.	648	360	113	1121	37
VII. No. of Families assisted (in lakh Nos.)					
(a) Total	28.08*	25.65	18.78	72.51	7.82
(b) Scheduled Castes (lakh numbers).	7.00**	8.13	5.19	20.32(A)*	1.41
(c) Scheduled Tribes (lakh Nos)	2.26**	3.51	1.49	7.26	0.92
VIII. Employment Generated (lakh man days.)	1127.72*	471.81	456.39	2055.92(B)	175.06

(A) For the period from 1977-78 to 1979-80.
(B) For the period from 1975-76 to 1979-80.
* Relates for the period from 1975-76 to 1977-78.
Information for 1974-75 is not available.
** Refers for the yjar 1977-73.
Earlier years figures are not available.

ANNEXURE IV

Statement showing the Administrative Approval given to the Desert Development Schemes in Gujarat, Haryana and Rajasthan.

Name of the State	Name of the Scheme	Amount Sanctioned (Rs. in lakhs).
Gujarat		
Banaskantha	(i) Tubewells (14)	24.65
District.	(ii) Soil Conservation (6329 acres)	4.98
	(iii) Afforestation (600 Ha)	3.89
	(iv) Minor Irrigation (Adbandhas 1918 acres)	6.02
	Total	39.44
Haryana	Agriculture	
Mohind-irgar	(i) Contour bunding	14.50
District.	(ii) Pipe lines for tubewells	
	(iii) Sprinkler Irrigation Miner	
	Miner Irrigation	18.13
	Afforestation	8.00
	Total	40.63
Rajastlian	Desert Development Scheme in Barmer District.	
Maimer and Jaisalmer District	(i) Rehabilitation of Forests on hills. (ii) Grassland Development forFodder Bunks (iii) Development Pasture (iv) Reclamation of Saline Soil (v) Wind Break Plantation Cultivation of green fodder Pasture Development Raising of Wjodlots around tubwells & Nurseries in Jaiselmer District.	109.14
	Grand Total	197.31

4. STRATEGY OF DEVELOPMENT

4.1 We have reviewed in the earlier chapter the impact of the on going drought prone area and desert development programmes ever since their inception. The existing programmes aim at an integrated area development in the agricultural sector based on the watershed approach and optimum utilisation of- land, water and livestock resources, restoration of ecological balance, and stabilisation of the income of the people, particularly the weaker sections of the society.

4.2 We have to consider as to what reorientation is necessary to these programmes to insulate the economy of these areas from the violent fluctuations in productivity due to recurring droughts. So far the drought problem in India has usually been studied from the stand point of occurrence and frequency. What is equally important is the intensity of the drought. It is the duration and the intensity taken together, which determine the ultimate effect of the drought. A mild drought of prolonged duration may have a far more crippling effect than a severe one of brief duration.

4.3 In most parts of the country, 80 percent of the annual rainfall is received from June to September from the South-west monsoon. As far as Gujarat, Rajasthan and Madhya Pradesh are concerned, the corresponding figure is as high as 90 per cent. It is the variability in the South-West monsoon which is a major factor in determining the periodicity of droughts. The probability of deficient rainfall (deficiency equal to or greater than 25 per cent of the normal) was worked out some time ago for digerent meteorological sub-divisions. The conclusions are presented in the following tables:—

Periodicity of drought in different meteorological sub-divisions

Meteorological Sub-divisions	Recurrence of the period of high deficient rainfall
Assam	Very rare, once in 15 Years.
West Bsngal, Madhya Pradesh Kon-kan, Costal Andhra Pradesh, Maharashtra, Kerala, Bihar, Orissa.	Once in 5 years.
South Interior Karnataka, Eastern Uttar Pradesh, Vidarbna,	Once in 4 years.
Gujarat,EasternRajasthan, Western	Once in 3 years
Uttar Pradesh, Tamil Nadu, Kashmii Rayalseema Telengana Western Rajasthan	Once in 2*5 years.

4.4 The meteorological sub-divisions cover very large areas. The deficiency of rainfall in the region is calculated on formulae based on the differing rainfall patterns in the various rainfall recording stations in the region. Thus, the overall surplus or deficit recorded in the region does not reflect the actual conditions in the various blocks comprising the region. The Committee has accepted that a block should be the local area for assessing drought proneness. On the principles evolved by the Department of Meteorology for assessing recurrence of the period of high deficiency rainfall, an exercise should be done immediately to assess the position in the various blocks falling broadly in the region £f the present drought prone areas demarcated in the country. This exercise will be more relevant to the objective the Committee is seeking than a broad classification by regions.

4.5 Experience over the years has shown that every year some part of this vast country or other is susceptible to drought. Where the drought is severe relief measures are the obvious answer. The entire country cannot be drought proofed. What the Committee is seeking is a

methodology by which, in the chronically drought affected areas, the economy of the population can be improved optimally with potenlial available in the environment to tide over the bad years. The Committee is also trying to evolve a methodology by which the poorer sections of the community, who are most affected in drought areas are given some firm economic base so that their difficulties in a severe drought would be marginal and manageable by local relief works.

4.6 The drought prone areas, as at present identified by the Government of India, lie not only in the arid and semi-arid areas of the country but also in the sub-humid areas. The Committee has already analysed in Chapter 2 the existing criteria for delineating drought prone areas and have also suggested a new criterion for identification of chronic drought prone areas with a view to developing programmes of amelioration. Till the new delineation under the criterion suggested by the Committee is accepted and carried out, it is undesirable to break the sequence of development now taking place. The Committee has, therefore, recommended that fill the delineation under the new criterion is done with the necessary field data, the present area delienated as chronically drought prone may continue to be dealt with under the special area programme.

4.7 The problem of the desert areas are different in many ways from those in the semi-arid and dry sub-humid regions. An analysis of the situation shows a very complicated trend. Total cultivated area is much less than total area available for cultivation. Considering the density of livestock population, one would expect the uncultivated lands to be used as range lands, but this is not the case. There are as such digerent patches of land, cultivated or uncultivated, distributed in scattered bits, except may be for large units identified as forests lands. Animal wealth is under-exploited, inspire of the fact that the tract can boast of the best Indian dual purpose breeds of cattle and recognizable breed of sheep. The livestock economy is migratory in character, mainly due to iaclc of all the year around grazing and water facilities. In years of drought, a large number of animals, both cattle and sheep, die due to malnutrition and diseases, thus depleting a valuable resource.

4.8 The economic backwardness of the drought prone districts outside the desert area is due to not only the limitation of natural advantages but also to the manner in which the existing endowments have been put to use by man. The climatic and environmental conditions in these areas are less harsh than in the desert region. But unplanned and over exploitation of natural resources and neglect of conservation measures are responsible for substantial imbalance in the ecology of these areas. Though less pronounced than in the desert, it is sufficiently acute to merit serious consideration. The imbalance has arisen because of factors like denudation of forest and tree growth, over grazing pastures, crop farming on marginal and sub-marginal lands, the resulting surface run-off of rain water and soil erosion. The result has been a precarious production base and low productivity. In attempting the development of these areas, therefore, the restoration of the ecological balance between the water, the soils, the plants, the human and animal population should be a basic consideration and should under the development strategy. It indicates the need for bringing about an appropriate land use pattern which will be conducive to attaining the necessary ecological balance. If a proper balance is achieved, it is possible that there would be better and more uniform retention of soil moisture vital for the growth of crops and other vegetation.

4.9 The realisation that the high-yielding varieties programmes would touch only a fraction of the arable lands of the country came very early in the process of the Green Revolution. In 1971, an All India Coordinated Research Project for Dryland Agriculture was

sanctioned with its headquarters at Hyderabad for a specific research for the development of the semi-arid areas of the country. Twenty-four regional centres were placed under this project covering locations in all the types of lands, soils and rainfall patterns, for the operation research in the drought affected areas as then indentified. The merit of the scheme lay in the linking up of the operational research with the research itself. Each centre, which was an original adaptive research centre, was given an area between 8000 and 10000 acres nearby where replications on the farmers field were done and comprehensive area programmes were organised. This approach led to a substantial accretion to the knowledge as to how to treat drought prone lands for maximising productivity. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad with a special franchise undertook research and development- in Jowar, Bajra, chick pea and pigeon pea which are the major crops in semi-arid tropics. Groundnut was added to this later,on. The main thrust of this Institute is cpordinated'.research on proper land use and water use along with developing varieties of the crops mentioned above which are best adapted to the semi-arid conditions. This Institute has within a short period done systematic work in applied research into land use and water use in vertisols (black soils) and alfisols (red soils). By now, by the combined knowledge gained by the AH India Coordinated Research Project for Dryland Agriculture (AICRPDA) and ICRISAT, substantial technical support is available for reasonably aggressive field programmes in the drought prone areas of the country.

4.10 The Central Arid Zone Research Insti tute (CAZRI), Jodhpur concentrated more on arid zone research though they had within their franchise a responsibility for semi-arid zones also*. Further, the margin between aridity and semi-aridity disappears in many parts of the drought prone areas and research has to go across the fields. It may however be mentioned that CAZRI has' identified certain technologies, some of which can be applied to semi-arid areas.

4.11 The Committee is confident in asserting that, as of date, there is sufficient technology available for increasing productivity in drought prone areas of the country except in extremely difficult land and water situations. An aggressive adaptive research and technological transfer through a proper extension machinery should be able to increase productivity substantially.

4.12 Unless we adopt a systematic and scientific approach to the study and management of natural resources, it would be very difficult to tackle the problems of drought prone areas. To quote an example, Israel, which is a semi-rid country with highly undulating terrain, sandy soil and salinity has been able to make conjunctive use of surface and ground water and initiated land and soil management programmes which have produced wonderful results. The sources of irrigation in Israel are extremely limited and while 95% of these sources are in the north, the land to be irrigated is mostly in the southern parts. Against these odds, Israel has certainly succeeded in building up of modern agriculture. It has constructed irrigation bridges to convey water from north to many areas in the south. It has also developed water-saving techniques both in transmission as well as in distribution systems which are again important for drought prone areas. It enables the maximum production per unit of irrigation water. Israel has developed sophisticated and specialised agricultural programmes which concentrate on highly priced off-season crops for local consumption as well as for export.

4.13 A more difficult problem Israel had to face was the general salinity of their ground water and salinity of the surface soils. Israel has concentrated on proper agronomy for such conditions and has evolved many cultivars which appear to thrive under such conditions. A recent study has pointed out that most of the citrus in Israel is grown under such saline

conditions. Yet Israel has got a very large share in the citrus market of Europe. This gives us the confidence that if our research scientists take to intensive research in the field of saline soils and saline ground water, many problem areas in the arid and semi-arid areas of the country can also be given a reasonable productive economy.

Concept and approach

4.14 As stated earlier, the main emphasis in the existing approach in the drought prone areas is on agriculture and allied sectors and on restroration of ecological balance. We have already discussed the problems and differing conditions in the drought prone areas. Any approach towards the development of all these and other backward areas has necessarily to aim at realising their full potential, with special emphasis on the least advantaged. The aim and concept as outlined by the Committee in para 2.12 of Chapter 2 of its report on "Orga nisation of Administrative and Financial Structure for Backward Areas Development", should be to improve the quality of life of the people in the backward areas. Policies and programmes should be conceptualised and designed, keeping this overall concept in view, and administrative, social and economic institutions adapted and adjusted towards this end. Conversely speaking, the concept of planning and development should aim at an integrated area development programme, with special emphasis on the least advantaged. The beneficiary oriented approach has to be fitted in as part of the area development plan for the infrastructure and development of production activities. There is in fact no conflict between a beneficiary oriented approach and an area oriented approach and if we want "Growth with Social Justice", the two have to move hand in hand. An area cannot develop unless people in it develop and conversely the people cannot develop unless the area in which they live develops. The actual contents of the programme would, however, depend upon the conditions prevailing in the area concerned. While a comprehensive frame will be the ultimate objective, the spread and the expectation will have to be adjusted to the present level of absorbable capacity of the population of new techniques and skills and the capacity of the administration and institutions to cover the field in the comprehensive manner required in a backward area. Under this approach, it should be borne in mind that the programmes, would have to be both area and beneficiary oriented. For beneficiary oriented porgrammes, "family" should be regarded as basic human unit for planning and development and for the area planning and development "Block" should be taken as the unit. This approach has already been recommended by the Committee for the development of backward areas in its Report referred to earlier.

Natural Resources Survey

4.15 It is essential to prepare an inventory of the natural resources of arid and semi-arid lands. The Central Arid Zone Research Institute has already completed surveys for 45,267 km. in Rajasthan, Haryana and Gujarat States. These surveys provide comprehensive informa tion with regard to (a) land use capability classes, based on land use data, erosion hazards, both wind and water, types and intensity of sand dunes, soil texture and fertility, (b) vege tation types, pastures ; (c) water resources, both surface and groundwater, water quality (salinity), water potential zones ; (d) socio economic conditions of the desert dwellers, and (e) human-animal-vegetation relationship, etc. Such integrated surveys, based on aerial photos, lead to the assessment of basic resources of each bio-physical unit to upgrade production and suggest a rational approach for development of its natural resources.

4.16 It would be seen from the above that technology for integrated survey of natural resources is now available. The whole country has been covered by aerial photography in

black and white and this is to be repeated at an interval of 5 to 10 years, the Survey of India gets the areas photographed and the photo interpretation techniques have been very well developed, where one can see many things. We can interpret the photographs in terms of geology, geomorphology, geohydrology, landuse, soils and forestry and they give us very specific information and detailed maps can be prepared covering all these aspects. Combining all the data and maps available with suitable ground level, we can prepare optimal land-use and land capability maps, which would provide the basic guidelines for planning for agricultural and other development. This technique can be used on a large scale, district-wise, region-wise and basin-wise to study, in a scientific manner, our renewable resources of a proper land-soil-water- management.

Land Use

4.17 The National Commission on Agriculture in its chapter on "Rainfall and Cropping Pattern" has given elaborate suggestions for changing the cropping pattern in 62 rainfall regions they have identified and grouped into 11 groups according to the month of commencement of rainfall. In Part-VI of their Report on "Crop Production" Sericulture and Agriculture they have also suggested changes in areas in various foodgrain crops, commercial crops, horticultural crops, plantation crops and fodder crops. Though this analysis is extremely detailed, it does not quite fit in with the requirements of our problems in drought prone areas. The analysis is mainly on the rainfall pattern. The effect of drought is a lack of water balance which involves the soil structure, evapo-transpi-ration conditions of the various crops of the area and the rainfall pattern during the main rainfall season. This requires a much more detailed analysis of the environmental conditions for proper guidance on the types of crops and their varieties to be grown, proper land use in utilising pasture development, horticulture, plantations and forestry to make maximum use of the environmental conditions and land quality available. Utilising the macro guidance given by studies on the lines done by the CAZRI for districts in Rajasthan, the position will have to be refined for each block by suitably constituted inter-departmental groups which will, after local check of the various parameters and the scientific knowledge then available guide the extension workers in the types of land use that can be introduced, with profit.

4.18 The CAZRI may train state-level teams to carry out macro surveys in the drought prone areas as has been done by them in Rajasthan. These state-level teams must have the necessary technical expertise to further refine the macro studies and to give recommendations at the block-level for extension purposes. The Ministry of Agriculture may form a Working Group to develop this concept of a technical study team at the State level to perform this necessary function for drought prone area development. This working'group may also go into the adaptive research work that will be necessary in each stage to refine the macro research conclusions on a location specific basis for the drought prone areas and identify the farms and the groups that will do the necessary adaptive research.

4.19 The National Commission on Agriculture has drawn attention to the importance of preparing proper land use and land capability surveys and advising on the proper and use. The States had been advised to form Land Use Boards which would undertake this work in the States. The Ministry of Agriculture is at present performing the functions of coordinating 1 this work at the Central level. It was envisaged that a proper Land Use Board will be constituted at the Centre. The Committee iplaces great reliance on a proper land use capa-1 hility survey particularly in the »Yought prone 1 areas, for maximising productivity of land under the hostile environment. Role of Agro-meierology in anieleoratioii of droughts

4.20 Rainfall is highly varient in the semi-arid and arid regions and the temperatures are high, the evapo-transpiration trends of the various types of crops is very relevant in planning a suitable cultivation programme. Generally, moisture stress in some part or the other of the growing period of the major crop of the area would be felt. The strategy would be to see that during the crucial growth periods of a crop, there is sufficient moisture in the soil to support evapo-transpiration requirements. This needs a close link up between the pattern of rainfall in the area, the probabilities of the soil retaining sufficient moisture at particular periods and cropping pattern. The science of agro-meteorology deals with this particular applied science. We have separately dealt with this aspect in Chapter 6.

Crop Husbandry

4.21 The present cropping pattern in drought prone areas is based not on the proper land use under the environmental conditions but the need of every household to somehow produce sufficient foodgrains of the varieties most prevalent in the area. The National Commission on Agriculture has already commented on the result of this urge for basic food, leading to the improper land use and deterioration of the soils. The done in the All India Coordinated Research Project for Dryland Agriculture has established that it is only a mixed cropping system, suiting the crop to the land and introducing large scale pasture development and horticulture along with forestry that can maxi mise output from the drought prone areas. The food crops will be pulses, oilseeds and grains which may not be locally utilised. The basic sphere dominating the farm population is the possibility of drought and the famine, forcing it to produce as much as possible in a normal area not only for the home consumption but also as carry over for the next year when the food crops may fail. This fear complex leads to bad land use and anyhow does not satisfy the requirement for foodgrains. If the farm population is to be brought out of this fear complex, and persuaded to grow more valuable cash crops on that land, which is now possible by the technology available, or change over to pasture development and animal husbandry, there must be some guarantee that they will get their food requirements throughout the year at a reasonable price from nearby fair price shops. The country 'with its vast food distribution organisation is now in a position to give this guarantee provided the' requirements are esti mated in detail at the block level, adjusting requirements to the changes in cropping that have taken place and providing the necessary foodgrains through the season at nearby fair price shops. The Committee would specially draw attention to this support for a proper land use strategy. Incidentally, this change in cropping pattern would lead to greater availability of pulses and oilseeds for the nation's consumption whilst benefiting the population in the drought prone areas giving them better cash crops. The least the nation can do in this respect would be to ensure that the fair price shops properly function and the farmers get a confidence in the distribution system. Such a system is in any case needed for drastic management.

4.22 Most of the drought prone areas of the country are either with the classification of vertisols (black soils) or Aliisols (Red soils). Quite an amount of pioneering work has been done by ICRISAT in research on best use of such lands under varying environmental condi tions. There are a lot of research findings available in the All India Coordinated Research Project for Dryland Agriculture. A continuous up-dating of the technology has to be done in order to refine the field level advice to the extension organisation. Dryland farming research is much more complicated than research in irrigated agriculture. The number of disciplines that have to come together for proper dryland farming research includes such disciplines as meteorology, evapo-transpiration research, wind effect and extremely location specific breeding of varieties of crops. Uni- disciplinary research now generally prevalent in the Agricultural Universities and parallel research being carried on in 'various insti tutions

Central and State in various aspects of the sciences have to be brought together in a multi-disciplinary applied research programme in order to solve the specific problems ol drought prone areas. A joint team of the ICAR and the World Bank had recommended the constitution of regional research centres on a multi-disciplinary basis by Agricultural Universities in the country to deal specifically with a multi-disciplinary approach to regional agricultural programmes including crop husbandry, animal husbandry, forestry, horticulture and fisheries. The Committee will strongly recom mend that this concept already enshrined in the reports of the Joint Committee be translated into effect by ICAR whether the World Bank is financing the same or not. Such multi-disciplinary regional research centres in each of many different regions of drought are vital to support the drought prone areas amelioration programme.

Development and Management of Irrigation

4.23 Rainfall being scarce and highly variable and evapo-transpiration being generally high, water for development is the scarcest commodity in drought prone areas. Proper management of water to get maximum result out of the available precipitation, therefore, assumes extreme importance in the strategy for drought prone area amelioration. One of the systems of management is providing suitable irrigation schemes. The other types of management is moisture conservation of the precipitation of the land.

4.24 The Irrigation Commission has carried out an analysis of the status of irrigation in the districts selected for DPAP. This analysis shows that the average area irrigated in a DPA district is only 15 per cent of the gross cropped area. Preliminary information suggested that in some of the districts like Cuddapah in Andhra Pradesh, Ahmednagar in Maharashtra, Bellary in Karnataka, Coimbatore in Tamil Nadu and some districts in Ganga basin, irrigation coverage can be raised to more than 30 per cent of the gross cropped area, by balanced utilisation of surface and ground water resources in the basin. No doubt, detailed investigation will be necessary to judge the situation in each drought affected block. As against this, most of the districts identified as drought prone have however low potenial for irrigation. According to our information, as many as 32 districts had 10 percent or less of the cropped area under irrigation at the beginning of the Fourth Plan. In 12 of these districts, some irrigation schemes were already in command during "the Fourth Plan, in the remaining 20 districts, unless aggressive irrigation programmes are undertaken, some of them will remain with even less than 5 percent of irrigation cover. Four States in which the irrigation deficiency is high are Madhya Pradesh, Gujarat, Maharashtra and Rajasthan. These states would require special attention. In some of these districts, the precipitation being very low, availability of water for irrigation will be a serious constraint.

4.25 Whereas a lot can still be done by tap ping available surface and ground water resources in the drought prone districts, it has long ago been realised that amelioration of j drought prone districts can only be carired out effectively by transfer of water from more richly endowed basins to the drought prone areas. Many of the major irrigation projects designed and executed after freedom performs this important aspect of inter basin transfer to poorly endowed basins. Particularly, the Bhakra Canal system is a standing example of inter-State cooperation and collaboration in transfer ring water of the Indus Basin obtained by partition to ameliorate the desert areas of Rajas than and Haryana. In future planning, the strategy will have to be to ensure that such inter-basin transfers are systematically deve loped and relief given to drought prone areas. Particularly those which do not have much of natural-precipitation. This is being dealt with in the relevant chapter on 'Irrigation'.

4.26 Even with full exploitation of possible irrigation programmes in the drought prone districts and with all transfers of water from other basins and may be possibly on a national basis, water will still remain a very valuable commodity for agriculture and human develop ment. It is, therefore, necessary to ensure that available water is utilised to the maximum in improving the economics of the area. The National Commission on Agriculture has pointed out that in such areas our objective should be to get maximum return out of every unit of water. This necessarily means that waste of irrigation water should be avoided. Secondly, the crops should be so selected that they give maximum productivity for the water used. Studies in Gujarat have shown that in the ground water exploitation the farmers of Gujarat are even now wasting as much as 50% of the water in their anxiety to irrigate their crops sufficiently. Crops give maximum return when the evapo-transpi-ration balance is maintained during the crucial periods of crops growth. In other periods, slight stress can be stood by the crops without serious damage. A little under-watering in the other period is not a serious constraint. On the other hand, the mentality of sufficiency of water leads to too much watering throughout the season in order to save productivity. Here there is a need for the laboratory to get close to the land in translating the principle of proper and economic water use.

4.27 According to the present calculations of water use for crops, the broad assessment is that in the drought prone areas we may be reaching a level of irrigation of 30 per cent of the gross cropped area as against more than 50 percent that we shall be reaching on the average throughout the country. This brings out the necessity for making better use of available water in drought for crops to give maximum coverage in irrigation both by selection of crops needing lower water duty and by rigid control of water use in the irrigation systems by bringing into effect all aids for such control like linking of canals and canal controls—if this method is followed, may be much more than 30 percent of gross cropped area will receive attention. This should be the objective.

4.28 Precipitation being low, it will generally be found that surface irrigation projects will have a command much larger than what the storage water can irrigate under the present principles of irrigation. Similarly, the command of a ground water resources or a lift irrigation resource will be much larger than what the irrigation system can cover under present principles. In Rajasthan, it has been noticed that where there is irrigation well, water is supplied to the families in the command on an equitable basis so that all families can benefit. Recently, in Gujarat, a similar system is being followed with, it is reported, acceptance by the farmers. In the desert development programme, in the Banaskanta district, where deep tubewells have been sunk, this principle has been established. When the Jaikwadi system in Maharashtra was examined, it was proposed to enforce this system there also. In the Tungabhadra irrigation project, only a percentage of the command in each 'chak' was given irrigation. The entire irrigation system in Punjab, Haryana and Rajasthan is based on the system of a fixed amount of water being given to each family under the command. In Pochampad irrigation project in Andhra Pradesh, the quantity of water for the kharif and the rabi programmes is similarly controlled. All these systems except the deep tubewell system in Gujarat are based on the principle of giving each family an amount of water proportional to the area of his holdings based on a general calculation of availability of water. Where there is a serious constraint of water in irrigation system, there is need for much more equitable distribution of available water keeping in view the principle of social justice.

4.29 In Pune district in Maharashtra, Dr. Salunke had tried to introduce a method of guaranteeing each family water for 2 acres only out of a pump irrigation system. Though the farmers agreed in the initial stages to such a distribution, later on it was found that serious litigation developed. The Government of Maharashtra found that for such equitable

distribution of water, proper legislation should be introduced so that such irrigation systems in particularly bad areas may automatically control the distribution under a legal process. In the extreme drought areas where such equitable distribution has to be done, it will be found that alternative programmes of development of the families are generally non-existent. These are the areas from which large scale migration takes place during bad drought years. Our first objective should be to ensure that each family in the area gets reasonably firm base for his economy so that in serious droughts only marginal help will be needed for the family. Thereby also large scale migration of men and cattle can be prevented. There is, therefore, justification for bringing in the principle of social justice and equating the distribution of water to the families. The Committee would recommend seriously such an approach to be followed, if necessary, with a legislative support.

4.30 Surface irrigation systems are at present designed purely on gravity. In badly drought affected areas, the lift irrigation system can also be utilised for giving relief to areas at a higher contour than the irrigation channels passing through the area. In middle India, it is generally noticed that in major irrigation schemes main canals pass through deep cutting in several reaches and higher lands on both sides may be drought affected. It is desirable that where such situations exist, relief is given to the drought affected area by suitable lift irrigation projects. The Committee is informed that such lift irrigation projects under the Nagarjunsagar irrigation systems in Telengana are working extremely well.

4.31 Moisture conservation becomes particularly important in the drought prone areas to maximise productivity of lands. The Committee notices that generally minor irrigation schemes of surface reservoirs are not designed and con structed for commands less than in some States 200 acres and in some States 100 acres. This is due to the responsibility cast on various organisations for minor irrigation and their present capacity to survey and design the projects. In drought prone areas the precipitation has to be conserved on a watershed basis starting from highest available point for storage and gradually going down and trying to hold back as much as of the precipitation as possible within the watershed. This will require a system of designing small ponds and minor irrigation reservoirs for very small areas of command. The construction will be simple. An organisation will have to be given the responsibility for planning such wafer holdings structures on a watershed basis in drought prone areas. The obvious organisation would be the soil conservation organisation suitably strengthened with the necessary expertise. But on this the Committee will not express any firm view but leave it to each State to design their own structures. The Committee is dealing with all this in detail in the chapter on 'Watershed Management'.

4.32 Ground water exploitation and conjunctive use of ground and surface water will be an essential ingredient, in agricultural development of drought prone areas. In some of the arid and semi-arid areas the ground water is saline. In such specially difficult areas, a proper planning of conjunctive use of saline and fresh water and suitable agronomic practices and selection of cultivers tolerating levels of salinity, will all have to be filled in to the programme. The objective is maximum use of whatever water is available. In this context, the large scale experimentation by Haryana of utilising saline ground water in the canal system is worth looking into.

4.33 Percolation tanks have special value in drought prone areas in holding up the ground water but after the monsoon season. It has now been accepted that construction of such percolation tanks would be an essential part of drought prone area amelioration programme. Such programmes will not give the maximum benefit unless the down stream open wells are

constructed and as far as possible facilities should be given to the small and marginal farmers to" utilise the ground water from the percolation tanks.

4.34 Whilst there is a general cry for more irrigation water in drought prone areas, the Committee in its discussions with the Maharashtra' authorities came across a peculiar feature. Dr. V. S. Page who has done a lot of rural development in Maharashtra mentioned that he had identified more than 3000 reservoirs and percolation tanks in the drought prone areas of Maharashtra which hold water, but that water is not now being utilised for irrigation. He suggested that the Committee should look into this problem. It is not unlikely that a similar situation exists in other parts of the country. The Committee recommends that immediately the present stage of use of the reservoirs in the various drought prone areas, the system of reclamation and the cropping pattern may be investigated quickly and at least within the next year a proper pian of maximising the use of such water drawn up. Planning and execution of integrated programmes for optimum use of land and water on watershed basis

4.35 The areas now affected by drought in some instances, had productive agriculture and a population with a viable economy at some time in the past. As a result of population growth, the conversion of sleeper and marginal lands to cropping, denudation of pastures and destruction of forests, serious ecological disturbances occurred in these areas which led to soil erosion and damage to the soil structure, texture and productivity. As a majority of the population in the drought prone areas depend on land based activities like crop-farming and animal husbandry, the core task for development will be to promote rational utilisation of land and available water. The research institutions working in agriculture and allied sectors have evolved considerable amount of technology for improving and stabilising the econo my of water sheds in the drought prone areas. The major task now is its transfer, in a package, to the people residing in these watersheds.

4.36 A detailed description of the concept of watershed nature of technology required and types of activities involved in the developmsnt of watershed areas have been discussed by the Committee in its report on the development of Hill areas. How this technology should be transferred in the drought prone areas is being discussed in this report also in a separate Chapter.

Animal Husbandry *

4.37 The drought prone areas support a sizeable lfarge population of livestock. Most of the areas particularly the arid districts are endowed with reputed breeds of cattle and sheep due to the favourable conditions existing in this region. However, the productivity of livestock breed is very poor due to several reasons, one of which is lack of proper planning of water and fodder supply.

4.38 Development of livestock has an inbuilt superiority over crop farming in the drought prone areas in so far as these are less vulnerable to the dry spells of rainfall and the agro-climatic conditions in these areas. The Task Force on Rural Development as well as the National Commission on Agriculture has therefore rightly stressed that the strategy for development of drought prone areas has necessarily to be built mainly around animal husbandry. Animal Husbandry in conjunction with dairying is considered to offer a more stable base than crop farming for sustained income for the rural households in these areas.

4.39 Evaluation studies of DPAP clearly bring out the fact that performance of animal husbandry programmes such as distribution of milch animals and marketing of milk, develop-ment of infrastructure for collection, cooling and chilling of milk was fairly satisfactory.

There is, however, considerable scope, fpr improvement in performance through desired changes in the organisational set up and adoption of the technical recommendations within the watershed frame.

4.40 One of the important bottlenecks is that the animal husbandry programmes such as animal breeding, animal health cover and fodder development are implemented by the Animal Husbandry Department in most of the states while the other related programmes of sheep development and pasture development are im plemented by the Directorate for Sheep develop ment and department of Forests, respectively. Again, dairy development is the concern of the State Dairy Development Corporations. Though all these programmes are closely interrelated and form a part of a total project, yet their implementation is the responsibility of different development departments, as indicated above. Such multiplicity of agencies for the closely related programmes creates problems of coordination. The Committee has dealt with all aspects of livestock development in Chapter 10.

Fodder crops and grassland development

4.41 The drought prone areas are characterised by the scarcity of fodder and grasses for feeding livestock. The arid districts have less than five per cent area under pastures. Though the pasture areas in the other DPAP districts are larger no district has above 14 per cent of its area under pasture. Notwithstanding the land resources constraints, these areas do offer considerable scope for pasture ancTTodder deve lopment on the available areas if the latest technology for fodder crops and pasture deve lopment evolved at the' Central Arid Zone Research Institute, Jodhpur, the Indian Fodder and Grasslands Research Institute, Jhansi, and other places is adopted appropriately. The Committee has dealt with this aspect in great detail in a separate chapter.

Secondary and tertiary sectors

4.42 As discussed earlier, the main emphasis in the drought prone areas has so far been on agriculture and allied sectors and on restoration of ecological balance. But for an integrated development of any area, agricultural sector alone cannot help to achieve the objective. One of the major reasons for deterioration in the ecological balance in these areas has been excessive pressure of population on land. With the increase in population marginal lands were brought under cultivation and pastures and forests encroached upon. Therefore, unless alternative sources of income are provided to the population, any attempt to promote optimum use of land and water cannot succeed in spite of the improved dryland agricultural practices. The problem of employment has to be tackled by providing opportunities in the secondary and tertiary sectors. With the exception of a few DPAP areas near Pune, Ahmedabad, Nasik, Jamnagar and Rajkot, most of the drought prone areas are also industrially backward. Unless the industries and service sectors absorb the unemployed and underemployed, it will not be possible to reduce the pressure on land in the watershed area. These areas, however, have good potential to provide employment! in the non-agricultural sector. Some of the drought prone districts have very good industrial resources like lime-stone, bauxite and manganese. Though dairy and sericulture industries have been planned in some of the drought prone districts as part of the DPAP activity, comprehensive planning for industrial development as one of the components of integrated area planning in the DPAP districts have yet to be taken up.

4.43 For the development of industrial sector in the drought prone areas, the growth centre approach will have to be synchronised with the watershed approach so that a clear

appreciation might emerge on the extent to which the plans for secondary and tertiary sectors are complementary and supplementary to the land based activities. In -the context of development of drought prone areas, where new activities or functions are proposed, their location becomes extremely important because such location at appropriate places will start a chain reaction of development with far-reaching effects. Therefore, an understanding of functional inter relationships in space goes a long way towards the development of a drought-prone area. Further, decentralisation and the actual location of funtcions need to be done within the frame work of a region encompassing both urban and rural sectors. In the past, the development of these sectors was kept separate and towns could not be utilised for the development of rural areas. In relation to the drought prone areas, such separation of urban and rural areas spells harm from the point of view of the over all development of the region and its impact on the people. In the drought-prone areas, a gradual urban-rural continuance should develop with the intensity of watershed approach combined with growth centre concept. The Committee has already dealt with this aspect in its report on Industrial Dispersal and on the Development of Village and Cottage Industries.

4.44 From many drought prone areas in the country there is seasonal out-migration of various types of labour to take advantage of the semi-skilled labour opportunities available in the large scale industrial and construction development taking place in the country. There has also been seasonal migration during the agricultural season like the sowing season and the harvesting season to the more agriculturally endowed areas- to supplement the local labour in the crucial operations. In planning the development of a drought prone area, these out-migration opportunities should not be lost sight of. It has been noticed that intensive agri-culural activities in many parts of the endowed areas has resulted in high wage employment to a large number of out-migrants from the poor agricultural areas. One glaring example is the large outflux of Bihar labour to Punjab and Haryana for sometimes as long as 8 months in the year for high wage agricultural employment. It may be necessary to assess these 'opportunities and utilise them instead of trying to keep back people in the drought prone areas under low wage employment schemes like the Employment Guarantee Scheme in Maharashtra. In a sense, this works against the poor families bettering themselves. Further many large projects like irrigation projects in the country are to day suffering from lack of the right type of semi-skilled labour required for completing their work on schedule. There is scope here for increasing the number of semi-skilled labour who can get into these opportunities. The obvious places to look for such labour for upgrading their skills are the drought prone areas of the country. The Committee would emphasise that in planning labour for the people in the drought prone areas, the question of skill and wages should be kept clearly in mind. Whether within the area or by out-migration, if the family can earn more and cross the proverty line, every step should be taken to see that the people are advised in the correct direction. Particularly, when moving large masses of labour to new opportunity centres, a good deal of State support in organisation and movement will be necessary.

4.45 As development takes place along with the desired lines, many agricultural commodities for local processing and semi-processing will be available. Extraction of sunflower oil, milk processing, woolgrading and preliminary processing are instances. The scope for such economic activity needs to be assessed in each area and processing units located, where feasible. Such types of activities generate opportunities for sustained employment and income. Alongside, adequate measures are required for the disposal of agricultural commodities, including the semi processed or processed ones, at economic price. Without well planned marketing arrangements, the producers are not likely to get the economic price for the produce.

Drinking Water Supply

4.46 The provision of drinking water supply is an important element in any programme of development in drought prone areas. These areas experience acute scarcity of drinking water, both for human population as well as livestock, because of low rainfall. In fact, no development of livestock is possible in potential areas without the facility of drinking water. Priority attention, therefore, needs to be given to locating sources of drinking water in those, areas. Hot Arid Areas

4.47 Integrated plans of development have to be so designed as to pay simultaneous attention to the development of water resources, animal husbandry and pastures},. In the strategy of development, water plays a pivotal role. Since there is paucity of local water resources, water has to be inducted from outside the arid zone. The Rajasthan Canal Project is an.instance of such an effort. This canal is designed to irrigate areas along the western boundary of Rajasthan but the interior desert areas do not derive any benefit from it. The project should be recast to exclude unsuitable areas, where the cost of land levelling and development will be high, and to construct lift canals to take some water deeper into the desert with a view to bringing more areas under irrigation and extending the benefit to a larger section of the community. A beginning has already been made in this direction.

4.48 The limited quantity of groundwater available in pockets can be exploited mainly for domestic and industrial use, it being rather expensive for irrigation. Large parts of the desert will still have to depend on rain. For maximising the utilisation of the scanty rain water, suitable water conservation techniques like khandins, bandhis and adbandhis will have to be adopted'on a larger scale.

4.49 In the early stages of development of the canal command areas, there will be water to spare in the canals. This opportunity needs to be utilised. As water becomes available in an area, a large scale programme of tree plantation, rising of shelter-belts and wind breaks and rejuvenation of vegetal cover will have to be undertaken. This programme will arrest wind erosion, sand blowing and sand cashing on arable fields and also reduce the desiccating effect of hot winds on crops. Tree and grass cover on the unstable and new dunes in the canal command areas and on those which pose a threat to habitations, roads and railways should reduce the problem being faced now. The plantation programme is also intended to meet the requirements of fuelwood and small timber locally and to prevent* over-exploitation of the existing resources and digging of roots of phog bushes which is causing deterioration of the desert by loosening the" soil and creating the foci of sand blowing.

4.50 The economy of the desert area should continue to be mainly animal husbandry oriented. The desert area has a natural endowment of several good breeds of cattle and sheep. A major thrust of the development programme has to be on the prevention in a large measure, of the nomadism of the cattle breeders and sheep owners. An organised programme of livestock development will have stabilising influence. An increase of animal population is, however, ruled out, since the vegetal resources even after development cannot sustain a large number. While containing the number, the breeding programmes, through provision of facilities and services, will have to be designed to improve the quality and productivity of cattle and steep. In canal command areas dairy development and milk chilling centres and milk producers factories should be undertaken.

4.51 In the arid areas the major emphasis has to be on sheep development. The good breeds of sheep available in this region can be further improved both for wool and mutton. Apart from improving the quality of sheep, wool shearing and grading centres have to be established and arrangements made for wool and meat marketings. Another dimension to this development is the possibility of creating more employment in the cottage industry by processing the wool locally. For this, adequate extension support will be necessary.

4.52 A vigorous programme of livestock development is possible if feed and fodder resources are substantially increased to ensure the supply of nutrition to the animals. Attention has therefore to be paid to large scale development of pastures, regulated grazing to prevent over-use and creation of grass reserves and fodder banks for supply of hay in scarcity years. In canal command areas, the cropping pattern has to be adjusted tfo bring 30 percent of the area under fodder crops in mixed farming. All these are being dealt with in detail in the revelant subsequent chapters.

Cold Arid and Semi-Arid Areas

4.53 The cold desert in the country occurs in Ladhak valley in Jammu and Kashmir. The Lahaul Spiti Valleys and the Kinnaur region in Himachal Pradesh are also considered as cold semi-arid. The population in these areas is sparse. The extreme climatic conditions, lack of communication and the level of education make development of these areas a difficult task. All efforts made so far to develop these areas achieved little success.

4.54 The agricultural season in Ladakh is limited to a short period between May and October in view of the high altitude, extreme cold, deficiency of oxygen and humidity. There are some streams and glaciers but there are problems associated with the utilisation of this vjatet at hi&hei eVevattom. tubewell irrigation has not yet been established. The main crop taken in this area is a kind of barley. This area has, however, a valuable resource in pashmina goat.

4.55 The Field Research Laboratory of the Indian Army is experimenting on the feasibility of growing vegetables, wheat and maize in this area. This laboratory has also tried poultry production in underground concrete houses specially built for the purpose, where the birds can be kept warm during freezing surface temperature. These are at the experimental stage and their economics need to be fully established. The Indian Council of Agricultural research is also seized of the problem of development of Ladakh. We understand that the Central Arid Zone Research Institute is also planning to take up research programmes in the cold arid areas.

4.56 The Committee would, however, like to emphasise that the available information is not sufficient for formulating the strategy for development and indicating the feasibility of different programmes. In our view, many more investi gations and more extensive research based on local environmental, physical and socio-economic conditions are required before viable economic programme can be implemented effectively in these areas. This has to be given the top most priority.

Organisation and Administrative Structures

4.57 No strategy of development would be possible unless it is provided with adequate organisational and financial support for timely and effective implementation. The Committee

had already dealt with the Organisational and Administrative structures necessary for an integrated area development programme in its report on "Organisation and Administrative structures for Development of Backward Areas". Special emphasis necessary in the scheme of drought prone and arid areas is being dealt with in a subsequent chapter in this report.

5. WATERSHED APPROACH

The present approach in the drought prone area programme is integrated area development aiming at conservation and optimum utilisation of the land, water, livestock and development of human resources in the area selected. It is envisaged that area and skill development planning would be on a watershed basis.

5.2 The objective of soil and water conservation in drought prone areas can be best achieved by following a watershed approach for both. Soil conservation programmes have been a part for several Plans now. The National Institute of Rural Development, Hyderabad, had examined the position of soil conservation schemes in he drought prone districts of Panchamahals (Gujarat), Kurnool (Andhra Pradesh) and Jhabua (Madhya Pradesh). In this they had carried out studies in Kurnool and availed of the studies made by other institutions for the other two districts. Their conclusions were that there was no coordination between soil conservation, crop and minor irrigation at any of the three districts. Further, there was no coordination between the activities of the soil conservation and the agricultural departments. Contour bunds were not maintained. Coordination was lacking between the soil conservation work taken up"by the forest department and that by the soil conservation department. As a result, total impacf "was considerably reduced. Follow up measures which improve agronomic practices and cropping patterns were not introduced in bunding area and effective intra-sectoral and inter-sectoral linkages were lacking. Thus the soil conservation programme so far followed in the DPAP districts suffered from single line approach and non-coordination with the other departments and disciplines which only can ensure a watershed approach in the work for maximum effect.

5.3 For a complete watershed approach one has to bring soil conservation measures, water conservation and storage measures, dryland farming, animal husbandry, afforestation and minor irrigation as the minimum number of discipline under a coordinated approach. At present, the watershed approach in the DPAP is one of the many programmes that the district carries out under DPAP. It is taken as a separate programme by itself with a coordinated approach limited to the watershed taken up under the programme. On the other hand, in the drought prone districts, many programmes of soil conservation, water conservation, dryland farming, animal husbandry, afforestation and minor irrigation are carried out both under the DPAP programmes and under the general departmental programmes of the State. A haphazard and scattered handling by each department of its programmes cumulatively does not lead to the end result one can get in a watershed approach if all of them cooperate within the watershed with their programmes. This cannot happen unless the DPAP itself does not treat a watershed development programme as a separate type of programme but brings this in as a concept of coordinated handling of all the disciplines which only can lead to a watershed approach in soil and water conservation and utilisation of the base so created for better agriculture, animal husbandry, etc. The Committee would, therefore, suggest that if the sub-plan approach that the Committee has recommended for all backward area development programmes in its report on 'Organisation of Administrative and Financial Structure for Backward Area Development' is now brought into effect in the DPAP district, this scattered handling of programmes which should be brought together for maximum benefit will not continue to affect growth.

5.4 The increasing use of soil and moisture conservation measures to prevent floods and soil erosion has brought the term 'watershed' into common use. A watershed is a natural hydrological entity in its technical sense. Hydro logically, a watershed could be defined as an

area the run off from which drains through a particular point on the drainage system. It is an aerial expanse of land surface from which the run off flows through a defined drain, channel, stream or river. On reaching the land, a part of the rain water that does not evaporate or percolate into the soil, drains into diches, streams or lakes. The land area from which water drains to a given point is a watershed. The concept can be defined in a different way to develop better understanding about it. It is a self-defined area which does not allow any water from outside the catchment to enter it, and allows its water to discharge to a common point in a stream, rivulet or river. In other words, a watershed or catchment must be surrounded by a 'Ridge Line'.

5.5 For planning a proper watershed approach any watershed the basic physical features like the physiography, land slope, nature and depth of the soil and the hydrological behaviour of the soils and the slopes in the watershed have first to be studied and analysed. Scientific allocation of the various parts of the land for the right) type of vegetative cover, grass trees or agricultural crops will depend on this initial analysis of the physical characters. The type of soil-conservation measures and moisture conservation measures can be planned on the basis of the physiographic data. The present land use and the hazards in soil and water deterioration that this leads to, have then to be studied in detail so that initially a programme of stopping the deterioration, with a follow up programme of rehabilitation of the areas that have deteriorated can be suitably designed. As a first approximation in planning, this approach should be within the present traditional frame of land use with modifications acceptable to the field. The next stage of development will be through demonstrations and discussions to get the acceptance of the people in the watershed to the proper land use on a proper soil and water conservation plan. In this, the socio-economic and local aspects have to be carefully considered so that the most effective participation of the people can be obtained and where wilful obstruction is raised by mischievious elements, legal support to the action can be taken. The watershed characteristics vary according to the permutations and combinations of the basic factors of land, slope, nature and depth of soil, precipitation 2nd induction of water from outside. Thus, planning for two watersheds cannot be made on an identical pattern. A watershed management plan has to be highly location specific. It can therefore be carried out only by a technical group of experts who understand the variations of these factors in planning a watershed management programme. The planning cannot be left to lower levels of field workers. This group expertise should be available at the project level, supported by higher expertise in the line departments.

5.6 At present as already explained, there are many plan schemes carried out on a departmental basis which are not planned or executed on a watershed basis. As a result, such programmes may cut across watersheds and on many occasions prevent a proper watershed management approach. If the recommendation made in paragraph 5.5 above to bring all the programmes under watershed management approach is initiated and carried out urgently, this sort of mistake will not arise. Till such a comprehensive attack on the problem can be made on a sub-plan basis in the DPAP districts, it is essential anyhow to ensure that the departmental schemes are suitably examined by the project authorities to ensure that they do not create the hazards mentioned above and where such hazards exist due corrections are made in the project on a continuing basis.

5.7 The other watershed problem is that of major, medium and minor irrigation projects which go across watershed plans. Normally a watershed management approach and plan would have been based on the rainfall precipitation within the watershed. All other aspects of planning like soil and water conservation, cropping, etc. would naturally follow this basic factor. On the other hand, as and when the master plans for minor irrigation, medium

irrigation and major irrigation are carried out in the various districts it may so happen that the irrigation system will create complications in the plan already done and lead to substantial modifications in the watershed management programme. In order to avoid this, it is desirable to examine the watershed planning in a drought prone district against a master plan for irrigation and then work out a suitable plan of adjustment as the programmes of irrigation come into operation. This will have to be a continuous process of examination and adjustment.

5.8 Technological advancement will, no doubt, constantly aim at increasing the output from a unit of land and a unit of water, but the natural resources of soil and water are liable to deterioration and degradation under improper use. For obtaining maximum benefits from technological advancement, it would be imperative that the natural resources of soil and water be properly protected and judiciously utilised to improve their productivity constantly.

5.9 The basic physical factors of watershed management being soil and water conservation, a monitoring of the soil and water loss from the watershed will be a correct measure of the extent of success that has been achieved in the planning and execution of a watershed management. Monitoring of both soil and water loss is easy in a watershed approach if the monitoring unit is located at a point at the outlet of the drainage system of the watershed. A time series of soil and water loss $t this point will enable the monitoring authorities to estimate the effectiveness of the action, where the monitoring shows no significant imporvement as expected, the monitoring authority can work back to the minor watersheds within the watershed and identify the particular mini watershed which has to be dealt with in detail for better soil and moisture conservation. This action will have to be a continuous process of monitoring and improvement.

510. The size of the watershed varies according to the size of the stream of river for which it forms a catchment. From the practical point of view of proper utilisation of land and water resources, a workable size of watershed has to be decided in accordance with the aims and objectives of the particular development programmes in a particular area. For example, a big area of thousands of square kilometers will have to be considered while planning a river valley project reservoir for irrigation and hydro electric generation, whereas for a minor irrigation tank, the size of the watershed may be only a few hundred square kilometers. For a farm pond, the size of the watershed may be a few hectres only. Similarly, for areas having potential for agricultural development, generally speaking, smaller sized watersheds may be more convenient but for the development of grasslands and forests, large sized watersheds may be desirable. We have already drawn attention to the need for coordinating across the watershed programmes and the watershed management programmes in such a way that the watershed approach is not vitiated. Whatever be the size of the watershed that is handled under any programme, this basic consideration should be maintained in the sub-plan approach under the project area.

5.11 There is some amount of controversy as to the minimum size of watershed programme which can be effectively planned at local level. A notional size of 1000 to 2000 hectares was proposed initially when the watershed approach was to be introduced in all blocks in the country. This limitation was in a way directed towards undulating territory where watershed management has given maximum results. In drought prone areas there is an understanding that for agricultural purposes a notional size of 3000-5000 hectares may be workable watershed. In drought prone areas and desert areas, the land is not generally highly undulating. So large watersheds can be taken for planning without facing varieties of soil and land levels. At present there is serious limitation in high level technologists who can manage a watershed planning effectively. If we have to carry out large scale development on a

watershed basis quickly, it may be desirable to handle large watersheds in the initial planning. On the other hand, a watershed management pro gramme requires the cooperation of the villagers. If too many villages are brought within the watershed, it may be difficult to get the human cooperation that is necessary for effectiveness of the operation. Basing on these considerations the Committee would recommend that generally in drought prone areas a watershed of the order of 5000 hectares would be a workable proposition. Of course, in specially difficult areas, the approach may have to be changed to different limits.

5.12 Watersheds of smaller size have distinct advantage of involving a small number of villages within a resource unit that share the common historical, social and economic patterns. It will, therefore, be easier to get cooperation of people for group action in a soil and water conservation project as well as its management. Selection of large watershed entailing large financial outlay for its develop ment should be avoided because the larger the area of the water, the greater will be the heterogeneity in other watershed, characteristics like soil, vegetation, slope, land use and socio economic conditions. Hence, integrated planning will be complex for larger watersheds.

5.13 Watershed approach would mean plan ning and irnplementating soil conservation pro grammes for all types of lands and associated drainage system of selected watersheds within a reasonable time frame with the objective of providing maximum protection to existing land and water resources while optimising their use for increasing production and employment benefits. In order t0 comprehend the total problem vis-a-vis the total potential and to draw up a programme which could be implemented within a reasonable period (say five years), the size of such watershed be roughly 5000 hectares. Within such small geographical area understanding of the problems and the resources to meet the requirement of food, fibre, fodder and fuel, besides providing employment, becomes easier.

5.14 Watershed management has two objectives -one to stop the general soil and water erosion and rehabilitate the land generally for greater productivity and the other to provide the farmers with suitable programme for their lands which will enable them to reap better harvest and different types of harvests which will give them substantially additional income. As the funds for area development would naturally be limited, some priority in action will have to be brought in the planning. Where general deterioration has to be stopped and areas rehabilitated, the programmes would generally be of soil conservation and afforestation including pasture development. For this purpose, the watershed in the project area will have to be analysed for identifying mini water sheds falling under the following three classes :—

(i) substantial deterioration needing prompt action;

(ii) moderate deterioration where investments can be spread over a longer time; and

(iii) reasonably low deterioration areas which can be improved by mere human action in utilisation of the land and resources.

The large soil conservation programmes that the state undertakes every year should be worked out on above listed priority schedule. The other objective of improving farmers income will require a judgement as to when the investment can maximise returns within the Plan period. Here some judgement will have to be exercised within the project area to identify such watersheds where the technology will give quick results and where the people also are reasonably backward. This planning can be well done in the initial .stages of deciding the macro plan for a project in consultation wim the local people as mentioned in the

report on 'Organisation of Administrative and Financial Structure for Backward Areas Development'.

5.15 Watershed management planning will need data pertaining to watershed characteristics such as topography, soils, geology, vegetation and climatic data, besides incidence of erosion, flood and drought hazards. Land use details, with current returns, alongwith ownership patterns, size of holdings and plots would also be necessary for facilitating integrated planning. To make the protective measures more acceptable, the feasibilities of increasing production through integration of the growth of utility trees, horticulture, backyard plantations and of devices to collect, store and reuse available rain water should be explored. Therefore, there should be an adequate mechanism at the State Headquarters and at field level for collection of such data through field unitf'or from concerned agencies. The need for the basic data should be fully recognised and their collection, analysis and interpretation should be considered as a pre-investment towards proper planning and implementation of watershed management programmes. The Committee has already discussed this in detail in its report on "The Development of Backward Hill Areas" (Paras 4.7 to 4.9 of Chapter 4).

5.16 Under suitable technical advice and a proper planning mechanism, the project authority can identify the optimum watershed management programme that will be best suited to a watershed approach. Unless the acceptance of the programme wholeheartedly by all the farmers within the watershed can be simultaneously achieved, the best of plans cannot be carried through. Further, taking up a large scale transformation programme requires men, material and credit on such a vast scale that no community can readily come forth with the same for the enlire programme. This necessitates a gradual transformation from what is, to what is desirable. The most logical step would appear to be to incorporate corrective measures in the existing land use system to make the present land use practices less vulnerable to erosion and degradation hazards. Simultaneously alternative management practices should be introduced with emonstration of best practice slowly to encourage the beneficiaries to shift gradually to the improved land use pattern. If the agro-silvicultural practices or agro-horticultural practices can be made profitable while practising mixed farming, it may be possible to achieve this gradual shift in land use pattern, and retiring the marginal and sub-marginal land from cultivation of com mon agricultural crops to productive and remunerative alternative uses.

5.17 Some arrangements will need to be made in the planning Cell for collecting representative base level data for typical areas representing dominant combination of practices such as bench terracing, afforestation, water harvesting system, pastures, etc. These pockets would need to be watched over 2-5 years and data corresponding to the base level data would have to be collected to provide a time series for comparison and working out actual trans formation and benefits derived from implementa tion of the programme so that programmes can be reviewed and modified, as necessary. The Committee has already recommended this approach in its report on "Hill Area Development".

5.18 A scientific implementation of the soil conservation programme would require a multi-disciplinary approach. The technical competence for such a multi-disciplinary approach exists in the line departments. As at present envisaged, the DPAP authorities do not have easy access to the technology or the expertise available in the line departments either at the district level or the sjate level or even the central level. In fact, 'after the creation of the Department of Rural Development which handles the DPAP in the Ministry of Agriculture and Irrigation, the technical expertise rests in the Department of Agriculture where as the responsibility for

carrying out these programmes rests in the Department of Rural Development (now Ministry of Rural Reconstruction). There is, therefore, a need for bringing together the line hierarchies responsible for technical development and technical planners comprehensively into the DPAP planning "and implementation at all levels from the project upwards. The Committee has already dealt with the type of basic organisation at the project level and the coordination points at the district level where the line departments and the area development authorities can be brought together. The sooner (he comprehensive recommendations of the Committee on the organisational requirement are accepted, the better the implementation of the drought prone areas programmes will be. The Committee has no hesitation in saying that the most important improvement that can be brought in, in the drought prone areas programme is the organisational one.

5.19 At the project level, the project authorities must have directly under their control technical officers of sufficient capacity in water and soil management and afforestation.

5.20 Attempts to integrate all possible disciplines on watershed level should be checked. Since basic land uses are agriculture, forests, grass lands and basic concern is to provide adequate return in terms of food, fodder, firewood etc., the level of integration should be restricted to those line departments which are directly con cerned. Super imposition of other capital facilities, which improve the logistic support and thereby economic conditions, should be taken care of at a much higher level, say the District Planning Cells and suitable coordination with corresponding organisations should be made at that level. At watershed level, too many line departments should not be brought together as that would create confusion. The Ministry of Agriculture (Soil Conservation Division) has issued guidelines for planning and implementation of soil conservation works on watershed basis. These should be followed by identification of mini watersheds as well as for preparation of detailed programmes.

5.21 The major disciplines which are brought together in the integration unit in a project as advised in the paragraph above, will have to understand the overall objective of watershed approach and how their individual disciplines have to be tuned to the integrated requirements. Without such an understanding of the integra tion process by the' leaders and the field staff of the disciplines concerned, many a time counter productive action may be taken. Further the institutions which support the input supplies, marketing etc. and the administrative organi sations which are involved in the implementation should similarly understand the parameters of a watershed management programme and in their response to the programme adjust their policy to the integrated approach.

6. SOLE OF AGRO METEOROLOGY IN AGRICULTURAL PLANNING

In recent years, the main emphasis of national efforts has been towards stabilisation and augmentation pf agricultural productivity in the dryland farming areas, where the normal annual rainfall ranges from 375 mm to 1125 mm; where the year-to-year variations in the rainfall are large and where evapo-transpiration losses are high and irrigation is minimal. For developing dryland farming on a firm scientific basis, it is necessary to build up adequate rainfall climatology. The objective should be primarily to identify areas prone to drought of varying magnitudes and adopt a modified cropping strategy to fit in with the duration and quantum of assured moisture availability.

6.2 Information currently available on the average distribution of rainfall for the year as a whole and for the various seasons as well as charts showing variability of rainfall do not lend themselves for direct utilisation in agri cultural planning. Nor can such information be directly translated for decision-making in agricultural operations. The primary step for effective agricultural planning, therefore, would be to determine the duration of the farming season for various parts of the semi-arid tropics. Timely sowing is the first and the most important operation for raising crops successfully. The currently available and largely used charts showing normal dates of on set of the summer monsoon over different parts of the country gives only a gross indication of the arrival and progress of monsoon over a vast area as a whole. While changes in circulation characteristics portending the onset of monsoon and precipitation occurrence are often contemporaneous along windward coastal areas, in many other interior regions tihere is a lag before precipitation commences.

6.3 The agriculturists' interest lies in suitably timing the preparation of the soil for sowing. Hence, the lag in the occurrence of rainfall concerns him most.

Commencement of sowing rains—Evolution of Concept

6.4 In land preparation and sowing, the vital factor is the amount of rainfall penetrating and retained by the seed bed, which in turn is influenced by the pattern and quantum of rain fall and atmospheric conditions related to evaporation and evapo-transpiration. Reliability of occurrence of conditions suitable for sowing and identification of such specific periods are of considerable importance to agriculture.

6.5 In this context, the water balance tech nique seems to be a dependable approach for the objective of drought-prone area ameliora-ttion as it takes into account precipitation, evapo-transpiration and soil moisture storage and attempts to arrive at a balance between water income and water loss. However, owing to paucity of experimental data on evapo-fonspiration and soil moisture over the semi-arid tropical regions of the country and evolution of appropriate area-specific agroclimatic models, it is necessary to make a start with the preparation of a sowing rain commencement chart with available clima tic data, primarily to meet the needs of agricultural planning effectively and profitably. Such charts, in fact, have to be developed for different soil zones of the country. Using long term rainfall data and making certain assumptions, this method aims at mapping out the most probable time by which summer monsoon rains in a region would build up enough soil moisture to commence sowing.

6.6 The next step of great biological consequence to crops in problem areas is to assess the average inter-spell duration i.e., the mean period between effective rain spells. In other words, if the first CSR is missed, when to expect the next rain favourable for undertaking re-

sowing has to be identified. The third step is t'o assess the duration over which the soil can sustain the crop before moisture replenishment through precipitation takes place. These three steps put together and considered in relation to the soil and flora lead to a distinction between the various degrees of drought proneness and also identifying hard-core areas.

Blue print for Classification and modified cropping pattern

6.7 Summing up, the new methodology for delineation of drought-prone areas for a proper remedy to the situation would comprise :

(i) Assessment of the duration of the cropping seasons for various soil zones of the country. For this purpose, determination initially of the Commencement of Sowing Rains (CSR), utilising all avail-, able daily rainfall data and adopting a criterion (or criteria) that will contribute' to the building of a moisture profile in the soil.

(ii) Determination of dispersion of CSR.

(iii) Compilation of inter-spell duration and total rainfall realisation during the spells.

(iv) Determination of frequency distribution of inter-spell duration in verious ranges.

(v) Superimposition of niap showing medium dates of CSR and inter-spell duration on soil maps.

(vi) Identification of drought prone areas of varying magnitudes depending on soil depths, texture infiltration rates and water holding capacity.

(vii) Reassessment of most profitable croo-ping pattern.

Use in Agricultural Planning

6.8 This inter-disciplinary analysis directs attention to the possible strategies to be adopted in areas of various degrees of drought pronsness. By identifying the hard core areas, it also indicates the locations for intensification of ground water exploration, identifying possibi lities of other methods of water supple menta tion setting up of seed, fodder and fertiliser banks, etc. in the areas which are likely to be worst affected.

6.9 The statistical approach outlined above is useful for planning on a long range basis and has to be combined with a seasonal planning according to the progress of the season and March of weather. It is here that combined discussions among agrometeorologists, agro-nomists, plant protection and extension officials would help in framing area specific bulletins for dissemination through mass-media channels.

6.10 A pilot study for drought prone area delineation on the above lines was first done for Maharashtra State by Dr. C.R.V. Raman, Jawaharlal Nehru Fellow. A gist of the pilot study and the method followed therein is given in Annexure I. Work similar to the Maharashtra Study has also been initiated in the Karnataka State and a drought map may be ready shortly.

6.11 Discussions with the Maharashtra State indicate that the agricultural scientists and planners have found this approach of great interest in practical use for facilitating the adoption of scientifically evolved agricultural strategies and modified cropping systems.

6.12 The Committee would strongly urge that the State Agricultural Universities, in collaboration with the Indian Meteorological Department and other concerned organisations, should take up such an analysis in hand immediately and prepare maps of drought prone areas, delineated on the basis of inter-disciplinary exercises of superimposition of rainfall analysis of soil zones to provide the basis for drought proofing and modification of cropping patterns. The Committee would further recommend that such studies should be completed in respect of States having arid and semi-arid areas according to time bound programme. Discussions with the concerned people indicate that it should be possible to complete such studies for differet States substantially within a period of one year.

6.13 Once the maps of the drought prone areas' delineated on the basis of inter-disciplinary exercises of supenmposition of rainfall. analysis on soil zones to provide the basis for drought proofing are available, consequent steps to modify the cropping patterns, setting up of seed, fodder and fertiliser stores etc. in the areas which are likely to be worst affected would have to be taken up so that inputs are available to the cultivators when needed.

6.14 Contingency plans to meet precipitation (water) aberations would also have to be prepared. The All-India Coordinated Research project for Dryland Agriculture, Hyderabad, in this context has suggested a contingency plan of aternate crop strategy under various soil conditions.

ANNEXURE I Chapter 6

MAHARASHTRA

Administratively, the State is divided into four divisions, roughly corresponding to the meteorological sub-divisions—Konkan, Madhya Maharashtra, Marath-wada and Vidarbha and 26 districts. The coastal strip of Konkan and the windward side of the Western Ghats receive an annual rainfall of over 200 to 250 cm where the annual variability (variability/coefficient of variation is obtained by dividing the standard deviation by mean annual rainfall and by expressing it as a percentage) ranges from 20-25 per cent. To the leeward side of the Ghats, rainfall rapidly decreases to 60 cm over western Madhya Maharashtra. A sizeable portion of each Madhya Maharashtra receives a scanty annual rainfall of less than 60 cm. Parts of the districts of Dhulia and Nasik in the north, and Poona, Satara and Sholapur in the South, receive even less than 50 cm. In this generally scanty rain belt, the coefficient of variation of rainfall exceeds 30 per cent. Western parts of the Marathwada sub-division receive a rainfall of 60-75 cm. Annual rainfall then progressively increases to 100 cm. as one goes east with a variability of 20 to 25 per cent; west Vidarbha registers 75-100 cm. with the variability touching 30 per cent over parts of Akola and Amravati districts. The map for the monsoon season (June-September) exhibits similar characteristics.

The annual or seasonal rainfall distribution charts, no doubt, help demarcate the scanty rainfall zones of the State. The coefficient of variation is also found to be large in this very zone. But this picture alone is not adequate to delineate areas of drought proneness subject to varying magnitudes of severity. The agriculturist should know when it would be most beneficial to 'sow a crop' and also 'when to expect the next rain favourable for its growth". It is here that more detailed climateological analysis is called tor.

Commencement of Sowing Rains

To meet the above specific requirements, more realistic criteria have to be adopted to determine the dates of commencement of sowing rains. In deciding on a criterion of rain fall occurrence favourable for the commencement of sowing operations, two basic requirements have to be satisfied. First, the sustained rain spell, which more or less represents the transition from pre-monsoon conditions, should be identified. Second, in the spell so chosen, the rain that falls should be such as to percolate into the soil up to a reasonable depth and also built a moisture profile therein after evaporative loss.

After pilot studies with several plausible criteria, the following criterion was chosen for identifying the dates of commencement of Sowing Rains (CSR) over the Maharashtra State: 'A spell of at least 23 mm of ram in a period of 7 days with 1 mm or more on any five of these seven days'.

As far back as 1890, the India Meteorological Department had taken account of the need to consider the agricultural component of the character of rainfall, besides the total amount of rain. Accordingly, a criterion of 2.5 mm (0.1 inch) had been fixed for a rainy day. Plant ecologists consider values ranging from 2.5 mm to about 6 mm (0.1 inch to 0.25 inch) per day as the lower limit of effective precipitation needed for providing some moisture at the root zone of crops. With an average daily evaporation loss of 5 mm, it has been shown that in a rainspell, evaporative loss would be limited to a maximum of 18 mm, at the end of five days in the spell (the rate of evaporation loss would be as follows: 100 per cent on the first two days, 75 per cent on the third day, 50 per cent on the fourth day, 25 per cent on the fifth day and negligible, thereafter). Occurrence of rain in excess of this amount in the weekly spell chosen could then be expected to contribute to softening of the soil and storage of moisture in layers underlying the top stratum of the predominant black soils of the State. When this criterion is satisfied, on more than 75 per cent of occasions during the seventy year period chosen for the study, the recorded actual rainfall had exceeded 50 mm (2 inches) (Table 1). Even in the sub-division of Madhya Maharashtra, Marathwada and west Vidarbha, where the constraints are large, there is a three-to-one chance of the total amount in the first spells of CSR exceeding 50 mm.

Date used method of analysis

The daily rainfall data from 231 rain-gauge stations (scattered throughout the State) for a seventy-year period (1901-1970) were used in the study. Except for Marathwada, the data sample over the other sub divisions was large enough to be representative even up to the tehsil level of a district.

The sequence of daily rainfall data was examined year by year for every rain gauge station as per the criterion fixed for determining the data of CSR. The beginning dates of the commencement of the first spell, satisfying the criterion, were then picked out of each station, year after year. Applying the same criterion, the dates of commencement of the second spell in the daily rainfall series were also identified. Frequency tables of dates of first spell of CSR (the number of times a particular data occurred) were then prepared. The mean (m) and the medium (mi) of the dates so located were calculated from the frequency tables, for each individual station. (Median of a set of numbers arranged in order of magnitude, that is, in an array, is the middle value or the arithmetic mean of the two middle values). These parameters were then mapped to study the spatial distribution of the dates of CSR. To obtain a measure of variability of the mean and median dates the standard deviation (SD) and the semi-interquartile range (SIQR) were also compiled. (SIQR is defined as half as the difference of the upper and lower quartiles: 1/2 (Q3—Qi).

The data were then scanned to locate years in which rainfall of 25 mm (or more) occurred on any day in between the first and second spells already identified for each station. The interval between the first date of the first spell and the date of occurrence of 25 mm (or more) or the first date of the second spell was then compiled station-wise for the period of record. The inter-spell duration was again split up into frequency distribution maps for ranges S 10 days; 11-20 days; and S: 20 days.

Salient features of Maharashtra charts

A detailed examination of the frequency distribution of the dates of CSR shows that their spread is small over the Konkan and east Vidarbha. Over the remaining large areas of the interior of the State, the spread is too large to make the mean valute truly representative. On the other hand, the median dates are representative of the State as a whole.

The Konkan coast and the Ghats which get copious rainfall are the only areas in the State where monsoon rains favourable for commencement of sowing occut by the first week of June (4th). Immediately to the east of the Ghats, in the rainshadow regions of west Madhya Maharashtra, sowing rains are significantly delayed upto 22 June. In east Madhya Maharashtra, over a north-south belt of 80-120 km width, there is still further delay, the median dates ranging from 24-30 June. In this belt, in isolated areas over north east Ahmednagar and west Sholapur districts, the sowing rains are delayed till as late as 2 July. In pockets over Dhulia, Nasik, eastern half of Poona and Satara and west Sangli districts, the median dates range from 28 June to 1 July. An early tongue (20-22 June) lies wedged in between south-east Poona and west-Sholapur districts and links with the early belt over Buldana district in west Vidarbha through western Marathwada. Median dates range from 18 to 28 June over Vidarbha. Early and late sequences alternate from west to east roughly along plateau and valley. Available data show that the median dates span from 18-24 June in Marathwada.

Summing up, the agricultural planner considers the CSR to be early when the arrival of sowing rains is before 18 June, normal when it is between 18 and 24 June, late when CSR is between 24 and 30 June, and definitely late when the arrival is delayed beyond 30 June.

Dispersion of the median dates is also largest (extending even to 26 days) in the very 'hard core belt* over Madhya Maharashtra where CSR is late. The duration of the farming season thus gets severely restricted in the very area where rainfall is also scanty.

The distribution of the average interval between the date of CSR in the first spell and the next realisation of rainfall of 25 mm (or more) or the commencement of the second spell satisfying the criterion adopted in the study. The interval is longest over west Sholapur and east Satara districts (32 to 34 days). Northwest Ahmednagar and west Sangli districts register 26 days, while over the eastern half of Poona district the duration is as long as 26-28 days. The interval ranges from 10 to 16 days over Vidarbha, higher values being confined to Amravati and Akola districts in the west. Over Marathwada, limited data show that the interval spans from 14 to 22 days, higher values occuring over Bhir and Osmanabad districts in the west.

There is an extremely valuable chart in identifying areas of large water stress, where even good germination and initial crop growth would be affected and also where, in certain years, second sowing might become necessary.

Table II gives the percentage distribution of inter-spell duration in 10 days ranges at district headquarter stations in the four sub-divisions. Frequency of occurrence of small interspell

duration (10 days) is largest over Goa, the Konkan coast and east Vidarbha. Again, Madhya Maharashtra suffers the worst stress with a three-to-one chance of inter-spell duration exceeding 20 days. Even here, drought proneness is relatively larger in Ahmednagar and Sangli. The picture over Marathwada is quite similar to that over Madhya Maharashtra.

The interspell duration chart together with the map showing the freauency distribution of spells ranging more than 20 days help identify hard core areas in the State where the farming seasons get drastically curtailed resulting in severe moisture stress for crop 1 growth.

Use of agricultral planning

For effective use in agricultural planning, the maps showing the median dates of CSR and duration between rain spells were successively superposed on the soil map of Maharashtra State to enable identification of the areas where water stress for crop production is most severe. From a perusal of the map and assuming p.n appropriate average daily evaporation loss and taking account of soil type, texture, depths, water holding capacity and other characteristics, the agricultural scientist can assess the duration over which the Itoils in Maharashtra State can sustain a crop before moisture replenishment through precipitation takes place.

Such an exercise has, in fact, led to a realistic preliminary delineation of areas in Maharashtra State prone to drought occurrence of varying magnitude— high, medium, low and negligible. A significant outcome is that it has been possible to locate, on a scientific basis, high risk regions of drought prone areas in the State where ground water exploration has to be intensified and serious consideration given to organisation of seed banks.

Table 1
Percentage Frequency Distribution of Actual Rainfall Recorded During First Spells of Sowing Rain

Sub-Division/District	Range of rainfall	
	25-49mm	50mm
Goa		
Marmugoa	3	97
Konkan		
Ratnagiri	14	86
Kolaba	18	82
Thana	9	91
Madhya Maharashtra		
Dhulia	26	74
Jalgon	18	82
Nasik	30	70
Ahmed n agar	22	78
Poona	35	65
Satara	.32	68
Mahabaleshwar	16	84
Sangli	45	55
Kolhapur	24	76
Sholapur	31	69
Marathwada		
Aurangabad	35	65
Parbhani	32	68
Nanded	22	78
Bhir	31	69
Osmanabad	29	71
Vidarbha		
Bhandara	17	83
Chanda	21	79
Nagpur	19	81
Wardha	14	86
Yeotmal	19	81
Amravati	26	74
Akola	28	72
Buldana	24	76

Table II **Percentage Distribiution of Inter - Spell Duration**			
District HQ Station	**Days**		
	10	11-20	20
Goa			
Marmugoa	93	07	00
Konkan			
Thana	76	18	06
Kolaba	69	24	07
Ratnagiri	91	07	02
Madhya Maharashtra			
Dhulia	34	34	32
Jalgaon	50	41	09
Nasik	31	37	32
Ahmed nagar	28	28	44
Poona	20	44	36
Satara	31	37	32
Sholapur	38	33	29
Sangli	27	16	57
Kolhapur	39	29	32
Marathwada			
Aurangabad	35	39	26
Bhir	34	28	38
Osmanabad	27	33	40
Parbhani	34	37	29
Nanded	40	39	21
Vidarbha			
Bhandara	59	34	07
Chanda	61	36	03
Nagpur	66	31	03
Wardha	56	34	10
Yeotmal	49	46	05
Amravati	40	44	16
Akola	36	43	21
Buldana	36	54	10

7. SOIL AND WATER CONSERVATION

7.1 The Committee has already emphasised the need for restoring ecological balance in the drought prone areas. This pointedly highlights the role of soil moisture conservation in a strategy for integrated development for these areas, based on a watershed basis. In fact, in dry areas soil conservation is usually the basic need of the land. Without proper soil and moisture conservation a secure foundation for any worthwhile economic activity is not possible.

7.2 The routine soil conservation measures such as contour bunding, furrowing, terracing and levelling have naturally to be part of the programme in the light of the local conditions. However in many areas, there is need for pre venting losses of moisture in evaporation by surface as well as underground mulches. In addition, pointed stress needs to be given towards incorporating organic residue and organic manure into the 'Soil. * Finally, there is the urgent need for inclusion of grasses into the cropping pattern as an essential measures directed towards soil and moisture conservation.

7.3 In the dryland farming technology a new element that has been recently sought to be introduced is water harvesting. This technique essentially means the enrichment in moisture of one portion of the catchment i.e., cropped area at the expense of the rest of the catchment. There are several methods of water harvesting such as field, inter-plot and inter-row. The two major steps involved are (i) conserving moisture in the soil profile instead of allowing it to run off; and (ii) collecting run-off in the field, in a properly designed structure where seepage and evaporation are prevented or minimised and using this water for supplemental irrigation during' critical period of crop growth. The Commttee has dealt with this aspect in the Chapter on 'Crop Planning and Productivity'.

7.4 In drought! prone areas there is already a high degree of wind erosion caused by gens-rally winds of moderate to high velocity and bad management of the surface soil. As a result sand-casting in some areas has been a hazard for agriculture. In the Chapter on "Sand-dune stabilisation" the Committee has already drawn attention to the utility of shelter belts in :—

(i) protecting agricultural lands close to the shelter belts;

(ii) preventing sanding of the agricultural lands ;

(iii) if the field is covered by shelter belts, reduction of the temperature within the field ; and

(iv) reducing evapo-transpiration by moderation of wind. Thus shelterbelt formations in drought prone areas and afforesting the higher reaches of a watershed will give substantial benefit t0 the agricultural lands. This approach is recommended.

7.5 Soil and moisture conservation is an important component of the present strategy under the drought-prone areas programme. As per the statistics published by the Ministry of Rural Reconstruction 1978-79, soil survey and mapping have been done in about 3 million hectares of area and the area taken under soil conservation is reported to be as 1.2 million hectares from 1-4-74 to 31-3-79. This is apart from the area covered by afforestation and pastures. The evaluation studies of some of the DPAP districts carried out by the National Institute of Rural Development. Hyderabad have indicated that soil conservation measures comprise terracing, contour bunding, gully control and farm ponds. While the soil conservation works were planned in an ad hoc manner, there was no coordination between soil conservation and other sectoral programmes. Implementation of the schemes was not done within watershed frame

taking into consideration the complementary nature of intra-sectoral and inter-sectoral schemes. The Committee has already dealt with the steps necessary for bringing about the watershed approach as an essential element in the strategy of development of drought prone areas in Chapter 5 "Watershed Approach". In this Chapter, the Committee is confining itself to the soils and water conservation measures necessary in the drought prone areas.

7.6 Active factors in causing soil erosion in semi-arid region could be identified as rain water, soil characteristics and land use pattern. Soil and water conservation practices are aimed at reducing their contribution to the total ero sion by suitably managing the land, water and the plant cover on a watershed basis. In the agricultural lands, the practices should be aimed at reducing the energy of the rainwater and the maximum in situ utilisation of incident rainfall, run-off collection, storage and utilisation by proper land use management. These aims can not be achieved by any single measure. Hence, •the most scientific, practical and economic way is to make an integrated use of biological cultu ral and mechanical measures of conservation.

7.7 The prevention of damage to the land due to erosion and the repair of the damage already done is only part of the solution. Viewed only in this context, soil conservation means a process of adoption of anti-erosion measures to prevent soil loss. However the concept of soil conservation has broadened with time to meet the requirements of productive and efficient use of land. Thus, soil conservation means a change over from neglectful and wasteful use to intelligent, protective and fruitful use of land.

7.8 The soil conservation practices can be grouped into two categories, biological and mechanical. Biological practices seek to pro vide suitable cover to the land and to build up fertility of the soil. These include crop rota tion, strip cropping, mulches, manuring, affore station, growing of grasses legumes and sod- farming crops.

7.9 As supplementary and complementary to the iological methods, mechanical practices slow down the flow of surface water, impound water for a longer time to enable most of it! to percolate and allow surplus run-off to flow at non-erosive velocity. These include contour cultivation, contour bunding, terracing etc.

7.10 In planning an improved soil and water conservation and utilisation system, the charac teristics of soil and climate as well as farm sizes and the human, capital, and power re sources must be considered. Considering these characteristics, some of the specifications of an improved soil and water conservation and management system for rainfed cropping areas as designed by the ICRISAT are as follows :—

(i) Avoid large concentration of water and large streams except in a protected grassed water-way.

(ii) Lead the water slowly off the land in small streams uniformly spaced over the land (watershed) so as to reduce erosion, increase water-intake opportunity time and provide drainage during prolonged rainy periods, especially on deep black soils.

(iii) Provide year-round protection against erosion, even during the occasional storms of the hot dry season.

(iv) Establishment in the drainage ways grasses which are highly productive and palatable so as to provide nutritious forage for milch or draught animals and to protect against erosion of the drainage way.

(v) Use a combination of forage legumes and grasses to minimise nitrogen requirements and provide more nutritious forage.

(vi) Provide a storage facility (tank) to collect and store surface run-off from high-intensity storms as back stopping for rainfed agriculture. (This is particularly important in red soils and shallow black soils because of their low water retention capacity. However, a supplemental water can always be used for a responsive post-monsoon season crop in all soils).

7.11 At ICRISAT a wide range of soil and water conservation and management systems have been studied in natural watershed to deter mine run-off, soil erosion, crop production, rain fall use efficiency, power-use efficiency, labour use efficiency and profitability in operational scale research using improved animal drawn implements. Conservation and management systems studies include field, contour and graded bunds under flat cultivation with single and double cropping, beds and furrow with double cropping at various slopes with and without tanks and shallow wells. The All India Dryland Coordinated Project, Hyderabad has also been carrying out number of schemes. These findings are now available. What is important is that these should now be transferred to the cultivated fields by carrying out further operational research to the extent necessary.

7.12 The Committee has already dealt with in great detail the organisational and other changes necessary for adopting comprehensive conservation schemes. Some of the bottlenecks which could be identified are, to mention a few, the capital outlay may be high, lack of adequate trained personnel oriented to the planning and execution, necessary realignment of holdings and lack of upto date land records. These bottlenecks may be difficult to remove but would have to be removed for the success cf the programme. The Committee is quite aware that the economic conditions of the farmers in these areas is poor and free self-labour availa bility of the farmers is low. There are practical difficulties in mobilising self-labour for subsi dised working through extension methods under the Soil Conservation Acts. All these have resulted in the concept of integrated watershed management being rarely achieved, particularly when a large number of farmers are reluctant to join in the working. At the same time any soil conservation programme would be self-defeating unless the people on whose lands these are carried out are not only involved in it effec tively but have some stake in improving the land and maintaining it. The Committee has suggested certain measures in this regard in Chapter 4 of its report on "Development of Backward Hill Areas" and would like to reite rate the same here, namely :—

(i) that the existing practice of subsidising private works on farmers' lands should be continued.

(ii) If there are any works on the private lands like construction and renovation of risers, which would benefit not only the land on which vhey are located but also other lands belonging to other farmers, these should be treated as items of bene fit to the community and financed to the extent of 100 per cent by the State; and

(iii) the existing practice of financing the soil conservation programme on community land on 100 per cent basis should continue.

7.13 The Committee understands that there is some amount of confusion in the financing of farm ponds. Farm ponds may be of two kinds—(1) farm pond to be utilised by the land-holding itself, and (2) farm pond to be utilised on a joint basis by more than one holders. Where the farm pond is for the benefit of the holding itself, the expenditure has to be met by the farmer subject to such subsidies as are available in the State for the farm pond scheme for

various levels of holding. For joint farm ponds, similarly the level of subsidies available in the State for such joint enterprise will have to be followed. The subsidies vary from State of State.

7.14 Soil and moisture conseratvion is a complex subject which calls for appreciation of role of other technical disciplines besides dominant involvement of a particular discipline. It is necessary to devise a cadre of soil conservationists with basic background such as forests, soil science, animal science or agriculture engineering. It is equally necessary to acquaint the policy makers, administrators and financiers with the role of soil conservation in the area of national regional priorities affecting various development programmes of the country.

8. DEVELOPMENT AND MANAGEMENT OF IRRIGATION

Since water is the scarcest commodity in drought prone areas, development and management of irrigation assumes special significance, some areas have existing irrigation works to utilise surface and ground water sources. But to derive maximum benefit from these works, most of them have to be improved. There are also certain on-going irrigation projects in these areas. Improvement of the existing works and completion of the projects under construction have to be accorded high priority in the overall strategy of development,

8.2 Even with the improvement of existing works and the completion of projects under construction, the bulk of the drought prone areas will continue to be dependent on rainfall. The Irrigation Commission has, therefore, rightly emphasised the need for investigations into further possibilities of increasing irrigation by both surface and ground-water. We fully endorse this view.

8.3 An anaysis of the status of irrigation in the districts selected by DPAP and identified by the Irrigation Commission (a total of 87 districts) shows that the average area irrigated as a percentage of gross cropped area is about 15 per cent. There is some preliminary data that indicates that in some of the districts like Cuddapah in Andhra Pradesh, Ahmednagar in Maharashtra, Bellary in Karnataka, Coimbatore in Tamil Nadu and some districts in the Ganga basin, irrigation coverage could be raised to more than 30 per cent by utilising the surface and groundwater resources in the basins. No doubt, further detailed investigations will be necessary even in these areas.

8.4 Most of the districts identified as drought prone have, however, poor irrigation. Accord ing to our information, as many as 32 districts had 10 per cent or less of the cropped area under irrigation from various sources at the beginning of the Fourth Plan.

8.5 The Irrigation Commission has computed that, at present, about 13 per cent of the cropped area of the drought affected region is irrigated. This is likely to rise to about 19 per cent when the schemes under execution are completed. Even so, as much as 81 per cent of the cropped area will remain without irrigation. In the drought areas of Gujarat, Madhya Pradesh, Maharashtra and Karnataka, the position will be much worse. The Irrigation Commission had suggested the following priorities in any pro gramme of development of irrigation resources in the drought prone areas :—

(i) Improvement of existing irrigation works so as to stabilise/extend irrigation through available water supplies;

(ii) Expeditious completion of irrigation projects which have already been taken up.

(iii) Investigation of further possibilities of increasing irrigation from surface and ground water sources.

8.6 Even after the local water resources are fully utilised through projects and schemes being constructed, investigated and planned, the gross area likely to be brought under irrigation in most of the drought prone areas would still be considerably less than 30% of the cropped area and would continue to be acutely deficit in regard to their water needs.

8.7 The most sfriking feature of the drought prone areas is the absence of sizeable irrigation sources such as perennial rivers. Consequently, small worsk such as tanks,

bhandaras and dugwells constitute the most important sources of irrigation. A large number of these works have at present structural and other deficiencies which need to be removed in order to improve their performance. In certain areas, where ground-water level is low and irrigation from wells is precarious, attention may have to be given towards construction of percolation tanks and check dams on a watershed basis. Such tanks/dams do not provide direct irrigation but they are helpful in firming up water supply in the nearby wells.

8.8 Whereas a lot can still be done by tap ping available surface and groundwater re sources in the drought prone districts, it has long ago been realised thai amelioration of drought prone districts can only be carried out effectievly by transfer of water from more richl'y endowed basins to the drought prone areas. Many of the major irrigation projects designed and executed after freedom performed this important aspect of inter-basin transfer to poorly endowed basins. Particularly, the Bhakra Canal system is a standing example of inter-state co-operation and collaboration in transferring water of the Indus Basin obtained by partition, to ameliorate the desert areas of Rajasthan and Haryana. In future planning, strategy will have to be ensured that such inter- basin transfers are systematically developed and relief given to drought prone areas, particularly those which do not have much of natural precipitation.

8.9 As per Dr. K. L. Rao (India's Water Health-Assessment Uses and Projectls), New Delhi, 1975, the total quantity of water availa ble in India is 19,000 million grms. Out of this, 16,45,000 q.ms is through the river systems. While there is an adequate amount of water to sustain even 900 million people in India in 2000 A.D., there are a number of difficulties in actually using the available water due to unequal distribution of water resources in India. Two-thirds of the total water availability in the country is confined to the north of the Tropic of Cancer, but the cultivated areas to the south of the Tropic of Cancer constitute 50 per cent of the Tropic of Cancer, the wastern portion is quite deficient in water availaiblity. It is in these areas that drought prone areas are located.

8.10 The Irrigation Commission recomended inter-basin transfer of water for the develop ment of drought prone areas. Its recommenda tion was also endorsed by the National Com mission on Agriculture. In 1972-73, the then Central Wtare and Power Commission formu lated the National Water Grid Scheme. Under this scheme, it was proposed to inter link the various major rivers and transfer the surplus flows to areas of deficit supply. The scheme comprised two main groups of water transfer links : one extending from east to west and the other extending from north to south-west and south. Subsidiary links, branches and con nectors with inter-basin and local projects and other service utilities were also proposed as the main features of the National Water Grid.

8.11 Under the National Grid Scheme, it was perceived that taking the main link canal through all the drought regions will not be feasible or economical, but it was also realised that if the alignment is taken along the most economical route there will be many drouhgt areas which will be far away from the main artery. It was, however, found that the requirements of drought prone areas can be met by one or a combination of the following methods :—

(1) Water may be released along rivers which can be picked up en route and conveyed to the needy areas by means of link canals;

(2) Subsidiary links can be established from the main link;

(3) Exchange of water rights in the upper reaches; water flowing in the rivers which were previously earmarked for down-stream, water right can be met by equivalent amount of water from the Grid for use in the lower reaches, where water of the river was being used.

8.12 The Committee would also like to draw the attention to the observations made in the Sixth Five Year Plan (1980-85).

"Apart from the expeditious and efficient harnessing of the locally available water resources, formulation of a National Plan would be necessary to transfer waters from one system to another in order to utilise the surplus waters to meet the needs of drought prone and water deficit areas in the country. The need for transfer of waters from the basin for utilising part of the surplus water to meet the needs of the drought prone areas in the country has been recognised. The Central Water Commission has already taken up studies to deterrifine the quantum of shortages and surpluses in location and time in each river-basin and sub-basin. These studies will include among others, identification of drought prone areas, availability of water at present, potential of harnessing further water available locally and possibilities of transfer of waters from areas having surplus water. Proposals for inter-linking of rivers are also being studied and work in this regard will be continuing in the Sixth Plan."

8.13 These are no doubt gigantic plans and would take their time for execution and translation into reality. The Committee, strongly urge that necessary studies and investigations for formulation of a National Plan to transfer water from one system to another in order to utilise the surplus water to meet the needs of drought prone and deficit areas in the country should be given a very high priority. It is only when these plans are executed that the picture in the drought prone areas would urdergo a substantial change. Till then, the Nation would have to be content with taking such other measures, as are feasible for the development of drought prone areas keeping in mind the constraint that adequat water resources would not be available,

8.14 The schemes of inter-basin transfer of river water would take a very very long time to fructify, even if they are found technically feasible. In the meantime, it is the local source of ground and surface water, to whatever extent it is available which will have to be harnessed and reliance placed in the drought prone areas for bringing more area under irrigation. This under lines, among other thing the need for a quick and early completion of hydrological surveys in these areas. Recently, there has been a growing awareness on the part of the States to undertake these surveys. The Committee would strongly urge that this programme should be stepped up and both the Central Ground Water Board and the State Ground Water organisations should complete the hydrological surveys of all the arid and semi-arid areas as per a time bound programme.

8.15 Even with full exploitation of possible irrigation programmes in the drought prone district and with all transfers of water from other basins, and may be possibly on a national basis, water will still remain a very valuable commodity for agriculture and human development. It is, therefore, necessary to ensure that available water is utilised to the maximum in improving the economics of the areas. The National Com mission on Agriculture had pointed out that in such areas our objeotve should be to get maxi mum return out of every unit of water. This necessarily means that waste of irrigation water should be avoided. Secondly, the crops should be so selected that they give maximum produc tivity for the water used. Studies in Gujarat had shown that in the ground water exploitation the farmers of Gujarat are even now wasting as much as 50% of the water in their anxiety to irrigate their crops sufficiently. Crops give a maximum return when the evapo-transpiration

balance is maintained during the crucial periods of crop growth. In other periods, slight stress can be stood by the crops without serious damage. A Tittle underwatering in the other period is not a serious constraint. On the other hand, the mentality of sufficiency of water leads to too much watering throughout the season in order to save productivity. Here, there is a need for the laboratory to get close to the land in translating the principle of proper and economic water use.

8.16 This brings out the necessity for mak ing better use of available water in drought prone areas to give maximum coverage in irri gation by selection of crops needing lower water duty and by rigid control of water used in the irirgation systems by bringing into effect all aids for such controls like lining of canals, canals control, land shaping, field channels, etc. The Committee would strongly urge that the objective in all sources of irrigations in the drought prone areas should be to get maximum return out of every unit of water.

8.17 Precipitation being low, it will generally be found that surface irrigation projects will have a command much larger than what the storage water can irriagte under the present principles of irrigation. Similarly, the command of a ground water resource or a lift irrigation resource will be much larger than what the irrigation system can cover under present princi ples. In Rajasthan, it has been noticed that where there is irrigation well, water is supplied to the families in the command on an equitable basis so that all families can benefit. Recently, in Gujarat, a similar system is being followed and it is reported that it has the accept ance of the farmers. In the desert development programmes, in the Banaskantha district, where deep tubewells had been sunk, this principle has been established. When the Jaikwadi system in Maharashtra was examined, it was proposed to enforce this system there also. In the Tunga-bhadra irrigation project, only a percentage of the command in each 'chak' was given irri gation. The entire irrigation system in Punjab, Haryana and Rajasthan is based on the system of a fixed amount of water being given to each family under the commnad based on his hold ings. In pochampad irrigation project in Andhra Pradesh, the quantity of water for the kharif and the Rabi programmes is similarly controlled. AH these systems, except the deep tubewell system in Gujarat, are based on the principle of giving each family an amount of water proportional to the area of his holding based on a general calculation of availability of water where there is a serious constraint of water in irrigation system, there is need for much more equitable distribution of available v years ago indicated that even dugwells, which ordinarily had adequate water to provide irrigation for 2-3 acres, could irrigate 3 times the areas if proper water management practices like land shaping, field channels and suitable changes in the cropping pattern would be introduced. If such an arrangement could increase the irri-gation potential even from dugwells, it's potential for other irrigation sources whether canals, tanks, tubewells etc would be much more. The Committee, would, therefore, urge that it should be enjoined on all concerned that wherever an irrigation scheme of whichever type exists or is taken up, utmost priority should be given to the introduction of optimum use of water practices. This alone would go a long-way in increasing the protection available to the farmers in these areas.

8.22 Surface irrigation systems are at pre sent designed purely on gravity. In badly drought affected areas, the lift irrigation device can also be utilised for giving relief to areas at a higher contour than the irrigation channels passing through the area. In middle India, it is Igenearlly noticed that in major irrigation schemes main canals pass through deep cutting in several reaches and higher lands on both sides may be drouhgt affected. It is desirable that where such situations exist, relief is given to the drought affected area by suitable lift irrigation projects. The Committee is informed that such lift irrigation projects under the Nagar- junasagar irrigation systems in Telengana are working extremely well.

8.23 The Committee notices that generally minor irrigation schemes of surface reservoirs are not designed and constructed for commands less than in some States 200 acres and in some States 100 acres. This is due largely because of the responsibility of such works being cast on Irrigation Departments, which are not attuned to design and undertake small projects. In drought prone areas the precipitation has to conserved on a watershed basis starting from the highest available point for storage and gra dually going down and trying to hold back as much of the precipitation as possible within the watershed. This will require a system of designing small ponds and minor irrigation reservoirs for very small areas of command. The construction will be simple. An organisation will have to be given the responsibility for planning such water holding structures on a watershed basis in drought prone areas. The obvious organisation would be the soil conservation organisation suitably strengthened with the necessary expertise. But on this the Committee will not express any firm view but leave it to each State to design their own structures.

8.24 Ground water exploitation and conjunc tive use of ground and surface water will be an essential ingredient in agricultural development plan of drought prone areas. In some of the arid and semi-arid areas the ground water is saline. In such specially difficult areas, a proper planning of conjunctive use of saline and fresh water and adoption of suitable agronomic practices and selection of cultivars tole rating some salinity, will all have to be fitted info the programmes. The objective is maximum use of whatever water is available. In this context, the large scale experimentation by Haryana of utilising saline ground water in the canal system would be worth looking into.

8.25 Percolation tanks have special value in drought prone areas in holding up the ground water level after the monsoon season. It has now been accepted that construction of such percolation tanks would be an essential part of drought prone area amelioration programmes. Such programmes will not give the maximum benefit unless the down stream open wells are constructed and as far as possible facilities are given to the small and marginal farmers to utilise the ground water below the percolation tanks.

8.26 Whilst there is a general cry for more irrigation water in drought prone areas, the Committee in its discussions with the Maha rashtra authorities came across a peculiar fea ture. Dr. V. S. Page who has done a lot of rural development in Maharashtra mentioned that he had identified more than 3000 reservoirs and percolation tanks in the drought prone areas of Maharashtra which hold water, but that is not now being utilised for irrigation. He suggested that the Committee should look into this problem. It is not unlikely that a similar situation exists in other parts of the country. The Committee recommends that immediately the present stage of use of the reservoirs in the various drought prone areas, the system of reclamation and the cropping pattern may be investigated quickly and,. at least, within the next year a proper plan of maximising the use of such water drawn up.

9. CROP PLANNING AND PRODUCTIVITY

Approach

The Committee, at the outset, would like to draw pointed attention to the fact in the drought prone areas, one of the foremost tasks is to move in the direction of a proper ecological balance in water, plant, soil, animal and human population. As pointed out by £he Committee earlier, there is historic evidence to show that several areas, now comprising drought-prone areas, were at one time blessed with productive agriculture. Serious and persistent disturbance of the ecological balance in these areas contributed towards their decay. Hence, therefore, it is essential to evolve a proper approach to crop planning in the drought prone areas — whether arid or semi-arid-with a view to ensuring that a proper ecological balance in all the relevant factors pointed out above is achieved.

9.2 The Committee is quite cognisant of the fact that it is no easy task. It not only involves a distinct and deliberate reversal of the trends which have persisted in these areas right down to the recent years, but also necessary support and extension to see that the farmers would be persuaded to adopt the right approach towards crop farming.

9.3 That this is so would be clear from a few facts available for some years and areas. In 1951 the area used exclusively for grazing in western Rajasthan was 13.09 million hectares. Over a period of ten years i.e., by 1961, this area had declined to 11.04 million hectares, a trend which is still visible, although exact statistics are not readily available. On the other hand, the population of grazing animals increased from 9.4 million to 14.4 million. In other words, during this period of ten years, while grazing area declined by 15.6%, the population of grazing animals increased by 53.2%.

9.4 In terms of FAO Land Use Capability Classification, land use capability consists of eight classes with Class I comprising of lands which have hardly any soil or climatic limita tion and are, therefore, capable of giving return from a wide range of plants with simple manage ment without any risk of deterioration. From Class I onwards, the degree of the limitations increases progressively upto the last class, i.e., Class VIII, which comprises of lands that have so severe soil or climatic limitations that no significant commercial usefulness is obtained even from pastures or forestry with best management. In between upto Class IV, lands are considered fit for arable farming though under increasingly careful management from Class I to IV. Class V lands have even more severe limitations so that these are not suited for crops even with feasible intensive soil conservation measures and, therefore, their usefulness is limited to only pasture or permanent tree vegetation. From Class V upwards increasing care by way of deferred grazing is required for sustained production even under these land uses.

9.5 Sizeable parts of the area in the drought- prone districts, particularly those falling within the arid and semi-arid zones belong to Class V and Class VI in terms of this Land Use Capability Classification. Essentially, these are lands fit for being used for conservation purposes only. However, in actual practice, there has been a growing trend towards bringing these areas under crop farming. Crop husban dry has thus been taken the marginal and sub-marginal lands. The areas which were previ ously pastures and grazing lands have been sought to be brought under the plough. In some of the relevant districts there has been an increase of about 45% in the crops area during the last two decades. This has tended to link the economy of these areas to more and more precarious crop farming.

9.6 The important point to be considered is how to reverse this trend. The Committee lias already pointed, out in the relevant chapters that, given the necessary support, the technology makes it possible today to provide greater income to the farmer from the lands unfit for crop farming by putting these marginal and sub-marginal lands under pasture, horticulture, afforestation, etc. Why it is that, despite the technology being available and its economic fea sibility established, still the farmers are not changing over to new pattern? The trouble is that every household is anxious to somehow produce sufficient foodgrains of the varieties most prevalent in the area. This basic fear dominating the farm population is the possibi lity of drought and famine, forcing it to pro duce as much as he can do, not only to meet his current consumption, but also for a carry over for the next year when the food crops may fail. This fear complex leads to bad land use and anyhow it does not satisfy the requirement for food-grains. If the farm population is to be brought out of this fear complex and persuaded to change the present pattern of land use, there must be some guarantee that they must get their food requirements throughout the year at a reasonable price and the type of food required by them from nearby fair price shop. The country with its vast distributing organisation should now in a position to give this gua rantee provided the requirements are estimated in detail at the block level, adjusting the requirements to the changes in cropping pattern that have taken place and providing the necessary foodgrains throughout the season at nearby fair price shop. This is the first essential and foremost support for a proper land use strategy.

9.7 The next step is to prepare an inventory of the natural resources of all arid and semi-arid lands. The Committee has emphasised this aspect in para 4.12 of the Chapter on "Strategy of Development" and would reiterate that the topmost priority in the drought-prone areas must be given to prepare optimal land use and land capabiiiy maps, which will pro vide the basic guidelines for planning for agri cultural and other development.

9.8 Once such maps are available, it would be necessary for the concerned planning and development authority in the area to draw plans to take up relevant developmental strategy for such lands as are found unfit for crop cultiva tion, or are in a position to give better return if diverted to uses other than crop farming. The Committee considers this as a very essential step not only for proper land use, and improving the productivity and economic conditions of the people living in these areas, but also in restor ing the ecological balance which would go a long way in not only improving the conditions of the people in these areas but would also be in the larger national interests.

Improved technology for crop farming in dryland areas

9.9 Having outlined the concept and approach towards crop farming in the drought prone areas, the Committee would now like to take up as to how the crop productivity can be increased in such lands as are considered fit for crop farming and production.

9.10 The problems of crop production are many and vary from region to region. More important are :—

(i) Water limits successful raising of crops in drought prone areas. The main Source of water in these areas is rain. The rainfall is erratic, inadequate and concentrated within a short period. There are usually a short or long dry spells between on set and cessation of rains.

(ii) The nature and properties of soil vary widely from region to region, and even within the same region. Soils may be deep, shallow, light or heavy. Alluvial soils, red soils and black soils are found in these areas. Heavy and deep soils such as black soils are fairly retentive of

moisture whereas the red soils are light and shallow and poor in water-holding capacity. The soils may be flat or undulating.

(iii) Weeds are harmful on all crop lands, but they are more damaging on rain-fed lands where available rain water is inadequate to support healthy crop growth. These weeds compete with crops for water and nutrients.

(iv) The investment capacity of the farm families in these areas is generally poor. Lack of sufficient power and labour in time of often come in the way of timely completion of tillage operations.

9.11 As pointed out by the Committee, technology is now available to a very large ex tent for improving productivity in these areas. The All India Coordinated project for Dry Land Agriculture as well as the International Crop Research Institute for Semi-Arid Tropics (ICRISAT) in Hyderabad, and so also a number of State agricultural universities and other Central Research Institutes have done poineering work in this regard and have succeed ed to a large extent, in evolving a fairly sound technology to improve dry-land agriculture. Technology now available is able to maximise the: benefits of good season and minimise the ill- effects of an unfavourable one. The agricultural scientists claim that the challenge posed by erratic monsoons has been met to a consider able extent at the technology level.

9.12 Successful dry land agriculture requires a two-pronged strategy. When the monsoon is normal, it should be used most effectively. Mak ing the best of it involves a good deal of atten tion and work—the best varieties, the best prac tices, inter-cropping and, so on. The second part of the strategy comes into operation the moment the weather turns abberrant. This approach must outline for each agro-ecological region, the list of anticipatory measures and alter native crop strategies that ought to be adopted when there is evidence of the incidence of drought. This kind of programme involves steps like :—

(a) Maximising production and altering crop patterns, when necessary, in irrigated areas;

(b) proper development and management of irrigation sources;

(c) mid-season corrections in crop planning in unirrigated areas;

(d) introduction of crop life saving practices ; and

(e) building up to appropriate seed and ferti lizer buffer to implement the drought croping strategy.

9.13 There are crops that could give farmers something in return for his effort even in unfavourable years. These are fodder crops. Mixed cropping system comes into full play in this situation. If one crop fails, another comes to the rescue of the farmer. In earlier days, it was the mono-crop-fail ure syndrome that was the spirit-crushing feature of dry land agriculture.

9.14 It is important to treat all practices as a package because it is the cumulative effect that enables a farmer to raise crops successfully in rainfed areas. It is needless to say that partial adoption of this package will not produce the desired result. This is the task which the State Agricultural Development Organisation in these areas mustl take up in right earnest and gear up the extension machinery as well as the input supply organisation towards this end. It requires a close and coordinated effort on the part of the various agencies involved in intro-

ducing this package aporoach and all have to work together as per a pre-conceived cropping programme, based on proper land use pattern.

9.15 A map is attached showing the areas of deep and medium deep vertisoles (black soil) and low and medium vertisole in the country and the alfisols (red soils). On this map is superimposed the present identified drought prone areas. It will be clear at a glance that most of the drought prone areas of the country fall within these soil classifications. Of course, in any mini-watershed there may be variations but broadly these classifications give us a base for designing our land, water and cropping management in the drought prone areas for maximising return.

9.16 The International Crop Research Insti tute for Semi-Arid Tropics (ICRISAT) had undertaken village level studies in six villages in 3 agro-climatic zones of peninsular India since 1975 with a view to find out the rationa lity behind some of the traditional farming prac tices, e.g. rainy season fallows, inter-cropping, etc. The important results which could help in evolving a relevant technology for these areas have bee# summed up as follows :—

"In the deep Vertisol areas the practice of fallowing land during rainy season and planting it in post-rainy season is very important. This is more so in the case of small farmers than large ones. Hence, any techno logical advance facilitating rainy season crops in monsoon-fallow tracts, besides substantilly adding a double cropped area, can probably help small farmers more than large ones.

In the largely rainfed areas (other than those with extensive deep vertisol areas) the traditional practice of intercropping covers 35 to 73 per cent of gross cropped area. The extent of inter-cropping declines with increase in irrigation. The small farmers again have a significantly higher extent of inter-cropping than large farmers. This indicates that gene ration of a low cost new technology for intercropping may help less-endowed areas and farmers more than the relatively well-endowed ones. This suggest yet another of the few opportunities where egalitarian objectives could be achieved by technological means as opposed to institutional means in the SAT areas. This has significant implication for research resource allocation. As revealed by the number of crop combinations (as high as 84 in a single village), the traditional inter-cropping is highly complex. This is partly an outcome of farmers' informal experimentation with crops which could satisfy their requirements and also Hi to agricultural environment of the region. While evolving new inter-cropping technology the multiple objectives of the farmer such as security, profitability, employment and sub sistence requirements of his family members and cattle etc., should be taken into account".

The juxtaposition of requirements of prospective watershed based technology and the features of the traditional system of farming particularly land ownership and usage pattern gives an idea of the institutional constraints the technology is likely to face. Owing to indivi-sibility of integrated watershed-based technology, non-availability of individually-owned land parcels to constitute 3 composite mini-watersheds, there seems no alternative to a group action which can ensure management of land for higher productivity and conservation on a watershed basis. In order to induce group action among farmers for prospective watershed technology, the latter will have to be highly profitable.

9.17 Watershed based natural resource deve lopment which involves the optimum use of the watershed precipitation through improved wafer, soil and crop management has the potential to contribute significantly to .greater productivity and resource conservation. The development of improved watershed management technology adapted to what farmers

require is a complex and long-term task, all land use, including grass lands and forests must be considered.

9.18 "Watershed-based resource utilisation" involves the optimum use of the watershed pre cipitation for the improvement and stabilisation of agriculture on the watershed through improve- ed water, soil and crop management. More effective utilisation of water for the production of crops can be faciliated by one or more of the following means :—

(i) Directly by improving infiltration of rainfall into the soil and thus making more soil water available for plant use;

(ii) through drainage, collection, storage and reutilisation of run off; and/or

(iii) by water recovery from wells after deep percolation beyond the root profile.

9.19 The need for development, conservation and management of land and water resources is realised. However, many small farms and frag mented land parcel—and often several different land uses—together compose a watershed, their presence must be accommodated within efficient watershed development and management techni ques. In many situations, group action may be required to attain the desired objectives.

9.20 The diversity of environments encoun tered in the SAT is recognised. The problems with regard to technology development and the transfer of new information to farmers in this ecological zone are difficult to solve because the moisture environment is unreliable and because the appropriate practices will be complex. Improved technology will relate to crops, variety, fertility, management, land development, water conservation etc. In the end, millions of small, often illiterate farmers, who ha ve little capital, must learn to apply the tools of science to extract more food and ultimately a better quality of life from their hostile environment. Compromises must be found between private, short-term goals and common long-term objectives. The challenge is great.

9.21 Until a few years ago, little attention was paid to the semi-arid tropics (SAT) in terms of agricultural research and with regard to re source development projects. Except for cash crop agriculture on steep slopes of considerable elevation, the crops and farming systems common in most of the SAT (semi-arid tropics) have only recently caught the attention of scien tists. In the past, some of the approaches to ameliorate the problems faced by farmers in the rainfed semi- arid tropics ha ve been:—

(i) To meet drought by emergency relief programme;

(ii) to leave fallow heavy soils such as verti-sols during the rainy season in an attempt to accumulate a moisture reserve in the profile for growing a crop in the subsequent dry season;

(iii) to construct bunds as a soil and water conservation practice; and

(iv) to develop irrigation facilities.

9.22 The "Crash" resource conservation and development schemes implemented as part of relief programmes have net resulted in improv ing the stability and long-term productive poten tial of the environment. Cultivated fallow on deep vertisols is questionable because of the erosion hazard, this practice also frequently re sults in only a small portion of the total seasonal rainfall actually being used for crop production (Kampen 1977). It has not been

possible to identify any results of controlled experiments which show significant and stable crop yield increases due to moisture conservation by con tour bunds in the semi-arid tropics of India (ICRISAT 1976, ICRISAT 1978). Experi ence with irrigation in the semi-arid tropics shows that conventional projects usually provide continuous water on a seasonal basis to crops with high water requirements such as rice and sugarcane; they do not presently have the flexibility required to act in a supplemental fashion. Few serious efforts have been made to explore how the limited available water resources can be used to stabilise and support larger pro portions of rainfed agriculture for the benefit of a greater number of farmers.

9.23 Thus past approaches to resource deve lopment to increase agricultural production in the Semi-arid tropics have achieved only limited success (Kampen 1974). These development efforts have not been planned and executed on the basis of the natural drainage basins, nor have they recognised the basic climatologic and soil characteristics of the semi-arid tropics (Kampen and Burford 1979). Some of the techniques discussed have undoubtedly had beneficial effects in limited areas. However, they have not provided the break-through in soil and water conservation and utilisation which is imperative for rapid development of agriculture in the semi-arid tropics.

9.24 The International Crops Research Insti tute for the Semi-Arid Tropics "(ICRISAT) has been doing intensive work on the land and water management and cropping on a watershed basis in vertiso's and Alfisols not only in their farm at the Centre at Patancheru but in field level replications and improved technology studies in other parts of the country on farmers' /fields and elsewhere. Recently, in July 1980, they have brought together the present state of research work in their Research Bulletin No. 2 on "Farm ing Systems Components for Selected Areas in India-Evidence from ICRISAT". It is evident from this Bulletin that the research is at a stage where it can be translated into the farmers' fields through the extension network. Certain genera lisations have been attempted which seem to be substantially relevant for DPAP. ICRISAT has also indicated the further lines of research that will be needed to bolster up the findings in these studies. The Committee cannot do better than quote the objectives, the present position and the gaps as stated in the Bulletin by ICRISAT: —

"Operational scale research on natural watersheds at the ICRISAT research centres has demonstrated that substantial profits (after deduction of all costs, including those related to capital investments) can be earned by more input-intensive farming systems than those currently used by farmers. For the best systems on deep vertisols at ICRISAT, profits are in the range of Rs. 3000 per hectare while for the Alfisols they are of the order of Rs. 2000 per hectare. However, these systems are complex and require several inputs, before transfer to farmers; we need to ask if essential components of these systems can be identified. We must also more precisely describe the agro-climatic "and socio-economic conditions where specific components may be most appropriate".

The above shows that where the best systems of deep Vertisols at ICRISAT can be replicated, profits in the range of Rs. 3000 per ha. can be obtained and in Alfisols profits may be of ths order of Rs. 2000 per ha. These are certainly levels which can attract better agriculture in the drought prone areas of the country.

9.25 ICRISAT has been carrying out three types of watershed-based research in their farm at Patancheru with replications elsewhere from 1973. They have carried out field scale land management trials in the villages from 1975. Improved technology studies (SIIT) have been carried out on variety, fertilisation levels, soil, crop and fertility management methods and supplemental water where each factor was applied at two levels, traditional and improved.

9.26 ICRISAT watershed was laid out in 1973. However, reliable and meaningful results of the Vertisols and Alfisols watershed are available from 1976-77. Certain things have been done consistently only surface grading of the soil by bullock and human power and fertilisation and pest control are done at minimum farm level,

9.27 Investigations for deep Vertisols were aimed at developing management systems which could permit cropping both during rainy and post-rainy seasons. The broad bed and furrow system of cultivation and improved level of crop management have been found to facilitate double cropping, either sequential or inter-cropping. This appears to be quite suitable for deep Vertisols having relatively assured kharjif rainfall. This system has been simulated in a typical deep Vertisols watershed of 3.5 hectare size whose data are prescribed in Table I. Monetary returns for a few years are also indicated. Detailed information is available for 1980-81 for 5 deep Vertisols watershed and 4 Alfisols in tables 2 to 6 (appended). Table7 presents the criteria used in the cost and return analysis.

9.28 The all India Coordinated Research Pro ject for Dryland Agriculture has also been carrying out extensive research and experiments ever since its establishment in June 1970, with 23 centres located in different agro-climatic zones of India. It had been their endeavour to develop a graded technology to suit different income groups of farmers in the drylands. The emphasis has been to aim at a strong base in crop production by evolving good farming prac tices as the first step. These practices are low cost inputs and could be carried out by the farmer within his own resources. Adoption of practices like proper tillage, early sowing, choice of suitable crops and varieties, optimum plant population, weed and pest control etc. have been recommended. Some of the recommenda tions which are generally relevant to all regions growing the rainfed dry land crops are discussed below.

Year round tillage

9.29 Timely completion of all farm operations before the rains is essential. The period of crop growth is limited as the rainfall is concern- trated in a short period. The earlier the sow ing is done, the longer the period the crop has to grow and mature. Hence, the tillage opera tions should be completed before the onset of rains. In an inter-cropping system it is necessary to till or harrow immediately after the harvest of one of the component crops, as otherwise weeds take over and the yield of longer duration com ponent is drastically reduced.

Improved farming machinery

9.30 The various dryland researches over the last six years have identified and/or fabricated several farming machinery. Various types of machinery are now available at the respective centres. Their cost varies from Rs. 20/- (manually pushed top dresser) to Rs. 4,000/- (tractor-mounted rig seeder). The costly implements could be supplied to farmers on hire service.

Crops and varieties for efficient moisture use

9.31 During the last 6-7 years, scientists in different regions have evaluated all the important crops generally grown in the area for their rela tive efficiency of production. On the basis of data obtained efficient varieties/crops have been identified for different regions of the country and these are now available for use by the ex tension machinery. The experience has been that change-over to improved crop varieties is a basic requirement to enable the growers to bene fit fully from yield-based inputs, fertiliser, avail able moisture etc. A comparison of the yield levels achieved at the research centres and those obtained by the farmers who

continued using the old varieties indicates that as against the average yield by the farmer of 2 to 12 quintals per hectare, yield in the research fields varied from 8 to 48 quintals.

9.32 Data is also available of the yields obtained from traditional and efficient use of crops which shows that a change over in the cropping pattern would increase the farmer's productivity and income considerably. The following fable brings this out clearly :—

Yield

Crop	Crop System	Income (Rs. per ha.
Samba	Maize	1,502
	Maize + Grcengram	2,846
Indore	Jowar	1,839
	Jowar + Groundnut	3,702
Bangalore	Ragi	4,167
	Ragi + Chillies	6,433
Dehra Dun	Maize	2,825
	Maize -f Soyabean	3,348
Source :—The all India Coordinated Research Project for Dryland Agriculture and Fertiliser Use-September 1978.		

A study made in regard to Jowar programme in Ahmedanagr District of Maharashtra (Mahatma Phule Krishi Vidyapith) reveals that the average yield of traditional variety which was 13.3 quintals per acre in good areas increased in respect of CSH-4 to 28-12 quintals in the case of CSH-1 to 26.50 quintals and in respect of CSH-5 to 23.50 quintals.

Early sowing

9.33 Early sowing has several advantages, both general and specific. The general advantages are better moisture, seedling vigour and longer growing season. The specific advantages are avoidance of pests and diseases such as shootfly on Jowar and dowry mildew on bajra. These recomendations for early sowing will have to be suitably modified to fit in with the principles of seeding rain that has been enunciated now by Shri C.R.V. Raman in his agro-meteoro-logical analysis. The Committee h$8 dealt with this in Chapter 6 on "Role of Agro-Meteoro-logy in Planning". The farmer will have to be prepared to sow as soon as the seeding rain occurs. This can only be done if the land has already been tilled after the previous harvest. It is sometimes suggested that this tillage should be done after the harvest at a time convenient to the farmer. In drought prone areas, disturbing the top soil after the kharif harvest during periods of high temperature and high wind can lead to serious soil erosion. The tillage to be effective and, at the same time, not destructive will have to be done just after the harvest so that the land settles down before the temperature and wind increases. Alternatively the tillage will have to be done at a time shortly before the expected seeding rain so that erosion effects are minimal.

Methods of sowing

9.34 Poor stand establishment is a major problem with most farmers using bullock power. The traditional method of sowing is to open a furrow either with a slightly modified desi plough or a wooden hoe-drill and to distribute the seed either through an attached tube or directly into the furrow by hand. The seed is usually covered by planking. It was observed that mechanised sowing gives better stands and subsequently better yields. Mechanised sowing is more pre cise. The proper number of seeds is placed firmly at a uniform depth into the moist soil at the optimum time after a rain.

9.35 The most important contributor to the increased productivity of land in the drought/ prone areas is the utilisation of the land for a kharif crop wherever a kharif fallow, followed by a rabi programme, is the traditional practice. The analysis made by ICRISAT which we have reproduced gives the parameters for deciding which areas are suitable for a kharif sowing. The Committee would recommend that based on this analysis a kharif sowing shall be attemp ted at the seeding rain in all these areas in drought prone zones. The technologists have already devised suitable adjustment programmes, in case such kharif sowing is non-productive in any area because of lowest rainfall. The strategy devised for jowar and bajra is that if the rainfall pattern in kharif is against proper grain setting, the crop should be harvested for fodder and the ratoon crop taken as the rabi programme. This way the kharif moisture is any how availed of even in a bad year. In a good year, an extra kharif crop is availed. Rabi programme can be adjusted after the kharif programme which should be of a reasonable short period crop.

9.36 Even if it is decided that it is not desirable to introduce a kharif crop in a kharif fallow area for reasons explained above, it is necessary that a suitable soil cover is maintained in the rainy season on ai such lands. Water erosion of kharif fallow lands is pervasive deterioration. This has to be prevented. The best cover would be a suitable legume fodder which can be grazed off before the regular rabi cultivation is done. With the massive animal husbandry programme that is being attempted in drought prone areas, this will be a welcome addition to fodder availability.

Plant Population

9.37 Plant population density in relation to moisture is important for obtaining optimum yields. There appears no need to cut down the seed rate of kharif crops simply because they are likely to suffer from intermittent moisture stress during their life cycle, provided varieties of right maturity crop suitable for the region are selected. Iti has been found that the new crop varieties perform best at population level lower than those recommended for the traditional varieties. This has been established at most of the research stations.

Isiter-croppiug

9.38 This is sometimes called mixed cropping by farmers. It involves the growing of two crops in separate rows in the same season on the same land, such as jowar and pigeon pea (Hydera bad) groundnut and castor (Anantapur) upland rice and pigeonpea (Bhubaneswar and Ranchi), jowar and pigeonpea (Indore) etc. In a normal year, this system gives higher yield/income per hectare than a sole crop. In a sub-normal year, the drought tolerant component (pigeonpea, castor) does not fail completely. Traditionally, farmers have discovered the compatibility of cretain crops and have minimised the risk of production. In an inter-cropping system, the population of the base crop has to be main tained at the optimum level using full seed rate. It has been reported that in areas with rainfall of less than 500 mm., inter-cropping could be practised as an insurance against crop failure. In areas with 625—1000 mm. rainfall, inter cropping has the greatest possibilty. However, it should not be used in the post-monsoon sea son. Many crops have been tried at most of the stations. During the rabi season, crop mixtures have not shown any superiority over sole crops. In kharif, crop mixtures yielded much higher income in some regions as illustrated in the table below:—

Crop	Crop System	Income (Rs. per ha.)
Samba	Maize	1,502
	Maize + Grcengram	2,846
Indore	Jowar	1,839

	Jowar + Groundnut	3,702
Bangalore	Ragi	4,167
	Ragi + Chillies	6,433
Dehra Dun	Maize	2,825
	Maize + Soyabean	3,348

Sequence Cropping

9.39 Some regions have bountiful monsoon rainfall followed by some winter rain (around 10000 mm total) and this has allowed traditional farming systems to be developed on the basis of two crops a year (both kharif and rabi crops are grown at Samba, Ludhiana, Dehra Dun, Varanasi, Ranchi, Bhubaneswar, Jhansi, Rewa and Indore). In areas with clay soils the monsoon rains can make the soil unmanageable, and rarge areas are often kept fallow. The kharif rains are used to fiil he soil profile with moisture and a rabi crop is grown. This prac tice metyf be inevitable in some regions like Bellary and Bijapur for want of adequate rains in June, July and August but, unfortunately, some traditional fallow during monsoon is also practised in areas like Indore and Rewa where two crops can be readily grown. Newly demon strated cropping systems using short-duration kharif crops and better sowing methods for the second crop make double-cropping easier for farmers over large tracts of land.

Manures and Fertilizer Use

9.40 Special efforts should be made to enrich the organic matter content of drylands. All the organic wastes of plants, cattle-dung, etc. should be incorporated into the soils as FYM or com post. This practice will improve the soil struc ture and their water holding capacities. Trials on fertiliser use for dryland crops have conclu sively shown that these crops respond economi cally to application of nitrogen (N).

Weed Control

9.41 Farmers know that weeds are wasteful in crops. It is, however, not generally realised that they reduce crop yields to unbelievably low levels. In those investigations, cultural and chemical methods of weed control were evalua ted. The benefits from weed control were very substantial in kharif season crop. These are summarised in the table below :—

Yield

Centre	Crop	Weeds controlled	Weeds not conirollec
Varanasi	Upland rice .	44.2	15.5
Agra	Bajra	17.8	9.3
Dehra Dun	Maize	46.0	17.6
Hyderabad	Jowar	14.6	9.2
Sholapur	Bajras	17.6	1.2
Rewa	Upland rice	34.1	10.6

The important point, therefore, is not how weeds are controlled but that these are controlled (culturally or chemically) to realise the full benefit from the potential of new crop varieties, fertiliser use etc.

9.42 Whilst various types of weed control have been experimented upon in the coordinated research programme, a pioper cost benefit ana lysis has not yet been done which can enable

the extension organisation to effectively introduce a chemical weed control programme. Even in a cultural weed control programme, the labour costs will have to be covered with a profit in weed control operations. It is rather unfortunate' that the cost benefit criterion has not yet entered the experimentation. There are a number of operational research programmes being carried out in many large areas in the country under strict technical control. It is necessary that these operational research programmes go into a proper analysis of the cost benefit that can be attributed to weed control in lands similar to those found in drought prone areas. Particularly, as Vertisols (black soils) and Alfisols (Red soils); predominate, experimentation should now be done for these two types of soils in varying depth conditions immediately.

9.43 Whilst doing the cost benefit analysis it is not enough to assume that the yield in a weed controlled plot as against a plot where the weed are not controlled is entirely due to weed control operations. The question of comparable inputs and other cultural practices also have an effect. The proper scientific analysis alloting the bene fit arising from weed control will have to be carefully done. On the other hand, where weeds are not controlled, a lot of fertiliser applied to the crop is actually wasfed by absorption by the weeds. The advantage in weed control will have to include the fertilizer saved for the crop and the cost thereof. The Committee would recommend an early examination of the weed control cost benefit as it has no doubt at all that in drought prone areas, with all good cultural practices, unless weed control is effectively done, substantial part of productivity will be lost.

Use of Surface Mulches

9.44 Use of Surface Mulches (organic and inorganic) has been found effective in short-term carry-over of soil moisture under certain condi tions of soil and climate. In the kharif season, shallow stirring of the surface soil (dust mulch) helps to retain more moisture in the seed zone and, thus extends sowing time by about a week in soils which dry up and harden fast only after a few days of rain at Hyderabad. In the rabi season, use of organic surface mulches has been found to increase the yield of crops in several areas. Examples from Ludhiana and Sholapur are illustrative of the benefits from surface mulches as in the table below:—

Centre No.	Treatment	Yield(q/ha.)
1. Ludhiana		
wheat	No mulch (control)	19.4
	Dust mulch (in maize)	20.8
	Straw mulch (in maize)	25.3
	Fallow* mulch	34.9
	Bare fallow	30.0
2. Sholpaur		
Soraghum	Control (no mulch)	12.2
	Dry grass mulch	21.6

Improved vs. Standard Practices—Effect on Yield

9.45 Improved production practices developed at the dry land research centres are continuously being evaluated in comparison with the local practices. The increases in yield attribu table to improved practices are about 140 per cent in kharif crops and 180 per cent in rabi crops as would be seen from the table below:—

		(Yiel	d q/ha)
Centre	Crop	Standard practices	Improved practices
(a) Kharif crops			
Akola	Sorghum	1.6	13.1
Agra	Bajra	11.5	22.7
Samba	Bajra	10.4	24.0
Hyderabad	Bajara	7.4	20.3
Ranchi	Upland	9.4	28.8
Dehara Dun	Maize	8.5	32.3
Ludhiana	Maize	20.8	35.3
Hyderabad	Castor	10.4	17.3
Average		10.0	24.2
(b) Rabi Crop			
Bellary	Sorghum	7.3	31.1
Sholapur	Sorghum	1.6	9.8
Dehra Dun	Wheat	8.0	22.8
Ludhiana	Wheat	9.0	21.1
Ranchi	Barley	3.7	19.0
Agra	Mustard	6.3	13.6
Sholapur	Sunflower	6.2	11.7
Sholapur	Chickpea	10.7	17.2
Average		6.6	18.7

9.46 Details regarding locations, specific improved practices for controls for different regions can be seen in the brochure brought out by the Indian Councils of Agricultural Re search, All India Coordinated Research Project for Dryland Agriculture entitled "Improved Economic Practices for Dryland Crops in India—1979".

Cultivated Rainy Season Fallow on Deep Vertisols

9.47 Leaving the black soil areas fallow during the kharif season and utilising the accumulated moisture for a rabi crop is a very well-known practice in middle India. Wherever the low rainfall makes it hazardous to have pro per seed sprouting and sustained moisture for growth during the kharif, this practice has been traditionally adopted. Attempts have been made to introduce a kharif crop in such areas followed by a rabi crop in case the kharif crop fails. To support this experiment, meteorologi cal analysis has been availed of for identifying the best time in the season for seed bed. The method of rationing kharif jowar where the kharif crop is a failure, has been advocated.

All these experiments for a kharif crop with a reserve rabi crop will have to continue. The ICRISAT experiments, on the other hand, have worked more on the dependability of rainfall in a season and their findings on this subject are very relevant to the Agricultural Administrators to decide upon the correct strategy in their area.

9.48 Recent mapping work suggests that the important kharif fallow areas indeed fall into two clearly distinct groups : (i) the low-rainfall kharif fallow found parallel to the Western Ghats through Maharashtra and Karnataka, and (2) the high rainfall kharif fallow concentrated primarily in Madhya Pradesh. A rainy season cropping belt is found in between the two zones.

9.49 It is found from the ICRISAT study that the total probability of a 90 day kharif crop encounters good growth conditions throughout the growth period. At Sholapur in the low rainfall kharif fallow regions, this is the case only in roughly one-third of the years. For similar Vertisols in Hyderabad and for medium Vertisols in the higher rainfall zone represented by Akola, this is the case in two- thirds of the years. The most serious setback in Sholapur arises from a much lower probabi lity of successful crop emergence before 1,5th July, which is probable in only two-thirds of the years. However, all subsequent conditional probabilities also show that the plant is at a higher risk in Sholapur than in the other two areas at every growth stage, even after it has completed the earlier stages successfully. A 33% probability of a favourable soil moisture regime is too low a basis for encouraging rainy season cropping on a normal annual basis. The loss of seed and cultivation expenses in some years and the low returns in other years would almost certainly reduce average profits of any crop to zero or result in losses.

Probability of adequate soil moisture

9.50 The probabilities of adequate soil moisture for a post rainy season crop after kharif fallow are high at Sholapur (80%) this level of probability exceeds crop in Hyderabad or Akola. However, if a rainy season crop is taken in Sholapur, the chances of the rabi crops are reduced by 20%. Not only would consistent rainy-season cropping often not be profitable, it would probably endanger the pro fitability of the more important post-rainy season crop. We, therefore, emphasise strongly the importance of breeding for high yield potential post-rainy season sorghums for these and similar regions.

9.51 ICRISAT has also mentioned the need for further research in taking a kharif crop in such low rainfall regions in the following words :—

"One possibility for rainy season cropping in low rainfall regions remains to be investigated : the establishment of 'decision rules based on observed soil moisture in the early rainy season to sow a low input, short-duration crop that primarily provides- cover to prevent erosion and also produces some yield in these years when it can be left on the land until maturity. If high rainfall in the early rainy season is correlated with above normal rainfall later, the farmer may protect the soil during these years when it is most endangered and get a modest return in some years. We recommend that further work on rainy-season cropping (simulation and actual experiments) in the low-rainfall kharif fallow areas be oriented to explore this option. However, more emphasis on replacing the kharif fallow by rainy season cropping must be concentrated in the high rainfall regions".

9.52 The analysis made by ICRISAT shows clearly that the approach to kharif cultivation in kharif fallow areas and the adjustment of crops in the kharif and the rabi seasons for greater productivity will depend upon :—

1. location specific breeding of varieties which will answer best to the constraints in soils and moisture in the zone; and

2. development of a technique for adjusting the crops to variant moisture conditions.

Whilst the breeder will be producing the seeds on the basis of the macro analysis of local conditions, continuous adaptative research for these varying zones will have to be carried out by the adaptative research organisations of the State Department of Agriculture to work out the best permutations and combinations of cropping in the zone for maximising productivity. This will be a continuous process as more and more varieties are released.

Farm Pond System

9.53 For extension and implementatipn pur poses it is convenient to divide the system for farming into two parts (i) soil and water management technique; and (ii) cropping pat terns and agronomic practices. Soil and water management techniques designed to control run off to dispose of excess water and to minimise erosion, frequently including direction of culti vation, have to be planned and implemented on a whole watershed basis since guidance of water from plot to plot is crucial. On the other hand, cropping pattern decisions and agronomic practices should be adapted to the watershed topography, only if the benefits of such group action are sufficient.

9.54 The ICRISAT experimentation is of variety, fertilisation levels, soil, crop and fertility management methods and supplemental water. Basically, it also aims at prevention of erosion of surface soil and to ensure a controlled run off. Experiments have also been done in collecting the run off in suitable farm ponds for utilistion whenever therer is moisture stress in the crop in the watershed.

9.55 The farm pond system has been advocated in the agriculture strategy for low rainfall areas for long years now. Substantially, in black soils (Vertisols) a farm pond has been recommended as an important auxiliary for supplemental water. Many States have already experienced with the system and must be having substantial experience in the cost benefit of the structure. In ICRISAT itself in their paper "Using rainfall excess for supplemental irrigation of Vertisols in India" the experience at the ICRISAT Farm at Patancheru has been analysed and the following table shows the position over 7 years.

Rainfall and run off on two Vertisol watershed at ICRISAT						
Year	Cropped Watershed			Monsoon fallow watershed		
	RF	FO	RO/RF	RF	RO	RO/RF
	(mm)	(mm)	(%)	(mm)	(mm)	(%)
1973	697	51	7.3	7355	59	8.0
1974	810	116	14.3	807	223	27.6
1975	1042	162	15.5	1055	253	24.0
1976	687	73	10.6	710	238	33.5
1977	586	2	0.3	586	53	9.0
1978	1125	273	24.3	1117	410	36.7
1979	689	73	10.6	682	202	29.6
1973- 979	5636	750	13.3	5692	1438	25.2

Further, in Bellary (Karnataka), in a study conducted on deep Vertisols, Vermactaal (1972) have reported the following situation:—

Effect of supplementary irrigation from a farm pond on the yield of Sorghum at Bellary (Vermactaal 1971).					
	Depth of Water	Yield(kg/ha.)		Percentage of increase grain yield	
		Grain	Straw	Over control treatment	Per cm. of water applied
No Irrigation Tl (Control)	0	527.8	2537		
Irrigate beet leaf stage (T2)	11.78	1361.1	2623	158	13.4
Irrigate seed setting stags (T3)	12.62	1722.2	3485	226	17.9

Irrigate (T2) and T3 stage (T4)	19.37	2711.4	3719	414	21.4

9.56 The All India Coordinated Research Project for Dryland Agriculture have also carried out experiments using collected run off for supplemental irrigation. In a case study of an area covering about 9 hectares of five farmers, where the land had an average slope of 2.3%, there were no soil and water conservation practices, local varieties of castor and Sorghum were being grown under local crop management, with an average yield of 4-6 quintals per hectare of sorghum, 1-2 quintals of pigeonpea and 2-3 quintals of castor. Apart from the improved crop management and key line cultivation, graded terraces and run off storage structures were provided during 1979 kharrf. Five ponds of 180 cm. each were dug and the material excavated from these ponds was used to strengthen alternative keylines to get a 0.63 m. cross section terraces at 1.5 m. vertical interval. Two of these ponds were lined with about 2 to 3 mm thick asphalt layer to prevent seepage losses and to facilitate storing of water for use as supplemental irrigation. Water from these ponds was utilised for giving supplemental irrigation in October to the pigeonpea crop which was suffering from moisture stress due to early recession of monsoon. The grain yield of redgram crop with and without supplemental irrigation is given in the table below.

	Treatment	Grain yield of Pigeonpea (g/ha.)
1.	Control	2.02
2.	8 cm of irrigation (on October 9 and 29, 1980)	2.67
3.	12 cm of irrigation (on October 16,25 and Novermber 5, 1980)	2.80

The data indicates that 35 to 40 per cent increase in yield was obtained by giving 8 and 12 cm of water to the pigeonpea crop respectively.

9.57 The response of the farmers to this technology has been encouraging. The cost of the graded terraces and run-off storage structures was about Rs. 2,000 per hectare. The general fear that considerable area gets lost in graded terraces etc., was also belied. The loss of cultivable land was 5.1%. It is often forgotten that though some area get lost to cultivation, the area on bunds could be used for fodder-cum-fuel plantation or vegetable etc., which works out to 4.1% when this is taken into account, the total loss of land for cultivation is only 1%.

9.58 All this shows conclusively that in actual field level experimentation, the farm pond has been found useful under vertisol conditions. The Committee will, therefore, recommend that the present policy of supporting a farm pond system in the Vertisols in the low rainfall areas may continue. The actual cost per hectare of the system is not such that one should wait for the further field experience and holding back the national priorities. If necessary, adaptive research can be carried out on a sufficient sampling basis by State Department which may yet have some doubt on the subject.

Broad bed of Farrow System

9.59 ICRISAT has also given generalisations for medium and shallow Vertisols. They have further explained these conclusion drawing out the differences in the generalisations between deep Vertisols and medium and shallow Vertisols in the following manner :—

"Many of the tentative generalisations on these soils are similar to those derived earlier for the deep Vertisols (Table 3, Generalisations 1, 3 and 4). As expected, intercropping relative to sequential cropping is even more attractive on these soils of lower water storage potential because post-rainy season cropping is often not at all feasible on the medium and shallow Vertisols (Generalisation 2). On these soils the presence of vegetative cover during the rainy season also has a major impact on run-off and erosion. Contour bunds are now common in these soils. Regression and simultation modelling of run-off has not been done separately for the medium to shallow Vertisols. This is because most analysis in the past assumed that one could expect deep and less deep Vertisols to behave similarly with respect to run-off and soil loss, which are primarily soil surface phenomena. However, hydro-logic data collected on soils of different depths during the past few years in the FSMT indicate the run-off potential (and therefore erosion) decreases as one moves to shallower soils (Generalisation 5). Thus resource conservation may be a less critical issue on these soils.

A key difference with the deeper Vertisols (based on WBR and FSMT data) appears to be that on medium and shallow Vertisols BBF do not affect run-off or erosion (Generalisation 6) nor substantially increase yields or profits (Generalisation 7). Our intuitive explanation and hypothesis is that this difference is caused by the absence of serious surface sub-surface drainage problems on the medium and shallow Vertisols used for experimentation in WBR and FSMT and that some situations may exist where BBF would be profitable because they solve specific drainage problems".

For the present, appreciation seems to be that in medium and shallow Vertisols, broadbed and furrow system may not be necessary. At the same time, ICRISAT has recommended further research on this1 as follows:—

"We suggest that the difference in the effects of BBF on medium to shallow Vertisols, compared to medium-deep and deep Verti-sols, requires urgent scientific resolution, to be done by careful analysis of existing data and, if necessary, by specifically directed experiments, and that the already initiated research on alternative soil configurations be further strengthened. We also recommend an urgent search for more effective means to utilise the total available rainfall on these soils (e.g. through mulches and improved residue management)".

9.60 The cost of a broadbed and furrow system is not very high considering the crop advantages that appear to arise from the package of practices. Time taken for primary tillage is a very important aspect in drought prone areas where the rainfall pattern is extremely variant and the moisture accumulation in the soil for seed bed persists only for very short spells of time. It may, therefore, be worth considering by the extension organisations whether this additional expenditure should be undertaken or not. Anyhow there is definitely a case for adaptive research analysis in the medium and shallow Vertisoi areas.

9.61 In the foregoing paragraphs we have tried to sum up to the extent possible, the important research findings so far claimed to have been established by the scientists, whether in the All India Coordinated Dryland Research Project, agricultural universities or ICRISAT. The Committee would, however, like to point out that researchers and experiments by themselves are not enough to decide on detailed advice on either the crop patterns or improved agricultural practices for various zones of the country with various types of soils and rainfall pattern under the low-rainfall group. A lot of adaptive research will have to be done by the State Agricultural Departments in close association with the ICAR research stations with the technical support of agricultural university, to evolve the most profitable or most fool-proof

crop or mixed crop system and improved practices which can be recommended in micro regions in the States under different soil conditions in drought-prone areas. The Committee recommends that necessary adaptive research should be organised quickly in the blocks, particularly having black soils.

9.62 Broad-Bed and Furrows definitely have a benefit in the deep and medium Vertisols situation. Compared to the cost of land shaping on this basis, the benefits are substantial. The broad-bed and furrow system can be adopted in individual fields and need not necessarily be with adjustment of boundaries on a watershed basis. ICRISAT experimentation seems^ to prove that watershed based adaptation of field boundaries to graded cultivation may result in only modest increase of gross returns. But this may not be sufficient to motivate farmers to exchange land on a voluntary basis. They have also pointed out that whereas water control on a watershed basis is desirable for drainage and run-off and irrigation control, the existing field boundaries can be respected. From the practical angle, however, for selling this strategy to the farmers, more rational research on the field under varying conditions is absolutely essential and the earlier it is undertaken, it would be better.

9.63 Even at the cost of repetition, the Committee would like to draw pointed attention to the role of Agri-meteorology in planning a suitable cultivation programme. The Committee has dealt with this aspect in detail in Chapter 6.

9.64 It is already apparent; from what has been stated earlier that lot of research findings is now available. A continuous updating of the technology has, however, to be done in order to refine the field-level advice to the extension organisation. Dry farming research is much more complicated than research in irrigated agriculture. The number of disciplines that have to get together for proper dry farming research includes such disciplines as meteoro logy, evapotranspiration research, wind effect and extremely location specific breeding of varieties of crop. Uni-disciplinary research now generally prevalent in the Agricultural Universities, and parallel research being carried on in the various institutions—Central and State—in various aspects of sciences have to be brought together in a multi-disciplinary applied research programme in order to solve the speci fic problems of drought-prone areas. The Com mittee would reiterate its recommendation in the Chapter _ on "Strategy of Development" that multi-disciplinary regional research centres should be established by the agricultural univer sities in the country to deal specifically with a multi-disciplinary approach to regional agri cultural programmes including crop husbandry, animal husbandry, forestry, horticulture and fisheries. Such an approach is vital to support the drought-prone area alleviation programme.

9.65 Finally, and the most important one, is the need for transfer of technology from re-search States to the field. This involves a vigorous extension effort aided by a package of support to translate the new techniques on the farmers' fields. The Committee has dealt with this- aspect in detail in the Chapter entitled "Transfer of Technology"."

Table 1
Grain yields and monetary returns of maize-chickpea and maize-pigeonpea double system in a deep Vertisol Watershed(DWI) at ICRISAT 1976-80

	Rainfall mm		Seq .eatial cropping yields Kg/ha.				Intercropping yields kg/ha.				
Year	Kharif (June-Sept.)	Rabi Oct.-Feb.)	Maize	Chick-pea	Gross return Rs./ha	Net return Rs./ha	Maize	Pigeon-pea	Gross return per Rs./ha	Cost of Production Rs./ha	Net return Rs. / ha.
1976-77	678	30	3475	610	4480	—	3523	760	4285	2179	2706
1977-78	486	117	3478	1121	5652	—	2491	1092	4974	1375	35S9
1978-79	1008	121	2062	1323	4766		2529	1067	5126	1973	3153
1979-80	610	104	3055	515			2018	242			
1980-81	725	25	4167	846	7920	5822	3182	949	6533	1640	4993

Table 2
Land Management Treatments and Cropping data for Watersheds in Alftsols, ICRISAT, 1980-81

Watershed/ Land Treatment	Crop/Cropping System	Variety	Date of sowing	Date of emergence	Date of inter culti-vation	Date of weeding	Date of harvest
RW3A	Sole Sorghum	Local yellow	22-6-80		17-7-80		12-11-80
Flat/W/Field bunds.	Intercrop	Local yellow	22-6-80		29-7-80		
Traditional	Sorghum				18-7-80	24-8-80	12-11-80
Practices (3.15 ha)	Pigeonpea	Local white	22-6-80	19-6-80	29-7-80	24-8-80	29-12-80
RW3B	Sole Sorghum	HY-I	14-5-80	20-5-80	29-6-80	22-7-80	5-10-80
Flat/W/Contour bunds.	Intercrop P	BJ104	14-6-80	18-6-80	5-7-80		
	Millet+				5-7-80		
Improved practices(2.93 ha)	Pigeonpea	ICP-1	14-6-80	21-6-80	5-7-80	23-7-80	12-9-80
						23-7-80	12-12-80
RW3C	Sole Sorghum	HY-2	22-6-80	28-6-80	29-6-80	29-6-80	5-10-80
Graded broadbed	Intercrop	P. BJ 104	12-6-80	16-6-80	4-7-80	21-6-80	11-9-80
0.8	Millet +				4-7-80		
Improved practices (4-25 ha)	4= Pigeonpea	ICP-1	12-6-80	19-6-80	4-7-80	21-6-80	12-12-80
RW3 D	Sole Sorghum	HY-1	17-6-80	22-6-80	4-7-80	27-6-80	5-10-80
Graded broadbed	Intercrop P	BJ 104	17-6-80	20-6-80	16-7-80	25-6-80	10-9-80
0.8	Millet +						
W/Tank millet improved	Pigeonpea	ICP-1	17-6-80	24-6-80	16-7-80	25-6-80	12-12-80
Pratices (3.80 ha).							

TABLE 3
Crop yields, gross monetary value and rainfall productivities of alternative farming system on watersheds on deep Vertisols, ICRISAT 1980-81

Watershed	Treatment	Cropping system	Crop	Yield Q./ha.	Value Rs./ha	RP Rs./cm./ha.
DW I	BBF 0.6 Grade	Sequential Crop	Maize (DH 101)	41.07	4875.39	108.5
	Relay	Relay Crop	Chickpea (local)	8.46	3045.6	
					7920.99	
		Inter Crop.	Maize (SB 23) +	31.82	3691.12	90.86
			Pigeonpea (ICR-1)	9.49	2941.9	
					6633.02	
DW2	BBF 0.6 Grade crop-	Sequential crop.	Maize (DH 101)	41.78	4888.26	102.22
		Relay crop	Chickpea (local)	6.95	2502.0	
		Intercrop	Maize (SB 23)	28.8	7390.26	
					3340.8	
			+ Pigeonpea (ICP1)	11.89	3685.9	97.15
					7026.7	
DW 3B	Flat cultivated	Sequential crop	Maize (DH 101)	37.52	4389.84	106.44
		Relay crop.	Chickpea (local)	8.65	3114.0	
					7503.84	
		Intercrop	Maize (SB 23)	26.6	3085.6	
			+Pigeonpea (ICP-1)	7.43	23033	76.44
					5388.9	
BW 4C	Fiat cultivated (Monsoon fallow,	Single crop	Chickpea (local)	7.43	2674.8	38.88
	Half traditional (SE)	Single crop	Sorghum (M 35-1)	5.96	655.6	9.53
	Half improved (SEF)	Single crop	Chickpea (local)	5.73	2026.6	29.46
		Single crop	Sorghum (ICRI, SAT Variety)	10.67	1173.7	17.06
DW 7 A	BBF 0.6 Grade	Sequential crop	Maize (DH 101)	42.71	4997.07	111.18
		Relay crop	Chickpea	8.17	2941.2	
				14.41*	***5187.6***	
		Intercrop	Inter	26.92	10184.67	142.64

			Maize(SB 23)		***3122.72***	
			Pigeonpea(ICP-l)	7.65	2371.5	76.95
					5494.22	

*One irrigation at flowering stage.

RP= Rainfall Productivity is defin;d as the agricultural produclion (in kg/ha. or the monetary equivalent) in relation to the seasonal precipitation (in cm)., it is the product of ths emotively used rainfall and wateruse efficiency

Table 4
Gross yields, gross monetary values and rainfall productivities of alternative farming system on watersheds on Alfisols, ICRISAT 1980-81.

Watershed	Treatment	Cropping system	Crop	Yield	Value (ha)	RP Rs./cm/ha.
RW3A	Traditional (SEF) Flat W/ Field bund	Single crop	Sorghum (local yellow)	1.28	131.84	1.77
		Intei crop	Sorghum (local yellow)	1.56	160.68	14.2
			Pigeonpea	2.80	895.0	
					1055.68	
RW 33	Fiat cultivated W/contour bunds	Single crop Intercrop	Sorghum(HY-l) P. Millet (BJ104)	20.38 13.3	2241.8 1463.0	30.14
			+Pigeonp;a(ICP-l)	5.31	1465.1	41.8
RW 3C	BBF 0.8 (Grade) improved CSFF1	Single Crop	Sorghum	27.15	2986.5	39.58
		Intercrop	P. Millet (BJ 104) +	14.41	1585.1	
			Pigeonpea (ICP-1)	6.22	1928.2	46.59
					3513.3	
RW 3D	BBF 0.8 Grade W/iradi-	Single crop	Sorghum (HY-1)	28.97	3186.7	42.92
	tional improved (SEF)	Intercrop	P. Millet (BJ 104)*	55.62	1718.2	
			Pigeonpea(ICP-1)	6.68	2070.8	

Table 5
Gross return, Production costs and Net returns of alternative farming systems on watersheds on deep vertisols, ICRISAT, 1980-81.

Water-shed	Treatment	Cropping system	Crop	Gross return Rs./ha.	Production cost Rs./ha.	Net Return Rs./ha.
BW 1	BBF 0.6 Grade	Sequential crop	Maize (DH 101)	4875.39		
		Relay crop	Chickpea (local)	3025.6		
				7920.99	2098.69	5822.3
		Intercrop	Maize (SB 23)	3691.11	1639.56	4993.46
			+Pigeonpea(ICP-1)	2941.9		
				6633.02		
DW2	BBF 0.6 Grade W/farmers bunds	Sequential Crop	Maize (DH 101)	4388.26		
		Relay crop	Chickpea	2502.0		
				3340.8	2123.08	5267.10
		Intercrop	Maize (SB 23)	3340.8		
			+Pigeonpea (ICP-1)	3685.9	1718.64	5308.06
				7026.7		
DW 3B	Flat cultivated on 0.6 Grade	Sequential Crop Relay crop	Maize (DH 101) Chickpea (local)	4389.84 3114.0 7503.84	2043.79	5460.05
		Intercrop	Maize (SB 23) + Pigeonpea (ICP-1)	3085.6 2303.3 5388.9	1509.00	3879.9
BW 4C	Flat cultivated (Monsoon fallow)	Single crop	Chickpea (local)	2674.8	704.71	1970.09
	Half Traditional (SE)	Single crop	Sorghum (M35-1)	655.6	342.19	313.42
	Half improved (SEF)	Single crop	Chickpea (local)	2026.6	704.71	1321.98
		Single crop	Sorghum (ICR1-SAT) variety	1173.7	342.18	831.52
BW7A	BBF 0.6 Grade	Sequential crop	Maize (DH 101)	4997.07		
		Relay crop	Chickpea (local)	2941*2	2120.28	5817.99
				7938.27		
				5178.6*		
				10184.67		
		Intercrop	Maize (SB 23)	3122.72		
			+Pigeonpea ticp-n	2371.5	1591.39	3902.83
				5394.22		

*One irrigation at flowering stage.

Table 6
Gross return, production costs and Net returns of alternative farming systems on

watershed on Alfisols ICRISAT 1980-81.						
Water-sheds	Treatment	Cropping system	Crop	Gross Returns Rs./ha.	Production cost Rs./ha.	Returns Rs./ha. 250-06
RW 3A	Traditional (SEF) Flat W/Field bunds	Single crop	Sorghum (local yellow)	131.84	381.90	
		Inter crop	Sorghum (local yellow)	160.68		
			+Pigeonpea	896.0		
				1056.68	750.76	305.22
RW 3B	Flat cultivated W/contour bunds Improved (SEF)	Single crop	Sorghum (HY-1)	2241.8	1194.60	1047.2
			P. MilIet (BJ 104)	1463.0		
			Pigeonpea(ICP-l)	1646.1		
				3109.1	1393.22	1715.88
RW 3C	BBF 0.8 Grade Improved (SEF)	Single Crop	Sorghum (HY-1)	2986.5	1399.61	
		Inter crop	P. Millet (BJ-104)	1585.1		
			P. Pea (ICP-1)	1928.2		
				3513.3	1809.3	1703.87
RW 3D	BBF 0.8 Grade W/Traditional Improved (SEF)	Single crop	Sorghum (HY-1)	3186.7		
		Inter crop	P. Millet (BJ-104)	1718.2		
			P. Pea (ICP-1)	2070.8		
				3789.0		

Table 7
Unit prices and costs used in the cost and return analysis

1. Prices of watershed produce supplied by Mr. R. Sarin of the Economics Programme of ICRISAT as evaluated by the Osmangunj Market.	
Sorghum :	Rs./Q
Sole crop	110
Intercrop	113
Local .	103
Pearl Millet .	110
Maize:	
Sole crop	117
Intel crop	116
Pigeonpea:	
ICP-i .	310
Local .	320
Chickpea :	
Local .	360

2. Unit cost for doing various field operations :		
Labour .	Rate/day	Rate/Hr.
Female .	Rs.4.50/8hrs.	Rs.0.563/hr.
Male	Rs. 5.50/8 hours.	Rs.0. 688/hr.
Bullock pair hire	Rs. 10.00/8 hrs.	Rs.l.25/hr.
Tropiculture hire	Rs.21.76/8hrs.	Rs.2.72/hr.

3. Material Input cost.		
Seeds	Pigeonpea	Rs.2-.60/kg at lOkg./ha.
	Chickpea	Rs.2.10/kg. at 70kg/ha.
	Maize	Rs. 1.02/kg at 15kg/ha.
	Sorghum	Rs. 1.5/kg. at lOkg/ha.
	Pearl Millet	Rs.8.5/kg at 4kg,'ha.
Fertilizer	DAP Rs. 220/Q. As Rs. 89/Q. Urea Rs.l45/FYM Rs.l50/ha. Insectiside Rs. 62.55/kg. or Rs. 142.55/ha. for pigeonpea or Rs.285.10/ha or Chickpea Herbicide Rs.250/ha	

10. LIVESTOCK DEVELOPMENT

10.1 Drought-prone areas support a fairly large population of livestock. Most of the areas, particularly the arid, are endowed with reputed breeds of cattle and sheep, due to the favourable conditions existing in these areas for their breeding. Area-wise, livestock and poultry population in drought-prone areas are given in the table below:—

Area-wise Livestock and Poultry population in DPAP areas - 1972

Region	Cattle	Buffaloes	Sheep	Goats	Horses and Ponies	Mules Donkeys	Camels	Pigs.	Total livestock	Total poultry
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Arid Region	1636.1	453.1	2730.8	3097.2	7.2	58.9	389.4	4.3	8377.0	65.6
Ssmi-Arid Region	9068.7	3553.1	7563.8	6047.6	49.0	114.5	108.0	184.2	26693.1*	6811.4
Sub-Humid Region	0098.9	2998.4	2678.9	4318.1	47.3	77.2	23.6	275.1	20517.5	5900.2
Humid Region	10541.1	2004.3	1202.0	3942.7	39.8	15.0	1.4	434.S	18181.1	6790.4
GRAND TOTAL	31344.8	9007.9	14175.5	17405.6	143.3	265.6	522.4	898.4	73768.7*	19567.6

* Includes 5188 Yaks of population in Doda (J&K)

10.2 Livestocks breeds found in the DPAP districts are given in Annexure I.

10.3 Hot arid areas support sizeably large livestock population as will be seen Irom the table above. Despite the presence of good milch breeds in the area (Annexure I), the pro duction of milk per animal is low due to the scarcity of food and fodder resource, including the poor grazing lands. Arid areas are consi dered to be the best suited for sheep husbandry, which is already an important source of liveli hood for a large number of rural people. All breeds in the areas are fairly good in body weight and in wool yield. However, the quality of wool varies from fine to medium and medium to coarse grade in different breeds. Sheep development is handicapped due to scarce grazing resources, drinking water and other required infrastructure facilities. In cold arid areas, these are also known to be sheep, goat and yak.

10.4 In semi-arid areas the total livestock, as would be seen from the earlier table, is pretty large. Important breeds of cattle are listed in Annexure I. They are poor milkers but good drought breeds. The buffalo breeds, Mehsana and Surathi, are fairly good milkers. However, these cattle and buffalo breeds require further improvement of their potential for production. The population of sheep and goats1 is also substantial.

10.5 Sub-humid arid areas also have sufficient livestock resources, but it is their proper use and management that would determine the success of the programme for their develop ment. Water is not so much limiting factor as it is in the arid and semi-arid regions. Cattle are mostly drought breeds, milk yield per day per animal is low, due to deterioration of the breed generally, poor fodder resources and animal health cover facilities. The same is true in the case of sheep and goats in these areas.

10.6 In humid arid areas, the resource endowment rs the best. Of all the areas in DPAP it is only because of the erratic distribution of rainlau and the terrain that they have become susceptible to droughts. The earlier table has already given the figures of the live stock population. The productivity of cattle is low and efforts are necessary to develop them through improved breeding and management practices.

10.7 Though livestock development pro grammes were taken up in the country during the Five Year Plans and significant headway has.been made in expanding facilities of health coverage, breeding and fodder production, etc., the drought-prone areas received very little share of the resources earmarked for these pur poses (Cattle in Arid Regions by S. N. Bakshi Kunjkshetra December 1, 1979). Therefore, the infrastructure available for livestock develop ment in these areas is generally not adequate. The increase in rural population and decreasing soil productivity have conspired to increase the area under cultivation, to which the Committee has already invited attention, and, in the process, reduced the pasture areas. The pasture areas are low or negligible in some of the drought-prone districts and many have less than 5% area under pastures. In addition, livestock are characterised by defects of delayed maturity, prolonged inter-calving period (hence, long dry-periods) and seasonality in breeding. All these factors and the periodic droughts have brought about a constant decline in the productivity of livestock.

10.8 Despite all the limitations described above, drought-prone areas have in-built ad vantages for livestock development in so far as the livestock is less vulnerable to the dry spells of rainfall and agro-climatic conditions in these areas. The Task Force on Rural Develop ment (1973) had, therefore, rightly stressed that the strategy for development of these areas must be built mainly around animal husbandry. Animal husbandry in conjunction with dairy ing was considered to offer a more suitable base than crop farming for procuring a sustained income to the rural households in these areas.

10.9 The National Commission on Agricul ture (1976) had also observed that livestock and poultry production provided a much more stable economic base than crop production in such areas. It recommended that where irriga tion available and fodder production possible, a planned cattle development programme should be undertaken for milk and dairying, if such area was within a milk shed. These areas could then be linked to the milk supply scheme. Milk collection, chilling centres and dairy product units should be established as part of the infrastructure.

10.10 The Commission had identified a num ber of districts in the drought-prone areas where programmes should be taken up for milk, sheep, poultry and pig production by small and margi nal farmers and agricultural labourers. It had identified 21 districts for milk production, 53 for sheep production, 33 for poultry production and 9 for pig production. It had recommended that "in all these areas appropriate measures are required to be taken for the improvement of breed and yield, since the existing stock is mostly non-descript and has poor yield. The critical supply situation in respect of grass and fodder in DPAP areas has affected the producti vity of cattle and sheep. Adequate pasture lands is a pre-requisite to

animal husbandry. We have already referred to the need for develop ing pastures in dry lands as a soil and water conservation measure. As the land use pattern is readjusted in these areas in response to the need for ecological balance, pastures can support the livestock of improved breed".

10.11 As per the statistics 1978-79, published by th» Ministry of Rural Reconstruction, the achievements under the Animal Husbandry Programme in the DPAP for the period 1-4-74 to 31-3-79 have been—distribution of milch animals 62,193, calves born through artificial insemination 84,218, milk societies established 3,325, cross-breed rams distributed 9,333, progeny born with fanners 1,46,900, sheep cooperatives established 1,008, poultry units 25,647 and piggery units 2,747. In terms of financial outlays and expenditure, animal husbandry programmes were second only to minor irrigation sector

Sheep

10.12 Sheep as a specie is most suited for arid areas because of its close grazing habit and adaptability to the arid conditions. It is able to utilise the sparse and low-set vegetation available in the arid areas. It has also the ability to survive prolonged period of drought and semi-starvation and is less prone to extreme weather conditions. Because of its hardiness and adaptability to dry conditions, the north western region of the country has a large con centration of sheep. The State of Rajasthan alone has 8.5 million sheep which constitutes 21 per cent of the total sheep population in the country.

10.13 Expanding sheep _ population has however not only resulted in depletion of natural vegetation in their home tracts but also on their migratory routes. Depletion of vege tation cover and disturbance of the soil during migration exposes it for wind erosion. Also, when grass cover is scanty, sheep scrap the soil by means of their hard hooves and eat away the grass roots, which further loosens the soil and helps erosion. Sheep population has increased.

10.14 There are two types of migratory flocks found in arid areas (i) the truly nomadic flocks which have no fixed centres but follow seasonal migratory routes to grazing areas largely governed by the availability of foraging and drinking water resources; and (ii) flocks maintained for most part of the year on a system of free range grazing including stubble grazing on the crop land, but following definite i migratory routes to the seasonal pastures and , returning to their permanent abodes during certain season.

10.15 In Rajasthan, more than 0.5 million 1 sheep are in permanent migration and these 1 flocks are not brought to their home tract at 1 any time of the year. About one million sheep migrate for 6-9 months. These flocks start migrating from October and return to their home tract by July immediately before the onset of Monsoon. About 0.2 million sheep 1 migrate for only 3-4 months. They start 1 migrating during March and graze on crop I stubbles in Rajasthan Canal areas from April 1 to June. Quite often during migration, tliJ sheep graze in stubbles in harvested fields dfl in forest areas on payment of fees.

1.0.16 Because of their close and selective grazing nature and their ability to utilise many weeds and bushes and to travel long distances in search of forage and water, sheep have often been labelled as the creators of the desertic conditions. In reality, it is not jthe sheep but the man who owns the sheep who is to be blamed for mis-management of the grazing land which has resulted in the desertic conditions. Controlled and judicious grazing practices on the desert land could prevent soil from erosion and the droppings collected on the infertile land over the years could eventually convert it to more fertile land.

10.17 Sheep rearing is extremely important in the rural economy of a number of States. But very little information on the economics of sheep rearing in different agroclimatic regions is available at present. The Central Sheep and Wool Research Institute (CSWRI) conducted a limited survey in 1972 on the economics of sheep rearing in Chokla and Nafi tracts of Rajasthan. These studies indicated an average annual income of Rs. 3,881/- for Chokla and Rs. 5,642/- for Nali, with a flock size of 100 breedable owes, attendant rams and their fol lowers. The major difference in the economic returns of the two breeds was due to differences in wool yield and the number of lambs born and their survival rate. It was observed at the CSWRI Farm that the Rambcuillet x Chokla Nali breeds provided 25 per cent more econo mic returns from the sale of wool as compared with the Chokla breed. Improvement in pro duction and quality of wool and body weight due to cross-breeding, provision of a better health cover and adequate supply of feed and fodder is expected to provide higher returns. However, no reliable data are available on the economics of supplemental feeding of sheep during growing stages, breeding season, later part of gestation, lactation etc. In our opinion, it is necessary for the purposes of planning sheep development programmes to have detailed information on these aspects. We, therefore, recommend that the Indian Council of Agricul tural Research (ICAR) and Agricultural Uni versities should initiate without delay studies in this direction.

10.18 Reliable estimates on production of wool in the country are lacking. Those that have been published by various agencies are mainly based on the total sheep population and ad-hoc estimates of average wool yield. The table below gives the sheep population and esti mated wool products.

Sheep Population and estimated wool production in India

Year	Sheep population based on livestock census (Millions)	Greasy wool production (million kg.)	
.1951	38.96	27.50*	
1956	39.25	31.00*	(27.54)**
1961	40.22	32.70*	(28.74)**
1966	42.01	35.50*	(32.72)**
1972	39.99	30.10	(34.45)**
1978	N.A.	33.00	33.00
1979	N.A.	34.00	34.00
1980-85	N.A.	39.00	Projected during Sixth Plan

Sources: * WooIs and woollens of India— Handbook of Statistics and Government Notifications—Published by the Indian/Woollen Mills Federation Churchgate Chambers, Bombay-20 (1971).

** Figures in parentheses are those reported by the Directorate of Marketing and Inspection Ministry of Agriculture and Irrigation.

10.19 The importance of sheep rearing in the drought-prone are cannot be overemphasised. As mentioned earlier crop husbandry in these areas with low total rainfall, is a gamble. All the farming communities, particularly small and marginal farmers, can better depend on sheep rearing as the main source of livelihood. The arid zones of the Western and Southern parts of the country are the home tracts of some of the well known wool and mutton breeds of sheep. The percentage of lambing in these breeds is about 50% and the lamb mortality may be as high as 25%, which is mainly due to inadequate and insufficiently nutritive feed, the

result largely of over-grazed and degraded pastures. There was a significant decline in the sheep population of Rajasthan during the period 1966-72 when there were severe droughts, which is indicative of the precarious balance between the sheep population and the supply of feed. Cross breeding of superior local flocks with exotic rams for better yield of mutton and wool will result in the production of bigger animals with higher body weight having proportionately higher nutritional requirements. Unless, therefore, a strong feeder base is created, the potentiality of the cross breed animals cannot be fully harvested. DPAP districts and the IDA assisted drought-prone districts have been accepted as the foundation of the sheep development structure. Attempts are being made to tackle the problem through the formation of cooperatives of sheep farmers who not only produce and rear cross bred sheep but also undertake growing of qualitatively and quantitatively better fodder.

10.20 Service Centres have been established to implement the district project and cooperatives of sheep farmers. These Centres are responsible for publicising the project activities, assist groups of interested farmers in the formation of sheep cooperative societies and help them to manage societies by providing inputs and the technical services. Centres are to be staffed and equipped to provide guidance on improvement and management of grasslands, stock husbandry, veterinary services and marketing of wool and mutton for about 50 societies. They are also expected to operate ram multiplication farms and supply cross-bred and improved local rams to the sheep cooperative societies.

10.21 Sheep cooperatives have since been established in 9 States viz., Haryana, Uttar Pra desh, Rajasthan, Andhra Pradesh, Tamil Nadu, Gujarat, Karnataka, Maharashtra and West Bengal and their number at present is 1122. No sheep cooperatives have been formed in Bihar, Jammu and Kashmir, Madhya Pradesh and Orissa since the inception of the pro gramme. A State-wise statement showing cumulative achivements of sheep cooperative societies formed in the DPAP districts from the year April 1974—March 1980 is at Annexure II. Sheep cooperative societies established in the 6 IDA assisted DPAP districts of Anantapur, Jodhpur, Nagaur, Sholapur, Ahmednagar, Bija- pur during the year 1975-79 may be seen at Annexure III. The figures in respect of this statement are included in Annexure II also. The impact of sheep production parameters of sheep societies as compared to the village flocks of the district of Jodhpur and Nagaur in Rajasthan and Deccan Plateau district of Anantapur, Sholapur, Ahmednagar and Bijapur for the year 1978-79 may be seen in Anne xure IV and district-wise figures appear at Annexure V. It will be seen from the table at Annexure IV that the average body weight of iambs, weaners, hoggets, rams, breeding ewes, lambing percentage and wool production (Kgm/sheep/year) are higher in sheep societies as compared to the village flocks in the districts of Rajasthan and Deccan Plateau.

10.22 An evaluation of the DPAP in Kurnool district conducted by the National Institute of Rural Development in 1978 stated that:—

"Sheep units of Nellore and Bellary Breeds, each unit comprising of 20 ewes and one rain were distributed in an ad-hoc manner in so far as the sheep units were distributed in areas without grazing facilities. The beneficiaries reported that they faced problems regarding housing of sheep in the rainy season and health care of sheep due to which number of sheep died. Some of them, however, were of the opinion that the sheep were of better quality in terms of multiplication rate and wool production. Sheep cooperatives were also established on 100 acre pasture plots developed by the Forest Department. However, there was considerable scope for improving the programme in terms of adop'ion of technology available and proper implementation of the total programme within the watershed frame".

10.23 An analysis of the details1 in Anne- xures II, III, IV and V lead to the following conclusions :—

(a) In the States where IDA has taken up sheep development programmes, the bulk of the cooperatives have been organised in the IDA districts whilst the large number of other drought-prone districts in the State has not attained any reasonable coverage.

(b) As between the Rajasthan IDA districts and the Deccan IDA districts, the im provement under the various criteria like average weight of lambs weaners average weight, hoggets average weight, rams weight, breeding ewes weight, lambing weaning and wool yield, while all these criteria show uniform increase when compared with village flocks, as between Rajasthan and Deccan, Deccan has done uniformly better in the IDA districts. A simple explanation for this is that the Rajasthan districts were deisert districts whereas Deccan districts are semi-arid. Deccan has better soil mositure conditions. A significant fact here is that there is significant improve ment over village flocks in the IDA districts.

(c) No analysis has been made of the effec tiveness of the sheep cooperative schemes in the districts other than IDA even though cooperatives have been formed on a large scale in Haryana, Uttar Pradesh, Rajasthan and Tamil Nadu.

10.24 In the IDA programme, the sheep development programme has been laid out in extreme detail. There is continuous monitoring of the performance and. a constant pressure to improve the performance. As a result, we see significant differences in the improvement of the flocks under the IDA cooperatives'. On the other hand, not even a monitoring appears to have been done systematically in the sheep pro gramme in the non-IDA districts, even though sheep breeding programme is an important part of drought-prone area development. The limited survey in the non-IDA district of Kur nool carried out by NIRD shows conclusively how unorganised is the sheep cooperative pro gramme in a non-IDA district. The comparison is with Anantapur in Andhra Pradesh which is an IDA district. Having accepted a sheep rearing programme as an important part of drought-prone area development, the Committee would recommend that detailed planning of the programme as is being done in the IDA dis tricts on the basis of further experience so far gathered and a comprehensive attack on the programme in the district through a duly con stituted extension unit with the relevant technology should be immediately brought into effect in ail the drought-prone area districts considered to be good for sheep breeding. There must be continuous monitoring and im-provement of the scheme so that full benefit from the programme accrues to the sheep rearers.

10.25 Ano ther programme taken up under the DPAP in Rajasthan is the development of 100 hectare plots of degraded communal grazing land at present administered by the local panchayats. This scheme has started in 1975. 100 hectare plots were selected in different villages and they were fenced, contour furrowed, seeded with improved grasses and provided with stock water supply. The areas to be developed should not exceed 25% of the total area of such land available to the village community so that the stock which could not be accommodated on the improved land could continue to graze along traditional lines1 and the villagers could compare the productivity of their stock when subjected to different level of feeding and management. It is assumed that at full development from the third year onward one hectare of improved pasture would sustain four sheep units or their equivalent. The details of achievement so far and actual economics of these plots etc., are given in Anne xure VI.

10.26 The sheep pasture programme has been taken up only in Rajasthan and that too in the districts of Jodhpur, Nagaur, Jalore and Churu. The statistics of the district-wise position in Annexure VI shows that in Jodhpur and Nagaur the present strength for 100 hectare project has reached between 120 and 140 sheep per unit whereas in Jalore and Churu per unit flock is between 80 and 100. Jodhpur and Nagaur are IDA districts whereas Jalore and Churu are non-ID A districts. Further whereas under the policy of handing over the societies to the farmers cooperatives, 10 and 9 units have already been handed over in Jodhpur and Nagaur, none have been handed over in the other two districts. Whilst performance in the IDA districts can be considered as better than in non-IDA districts, it has to be noted that the recommended level of flock per 100 hectares is 400. This has not been reached so far anywhere. This means incidentally that the economics of the programme has not yet been achieved. The capital investment for 100 hectares is sufficient with proper management of the pastures to support 400 sheep units comprising ewes and lambs. The Committee recommends that the organisation for the technical management of these units and the technical support to the sheep rearer groups within the units should be improved to bring about the level of 400 sheep per unit within the next two years.

10.27 A bank scheme for sheen rearing under the 100 hectare plot scheme has been worked out by the ARDC and the details are in Annexure VII. ARDC had estimated an ultimate flock strength of 580 on the basis of which only they have analysed the profitability of the scheme. Thus for the scheme to be economically viable, the management structure win have to be properly organised and the continuous monitoring and advice in performance improved.

10.28 The present scheme of 100 hectare is to allow each small and marginal farmer a flock of 20 ewes and one ram which will be included within the plot for full annual management. The bigger farmers can put one such unit out of their flocks inside the unit. As at present contemplated, Government provides the watchman and sheep helper on a regular wage basis to look after the sheep within the area. Though it was intended that over time the unit will be handed over to the cooperative of sheep rearers who will find their own watchman etc., this has not yet happened because sufficient number of sheep for profitability has not yet been enrolled and not all sheep of the rearers came within the fold. Unless we find suitable answer for this, the shceme will not succeed. ARDC has recommended that one economic unit to be given to small and marginal farmers would be 30 ewes and one ram. The Committee recommends that this level should now be introduced uniformly. It should also be laid down that the small and margina- farmer must find his own shepherd to go with the flock inside the unit and not expect a government paid functionary for this. The larger farmers who put in one such unit within the fold should also find their own shepherd. This must be an invariable practice. If this is done, the grazing limits to be allotted to each of the flocks will have to be worked out by a controlling authority and its observations enforced if necessary by the superior authority. The Committee will recommend this approach now for the proper implementation of the programme.

10.29 The first essential in this programme of 100 hectares each is to ensure that there is sufficient fodder to support initially 400 sheep extending later to 580 sheep.. This cannot 'he .done without - effective pasture development and organised grazing. The super vising organisation should ensure through their technical support and advice and also actual supervision in the field for the improve ment of these pastures to take the load of sheep. Whereas theoretically it is possible, so far practically this has not been achieved.

10.30 The economics of the 100 hectare plot contains a good deal of capital subsidy in the scheme to the participants. ARDC, on the other hand, has worked out the level of subsidy that

will accrue to each small and marginal farmer on the basis of the levels of subsidy provided for sheep rearing. The Com mittee would point out that the subsidies for sheep rearing should be based on these general principles only. If that is done and the capital subsidy for the scheme is limited to this amount, the profitability worked out by the ARDC can accrue only if capital and recurring costs are reduced substantially. For this, two lines of action have to be taken:—

(i) The capital cost in fencing and drink ing water facilities etc., will have to be minimised. CAZRI has worked out various types of fencing for various soil and rainfall conditions in Rajasthan using natural vegetation and the ditch system. A permanent fencing with iron posts and wiring is a last resort. In the location specific planning the cheapest of these recommendations of CAZRI for the area will have to be followed.

(ii) Within the area the management of the flock should be left to shepherds themselves each looking after his own flock. The overall management will be supervised and common facilities and sale of common products will be controlled by the supervising authority.

10.31 The 100 hectare plots are a support to village based blocks in desert and drought prone areas. In selecting such area, if blocks within the Gochar of village where some irrigation facility can be provided or water from the Gochar can be concentrated through a suitable drainage system, it would increase the productivity of the area.

10.32 In the drought prone areas, there may not be many areas where a 100 hectare plot can be earmarked for sheep rearing within the village limits. In such places such plots can be identified within the degraded forest area near about if suitably located. But with all this in drought prone area this programme may not be replicable to any large extent. The programme will work best in the desert areas of the country.

10.33 Village based flocks must have addi tional pastures. This is very relevant in drought prone areas. The Committee has already point ed out how l/3rd to half of the land holdings, whether small, medium or big, are left fallow every year in the poor rainfall areas because of inability to cultivate them in time. An extension programme should be launched to put some of these general fallow lands under a permanent pasture cover with suitable cultivation practices to maximisefodder production within the hold ing. This way very substantial improvement in village flocks of the land-owners can be obtained. Even the n, sheep rearing in the villages is also followed by the agricultural labourers. They depend for the fodder on common lands. In the IDA districts of Ananta- pur, Sholapur, Ahmednagar and Bijapur, the cooperatives including the agricultural labour have been provided the wherewithal to improve the government pastures and in some cases lands allotted in forest areas in degraded forests. This approach has been found satisfactory. The Committee would recommend a combina tion of both these practices for village-based sheep development.

10.34 In the desert areas we have to handle not only the village based flocks but also the flocks which are nomadic perennially and those nomadic for some months in the year. For sheep development of nomadic flocks, there are two technical difficulties. Improvement of breed through introduction of exotic germ plasm can take place only if flocks can be gathered in one location during the breeding season and the breeding season is shortened. Secondly, maintenance of pre-natal Health of ewes and post-natal health of the ewes and the lambs can be most effective only if the ewes and the pro geny can be kept together at one location. The

statistics of lamb mortality in the IDA scheme as compared to village flocks in Annexure III to IV shows conclusively that a properly managed health cover at one location can lead to very substantial improvement of flocks. Generally it has been noticed that there are two breeding seasons for sheep—one in July-August and another in March-April. But sheep in flocks breed throughout the year though those breed ing outside the main season may not be very large. The first essential in flock management will have to be the gradual cull out of sheep breeding outside the normal July-August or March-April season. If this is done, the flocks will have to be brought to a location for breed ing during the months of July-August and March-April. Again the ewes which are impregnated in these seasons will have to be maintained under pre-natal care at the centre till the lambs are born three months later and for post-natal attention at least for two more months. Over the two breeding months, this will mean gathering at a location for 8 months in a year even for nomadic flocks.

10.35 In the Fourth Plan, a scheme for having a 2000 hectare pasture development v/ith irrigation was propounded and attempted in Rajasthan. Unfortunately, the scheme was not pursued. Nomadism is the problem mainly of the desert areas. If a large 2000 hectare plot is developed with groundwater where available or in a 'khadin' in a suitable location, the pas ture under good management can easily support throughout the year a flock of 4 sheep a hectare, or 8000 for the pasture. If the management levels reach in experimentation of 5.8 per hectare can be brought about, this can take 10,600 sheep. As the sheep will be at the location only for 8 months in the year, the fodder for four months can be converted into hay for utilising during the 8 months judicious ly thereby allowing a further population to be maintained during the 8 months. In all it is safe to work out a support for 12,000 sheep in one unit of 2000 hectares for the breeding and lambing season. If such centres are located in Rajasthan at convenient centres based uoon the nomadic block distribution, there is no doubt at all that the nomads will avail of the facility. Considering that nomadic flocks throughout the year are of the order of 5 lakhs sheep and part nomadism of 1 million, about 100 centres located suitably in the deserts of Rajasthan should look after the problem. In this planning, one can take advantage of the Rajasthan canal system which passes through the desert districts of Churu, Bikaner, Nagaur, Banner and Jaisalmer. Fully irrigated pasture units can be developed with small lifts at suitable locations in these districts to look after the nomadic flocks.

10.36 Another programme taken up under the DPAP is the genetic improvement of [sheep. This is being done through the establishment of either sheep cooperative societies or sheep and wool extension centres. The requirement of rams is 3 per cent of the total breedable ewes in the cooperative societies or the sheep and wool extension centres. Normally, one sheep and wool Extension Centre can handle about 2500 to 3000 breedable ewes and for this the requirement of rams will be about 75-90 per centre. The National Commission on Agriculture had recommended the establishment of sheep units with 20 ewes and one ram per small and marginal farmer in 55 districts. As against this the programme has been taken up by the States in 28 drought prone districts. In each district, 3000 families are to be provided with sheep units. There is a sizeable demand of rams for the programme and to meet this demand ram multiplication farms are required to be established under the DPAP.

10.37 The sheep cross-breeding programme in the DPAP areas can be divided into three regions:—

(i) States of Rajasthan, Gujarat and Jammu & Kashmir have carpet and fine wool sheep breeds.

(ii) States of Karnataka, Maharashtra and Andhra Pradesh have been recognised for rough wool and mutton breeds.

(iii) States of Uttar Pradesh, Madhya Pradesh, Orissa and Bihar have non-descript sheep with a low wool and mutton Productivity.

Sheep Breeding in Arid and Semi-Arid Areas for wool production

10.38 A major portion of good carpet wool comes from breeds like Magra, Jaisalmari, Marwari, Pugal and Nali in Rajasthan, Nali in Haryana and Patanwadi in Gujarat. Of these, Nali and Patanwadi are expected to be including in the fine wool production programme. The available literature indicates that average fibre diameters for Magra, Nali and Pugal is 34.46 and 34.95 and 34.96 microns and medullation percentage is 49.2, 32.24 and 62.36 and staple length of 6.18, 8.98 and 6.19 cm. respectively for six monthly clip.

10.39 It is necessary to reduce medullation percentage especially Kempy Fibres and average fibre diameter to improve the quality of carpet wool. The approach to sheep breeding for improvement of wool quality will involve the following:—

(i) Selection based on medullation percentage and six monthly greasy fleece weight former being given negative weight, will not only improve the wool yield but also wool quality. The present development programme for improving wool quality envisage selective breeding in breeds like Marwari, Jaisalmari, Magra and Pugal in Rajasthan and Marwari sheep in Gujarat. This approach could be followed in other arid districts also.

(ii) Cross breeding of indigenous coarse carpet wool breeds in Southern Rajasthan viz., Malpura and Sonadi, and South Indian woolbreeds, viz., Deccani and Bellary and breeds in U.P., plains, Bihar and West Bengal and with dual purpose exotic breeds such as Corriedale or fine breeds e.g., Merinds and also upgrading Shahbad, Muzzafarnagri and Chota Nag-puri with North Indian Carpet Wool breeds like Magra, Nali and Patanwadi to improve wool quality.

(iii) The exotic inheritance in sheep should be established at 50 per cent only.

10.40 A research project designed to evolve new wool breeds suitable for arid and semi-arid regions involved the crossing of Rambouil-let with three diverse indigenous types (medium fine carpet/medium apparel type chokla/me-dium carpet) wool Jaisamlari and coarse hairy carpet wool Malpura of sheep with three levels of Ramboullet inheritance viz., 50, 62.5 and 75 per cent and their interbreds. The results indicated that there was little improvement in body weight and greasy wool production beyond 50 per cent exotic fine wool inheritance. There is no serious decline in performance of 'the progeny produced from inter-breeding of crossbreds. The new strains of sheep viz., Avivastra and Avikalina evolved at CSWRI, Avilcanagar, are recommended for arid and semi-arid areas. The Avivastra was evolved from Rambouillet Chokla halfbred base through inter-breeding and selection and is being further improved through selection. It produces on an average 2.5 Kg. of greasy fleece of 20 micron average fibre diameters and gives 21 per cent higher income trough sa'e of wool alone as compared with Chokla. The new strain is also superior in young and adult survival.

10.41 Spinnability trials carried out on various grades of wool have indicated that Avivastra wool has performed equally well when compared with Corriedale's wool. There has been a significant improvement in Avivastra wool over Chokla in terms of yarn spinnability. These

wools can be spun in the range of 40 Nm to 45 Nm conveniently. This wool can conveniently be woven to 56 quality serve which are in great demand for use of defence forces. The mill scale processing trials on such wool conducted at Messrs Shri Dig Vijay Woollen Mills Ltd., Jamnagar, further confirmed that these wools possess the desired potentiality for the production of 56 quality apparel goods. It can be further improved with the increase in staple length. This wool performs exceedingly well in knitted fabrics.

10.42 The functional properties of hand knitted carpets made out of Avikalin have been tested. The Avikalin wool carpets demonstrate an excellent appearance retention potentialities at all stages of their use combined with mode rate compression value. The Avikalin wool in itself has been considered as an ideal carpet wool.

10.43 On the basis of results obtained, breeding strategy for evolving new fine wool and superior carpet wool strains suitable foi arid and semi-arid regions has been developed. For evolving superior carpet wool strains pro ducing around 2 Kgs. of greasy fleece annually of 48 quality the inter-breading of half breds of coarse and hairy carpet wool breeds with exotic fine wool breeds coupled with selection for greasy fleece weight may be carried out. For evolving good apparel wool strain(s) producing about 2.5 kg. of 48-64 greasy wool annually inter-breeding of half breds of exotic fine wool breeds with fine carpet/medium ap parel wool breeds may be carried out coupled with selection for greasy fleece weight and ave rage fibre diameter. The black faced white fleece breeds should not be crossed with Merino or Merino types as such crosses develop black fleece patches and such black wool cannot be easily skirted oat leading to reduced value of wool. Such carpet wool breeds be improved through selection for greasy fleece weight and fleece quality as measured by average fibre diameter and medullation percentage.

10.44 Very substantial work has been done by Avikanagar in improving wool quality both for garments and caroets through judicious cross-breeding. Whilst this work has to do with further refinement and with introduction of other exotic types of rams, there is at present no machinery developed fo avail of this scientific knowledge in improving the sheep flocks m the desert areas. In the Fourth Plan the Development of Agriculture sanctioned a central scheme for large sheep farm of the order of 5000-7000 hectares to develop pure bred rams and cross-bred rams for improving the sheep flocks in the desert and drought prone areas. The Member (Agriculture) Planning Commission visited the large sheep breeding farm as Fatehpur (Sikar) on 31st March, 1978. This farm has 9,300 acres of land out of which 8,700 acres were available for fodder development. The following observations were made by the Member :—

> "We must be a little more clear about the cross-breeding programme in Rajasthan. There are several breeds of established varieties in various parts of the State. When we are crossing these well known breeds, what are we expecting at the end of the exercise? Evidently, there has been no check up on the objectives of cross-breeding. Mal-pura should have been our basic adviser in large scale field programme we are contemplating. The end result of cross breeding can be the end use we want to put the wool to and the body weight of the crossbred in relation to marketable meat that can be produced. Incidentally as the present demand is very substantial for mutton, what is important will be our capacity to fatten the crossbred within a short period for the mutton market. I do not think this last aspect has so far been looked into."
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> "Having decided on the introduction of crossbred rams in the nomadic flocks, obviously the crossbred will have to be from the local breed. This means that we have

to develop various.breed crosses for supply of the crossbred ram. This will have to be organised at the Central Farm. This must have some relation to the capacity to introduce these rams in the nomadic flock. I understand that there is already a good deal of demand for crossbred ewes and crossbred rams in the field. The number of crossbred rams should have some relation to the needs and the types of flocks in Rajasthan. Looked at from that angle, chokla breed is the smallest in Rajasthan and that is the breed which has been taken up intially for crossbreeding. Some amount of detailed exercise can now be done about the relative numbers of the various types of crossbreds that will be required in the field programme in the next five years and the central crossbreeding programme adjusted to this."

10.45 Considering the very large acreage that have been reserved for the base sheep breeding farms, the number of rams produced per year for distribution by the various farms seems to be strangely extremely limited. The Committee would request that an immediate study of the situation in these farms be made and the reasons why the available facilities have not resulted in much larger issue of rams for the field programme be investigated and the faults remedied quickly. Otherwise, the support for the large sheep breeding programme in the DPAP would never be forthcoming. Further, it will be noticed that the farms are concentrating on breeding of exotic rams whose needs are obviously limited to the number of rams required for the exotic flocks in the breeding farms. Exotic rams are not to be supplied to the field programme because they cannot be maintained under the management conditions in the field. The field requires large scale cross-breedings and supply of crossbred rams. In 1979-80 the Sikar Farm has supplied 278 crossbred rams after the remarks of the Planning Commission. There is a long way to go yet and the Committee cannot but impress upon all concerned the need to tighten up the work in the basic breeding farms for sheep on which the country has invested substantial amounts. Simultaneously, the sheep rearing programme in drought prone areas should extend to utilise the rams as soon ag they come out of the farms.

10.46 One of the important aspects of cow development under Operation Flood was the examination of all profitable cows to identify the cows which are not yielding or having de layed yielding because of certain physical defects which are remediable by surgery. For improving the artificial insemination'programme and getting sufficient return, a part of the cow- development programme was to get such poor bearing cows identified and where possible surgically improved for proper insemination and calfing. There is such system yet developed for sheep rearing. From the statistics of per centage of lambing that has been given in Anne- xure V one can see that there is high lambing mortality in our sheep flocks. It is not unlikely that this is due to certain physical defects which may be remediable. Any sheep improve ment programme should give the necessary veterinary cover for identification of such sheep and improving them here possible. Where such improvement is considered not possible, such sheep should be culled out in the first instance to save unnecessary fodder consumption.

10.47 The performance of Karakul sheep imported from USSR has been tqsted at the Division of Carpet Wood and Karakul Pet Produc tion of the Central Sheep and Wool Research Institute at Bikaner as purebreds and has been found highly satisfactory as reflected from 15 kg. body weight at weaning, 92 per cent overall survival, 84 per cent conception and around 1 kg. six month greasy fleece. The quality of Pelt evaluated so far has been shown 44 per cent Jacket, 25 per cent Ribbed and 32 per cent Caucassing types. The results of cross breeding Karakul with some indigenous Carpet Wool breeds e.g. Malpura and Sonali has been encouraging. This technology can profi tably be utilised by the Sheep Farmers as a new dimension for increasing their family income.

Sheep breeding in Sab-Humid and Hamid Areas

10.48 No Critical data on the performance of the exotic breeds in various agro-climatic con ditions of the country have been maintained. It, however, apperas that most of these breeds have done fairly well in dry cool climate and their performance has been extremely poor in hot humid and even in hot and arid climate. The experience gained so far in the maintenance of exotic breeds under the Indian conditions has shown that cool dry climate, assured fodder supply, adequate grazing land, efficient health cover, and suitable housing are essential for their survival and satisfactory performance. While recommended breeds of sheep are now available for arid and semi-arid areas of the country, such breeds are not yet available for humid regions. It is, therefore, suggested that sheep development in humid areas should be brought about mainly through selective breeding in local breeds and introduction of exotic blood must wait or be done in stages by using halfbred rams.

Sheep Breeding for Million Production

10.49 Since the characters connected with mut ton production are moderately to highly heritable and the generation interval in sheep in short, selection within the indigenous breeds will bring considerable improvement in mutton production. Some of the Indian breeds like Mandya have dressing percentage comparable with those of exotic mutton breeds. However, the selection within the indigenous breeds would be slow in bringing improvement in mutton production because of extremely low level of present pro duction.

10.50 Improvement in inferior indigenous sheep through grading up with superior indige nous mutton breeds and through crossing indi genous ones with exotic mutton breedp seem - to be the alterative for making faster improve ments. The results of early attempts at im provement of mutton quality and quantity were not encouraging except those involving use of Sonali Ram at the Sheep Breeding Farm, Poona. During the Fourth Plan, the ICAR sponsored an All India Coordinated Research Project on Sheep for mutton with coordinating agency at Central Sheep and Wool Research Institute (CSWRI), Avikanagar, and Centres at CSWRI, IVRI and APAU Livestock Research Station, Palamer (Chittoor District). The project aims at developing new mutton breeds producing lambs weighing 30 Kgs at 6 months of age and suitable for different agro-climatic regions of the country, through crossing indigenous breeds with exotic mutton breeds (Sufiiolk and Dorset). The Committee has not been able to get the results of this project. These may be examined and suitable steps taken to improve inferior indigenous sheep for mutton products.

Migratory Socks

10.51 In regard to sheep improvement programme of migratory flecks, it is essential to provide necessary facilities on the migratory routes like improved grazing area availability of gome conservative fodder, necessary inputs for sheep improvement like prophylactic vacci- nation and drenching, superior pure breeding rams, sheep shearing and wool and live animal, marketing facilities. The Sheep and Wool Extension Centre should also have sufficient drinking water resources for humans and animals. They may provide credit and banking facilities to the nomadic sheep farmers. The migration will be controlled by these centres through communication among different centres. The staff located at these centres will direct the migrating flocks to areas where sufficient vege tation resources are available so that vegetation resources available are not over-exploited.

10.52 The breeding programme should be formulated in a manner that in areas where Mali and Chokla breeds are present, they will be improved for fine wool production through

introduction of exotic tine wool inheritance. The Central Rural Wool Research Centre, Avikanagar, Raj as than, has undertaken a pro gramme to crossbreed Nali and Chokla Rani-bouillet and merino. The halfbreeds will be interbred for stabilising the exotic inheritance at 50% level. The results of crossbreeding some of the native carpet wool breeds with exotic fine wool breed available so far indicate that the half breeds produce around 2-1/2 to 3 kgs. 58-64s wool. There is also an increase in live weight in crosses over the native parent. (Role of Sheep in the desert eco-system and drought proofing through improved sheep production by Shri R. N. Avharya and Shri B. C. Patnaik of the Central Sheep and Wool Research Institute, Avikanagar (Jaipur).

10.53 Majority of sheep under migration be long to Marwari and Jaisalmeri breeds which ars good carpet wool breeds. It may be desirable to improve the wool quality for manufacturing superior carpets. Although wool produced in North-Western region of India are known to be excellent carpet wools, they lack in lustre and uniformity and have excessive megullation, specially of Kemty type. The distribution of sturdy breeding rams selecetd for their greasy fleece weight and against megullation percentage will bring about improvement both in the quantity and quality of the carpet wool from the native sheep.

10.54 Under the existing conditions of cost and availability of grains and other conven tional animal feeds, it will perhaps be not possible to resort to intensive feeding practices for sheep production. Sheep in India will have to depend upon largely the grassland and for ages, top feeds and some by-product feeds to meet their nutritional requirements. Since the main emphasis in desert development programme is on range land improvement which will provide better grazing conditions, it may be possible to exploit the genetic potential of our native sheep and it may further be possible to sustain more productive crossbred animals. Although the nutrient intake by the animal through grazing would depend upon the quality of pasture and the grazing density under the existing conditions of our range lands, the intake is often less than the maintenance requirements especially during the months from January to June. Unless resorted to supplementary feeding on conserved fodders top feeds and/or cereals, the animals lose weight during this period. Because of the seasonality of availability of good grass cover which may not be utilised by the limited number of animals maintained over the whole year, it may be desirable to harvest the excess grass in middle of September and conserve it as hay. This will not only avoid wastage of grass through maturity and reduction in its nutritive value but will allow some regrowih which may increase the grazing period. This seasonality in availability of natural grazing does not seriously affect the wool production per unit weight from the animals, but the total wool production per animal is reduced because the animal maintain their body weight at a low level. This points out to the necessity of the conserved fodders and top feed during the period of scarcity of grazing so that body weight less is prevented during the lean periods and susceptibility to disease and mortality can be reduced.

10.55 The resume given above shows that under the natural conditions the sheep adjusts itself to a low level productivity because of absence of sufficient nutritious fodder in the crucial periods of its growth. Particularly, in the prenatal season of the ewes sufficient nutritious fooder has to be available if sheep rearing is to improve in quality. So far, sheep rearers have been depending upon natural fodder and particularly in the desert areas where substantial part of our sheep population are at present available, natural vegetation has already been over-exploited. The desert development report of the National Commission on Agriculture has emphasised the need for the development of pastures for sheep rearing. They have recommended that wherever irrigation schemes exist and particularly in areas commandable with lifts from the Rajasthan Canal system and by natural flows, substantial pasture

development under irrigation conditions should now be taken up. Particularly in the command itself, the cropping is expected to include 30 per cent fodder area. The Committee would reiteraitte this recommendation and ask for rapid action. The other factor which was not emphasised too much by the National Commission on Agriculture is the utilisation of tree fodder in sheep and goat development. Technology has since found in 'kubabui' and similar fodder trees substantial fodder availability to domestic animals. The norms for development of 'Kubabui' has been established by the BAIF and various forest departments have already taken up follow up action to introduce this tree in their Estates. Large scale afforestation has been recommended in the desert and drought prone areas. The Committee recommends that in the afforestation programmes that are now being taken up in a large scale, priority may be given to locating tree fodder units wherever possible and wherever sheep flocks are in a large number. One of the hazards which the sheep have to face is the lack of. shade in summer. If these tree fodder units can be spread over (Sufficiently large areas on a scattered basis, they will give sufficient shade for shep flocks which are nomadic in summer and even for village flocks which lias shade difficulty in summer.

Marketing facilities

10.56 Although the importance of develop ment of marketing facilities for wool and live animals and development of small scale wool based industry has been stressed earlier, it is further emphasised that such facilities must be organised both for 'tie sendenirised and migra tory flocks by the Government or the Coopera tive Agencies as this will avoid profiteering by a number of intermediary agencies dealing with the marketing of live animals and wool. Further, the development of wool based industry in the rural areas will help in providing remunerative employment throughout the year to the farming families. Establishment of large scale slaughter and meat processing plants and plants for pro cessing slaughter by-products in areas where large number of animals for slaughter are avai lable may be helpful in reducing expenditure on transportation and losses due to shrinkage and death. This will also help in more appro priate utilisation of slaughter house by-products and in the establishment of large industries, which may employ a large number of rural people.

10.57 The Central purchase of sheep from the cooperatives and slaughtering them at a modern abattoir necessarily means a follow up in deep freezing the carcass and marketing the meat in frozen condition. Obviously, in such a centralised location near the area of the sheep flocks there will not be any substantial market for fresh meat. The general consumption pattern in thijs country prefers fresh meat to frozen meat. In fact the practice traditionally followed in Indian houses is for fresh meat utilisation. Frozen meat is not utilised any where except in westernised families and large hotels which cater to a western taste. There fore, before any large scale introduction of central purchasing and slaughtering programme can be attempted, it is necessary to work out a pilot scheme to establish the parameters of such a programme. The Committee will re commend that a well thought out programme should be developed for one such centre with a minimum economic level of sheep to be slaughtered per day and a tie-up made with large metropolitan consuming centre like Delhi, Calcutta, Madras or Bombay. There will also have to be a well spread marketing organisation to push the sale of frozen meat to ordinary householders. In this context, the Committee would point out to the pioneering work done by the Fisheries Department of Karnataka in filleting of sea fish caught in Mangalore, transported in deep frozen conditions to a chain of retail centres in Bangalore for sale. By this and suitable promotion, substantial sea fish consumption has been developed in Bangalore. Such a network of retail centres with link up to the main production centres will have to be planned for mutton on a similar basis in the pilot scheme.

Health Cover Programmes

10.58 The success of intensive sheep pro duction programmes will to a large extent depend on the provision of an effective health coverage. The flocking habit of sheep is highly conducive to quick spread of communicable diseases. During migration, sheep from different areas mix up in the grazing zones and follow common migratory routes. Thus, one diseased flock may contaminate large areas of the grazing lands on its route causing serious threat to the other flocks grazing over those areas. As such, it is highly necessary to undertake routine pro phylactic measures against the commonly occuring diseases. Sheep should be regularly protected against diseases like sheep pox and enterotoxaemia. The need for periodic drench ing sheep with suitable anthelmintics is clear as gastro-intestinal parasites and liver flukes are responsible for losses among sheep. Broad spectrum anthelmintics as well as specific ones are now being marketed in the country and their judicious administration would considerably reduce the losses due to worm infestations. Sheep are also highly prone to infestation by external parasites probably on account of the covering afforded by the fleece. These ectoparasites cause considerable damage to the health of the sheep and to the quality of their fleece and skins. Very effective sheep dips are now available and with their regular application, menace of ectoparasites can be effectively con trolled. As such the extension veterinarians should visit the sheep flocks frequently for under taking vaccination, periodic drenching of sheep with anthelmintics and to arrange sheep dips. Lung worm infestation is responsible for causing serious losses in the sheep especially in North temperate regions. In 1977 an irradiated vaccine against lung worm infestation has been developed by the IVRI which has been reported to give satisfactory results under experimental conditions. It is necessary that this vaccine should be prepared on a large scale by the Institute for field use at an early date.

10.59 Some other sheep diseases which have recently assumed considerable importance are blue tongue and infectious epididymitis. Blue tongue appeared in a block of exotic sheep in Maharashtra in August, 1.973 and killed about 10 per cent of exotic sheep and a large number of lambs within a couple of months. Material from this out-break was sent to the Veterinary Research Institute, Onderstropoort, South Africa, which confirmed the disease. Some quality of monovalent vaccine against type 16 had been recently imported for vaccination at this farm. We do not know what steps have since been taken by the Government to control this disease which seems to be confined to a small area. We would strongly recommend that the Animal Husbandary Division of the Union Ministry of Agriculture should lay down policy for its eradication. The 1VR1 should initiate research work on this disease and should keep itself in readiness to start the manufacture of tongue virus vaccine whenever required.

10.60. Another disease which seems to have become serious problem at some of the exotic farms is the infectious epididymitis. Since epididymitis leads to impared fertility and other breeding problems, it is necessary for the concerned research institute to undertake a systematic survey to determine its incidence at the different sheep farms in the country and devise suitable preventive measure for the guidance of breeding farms. The problems of respiratory diseases in sheep also require special attention.

10.61 India ranks first among the countries of the work in goat population (FAO Produc tion Year Book 1972).

According to 1972 livestock census there were 68 million goats in the country constituting about 19% of the total world goat population. Goat constitute about one-third of the total meat in the country. Besides, by export of goat skin, carcasses and hair, valuable foreign exchange is earned. The manure produced from dropping enriches the soil.

10.62 It would be seen from the table given earlier that the drought prone areas account for over 17 million goats i.e., roughly 25% of the goat population in the country.

10.63 As per the 1972 census, there has been a growth of 5.3% in the population of goats. It is note-worthy that this increase has occurred despite the fact that no special goat development programme are being pursued and about 36% of goat are being slaughtered every year. The reason is that very nominal expendi ture on their upkeep has to be borne by the goat owners since goats can thrive in shrubs, bushes, vegetation and variety of trees. Because of the habit of nibbling at young plants and grasses, it can cause immense damage to areas under afforestation. As such, if the economic value of the goat has to be fully exploited, suitable management systems will have to be devised to exercise greater control over their movement and feeding habits. It may also be necessary to reduce their numbers in areas where afforestation, soil conservation and pasture development programmes have been introduced. Goats are raised mainly for meat. Two pilot studies of mutton production carried out by the Agricultural Research Statistics (ICAR) in 1966-67 and 1968-69 in Tamil Nadu and Haryana indicated that average, yield per animal was of the order of 10.2 and 10.9 kg. respectively. Hardly any serious efforts have been initiated for improving meat production of goats in the country. Some minor attempts were, however, made. No exotic germ plasm is available for increasing the yield of meat, since goat breeds found in foreign countries are essentially dairy breeds. Secondly, the approach for raising meat production from goat has necessarily to be selective breeding among the taller and medium size breeds and crossing the nondescript type with select meat type bucks. Cross breeding with exofic dairying breeds of goats can also be attempted for increasing milk production but this again has to be a selective breeding programme. The work at present being carried out by the All India Coordinated project for development of strains of high pash-mina producing goats should be pursued vigorously so that results are available earlier. Crossing breeds of goats with Ango-ta in cold aride areas is another programme worth pursuing vigorously. Slaughter of goats for meat purposes should be increased so that the rate of growth of goat population may come down. The Committee has already indicated that in view of its habit it can cause damage to areas under afforestation. As such, if the economic value of the goat has to be fully exploited, suitable management systems should be devised to exercise greater control over their movement and feeding habits.

Cattle

10.64 It has already been pointed out that the number of cattle in the drought prone areas is quite large. Particularly in arid aresa, the livestock are subject to high mortality due to frequent droughts. The cattle breeders migrate to other areas in search of grass-lands, fodder etc. As a result of lack of feed and fodder and lack of health coyer and despite the pre sence of some good breed of cattle, the average yield of milk per animal is low. Again, in the absence of marketing infrastructure for selling of fluid milk, farmers mostly sell ghee which is actually very wasteful use of milk besides being less remunerative.

10.65 The accepted policy of the Government is to foster and promote dairy development on cooperative lines as far as possible. With this end in view, accent has been placed on milk production in rural areas through a network of cooperatives linked up with processing and marketing of surplus milk in urban areas. Large scale replication of Anand pattern of milk co-operatives is the basis for Operation Flood II Programmes. The Anand Model consists of three-tier cooperative structure. The primary village cooperative will not only collect the milk from producers but also provide the opportunities, the essential feed and technical inputs for maintaining a steady increase in milk production. The district' union which is formed by a

number of primary societies federating into a union will own the processing facilities and distribute the miik to various consuming centres. The cluster federation which will comprise of an average of about 6 district unions will be the apex cooperative body determining the policies and targets for the smooth and effective functioning of the constituents and will also administer the flow of milk and milk products into the regional and national milk grids.

10.66 Ah integrated dairy development pro gramme has already been launched at the national project. This programme is expected to cover 155 milk shed district identified by the National Commission on Agriculture. Quite a large number of which are in drought prone areas. The implementation of the programme has already started in a number of States.

10.67 A study made by the Rajasthan Dairy Cooperative Federation in Jaipur District indi cates that the average income per family after the introduction of the integrated development programme increased to Rs. 3342 from Rs. 595. There was higher milk production per family and the area under fodder crops increased. This shows that considerable scope exists for in creasing the income of small farmers in the drought prone areas if the programme is taken up on an integrated basis. Apart from market ing and dairy development infrastructure which is now being taken care of under the national project referred to earlier, improvement in the quality of breeds is the next important aspect.

Cattle Breeding—Arid Areas

10.68 These areas have concentration of best milch animals such as Haryana, Gir and Tharparkar cows. The other breeds of cows are Rathi, Nagori and Kankrej.

10.69 Through the process of natural selec tion, only the cattle lines that are resistant to drought and better convertors of roughages have survived in these areas. Breeding a highly productive animal with sophisticated nutritional and management requirements will not adapt to the harsh conditions in these areas. Breeding programme, therefore, should be planned keeping in view the local agro-climatic conditions. This calls for a three-pronged strategy for cattle breeding. Firstly, the objective should be to develop animals with better productivity, while maintaining their drought-resistant qualities. This can be done through selective breeding among local milch and dual purpose breeds as this region has several good breeds of cattle. In other words, the productivity of cattle belonging to these breeds could be improved through selective breeding of cows with sires of proven worth of the same breed.

10.70 Secondly, the arid areas where non descript cattle predominate, breeding should aim at their improvement in terms of milch and draught qualities through upgrading by using bulls of good dual purpose and milch breeds from other regions having similar environmental conditions. But the dairy breeds of Indian Cattle do not prossess the genetic potential to produce enough milk to make milk production profitable. It will take S to 10 generations spread over 60 to 80 years to double the lacta tion yield of 2000 litres of the best Indian breeds of cows in the country.

10.71 Thirdly, crossbreeding of Indian cows with improved exotic dairy breeds is the quickest way of introducing new genetic characters into our cattle for improving their milk producing potentials. To fill the wide gap between demand and supply of milk from the point of the milk needs of the country and profitability of milk production from the farmers point of view, cross breeding seems to be the only solution for increasing milk production in the shortest possible time. A massive cross-breeding is underway in the country through the Intensive Cattle Development Projects, ICAR Research Institutes and Agricultural Universities. Crossbreeding with Jersey breed is recommended in these areas where assured irrigation facilities

for fodder cultivation are available with farmers and infrastructure for providing health cover and marketing of milk are also available. Jersey breed has been considered more suitable for breeding because of its comparatively smaller size and higher fat content in milk. The cross-breeding policy to be implemented in areas should broadly aim at producing crossbreed stock with 50 per cent exotic inheritance. However, it would be proper to fix the level of exotic inheritance depending on the level of management. If good management'practices can be followed and proper nutrition can be provided, 62.5 per cent level of exotic inheritance may be fixed.

Semi-Arid Areas

10.72 As a general policy throughout the country, the Government of India has gone in for improvement of milk production in a big way in areas wherever potential for increasing milk production exists. The policy adopted envisages cross breeding of local cattle or improved indigenous breeds with exotic breeds in selected pockets identified as future milkshed areas. In the semi arid areas, however, the approach to cattle-breeding should aim at improving both draught and milch qualities of animals. The programme will, therefore, have three main components—

(i) Cross breeding of improved indigenous breeds with exotic breeds for enhancement of milk production quickly in selected pockets with assured ifjigation and milk marketing facilities.

(ii) Cross breeding of local, non-descript cattle with high quality indigenous breeds for upgrading local cattle both for milk production and drought purposes.

(iii) Selective breeding among improved indigenous breeds for improving their production potentials further.

10.73 As a first step, therefore, identification of breeds both exotic and indigenous, suitable for the area has to be done, to develop their productive capacity. Improved indigenous breeds from other areas with similar agro-climatic conditions should be utilised for upgrading of local, non-descript stock in the villages under dryland farming conditions. Jersey and Hpjstein-breeds could be utilised to introduce 50 per cent exotic blood through cross breeding purposes in areas with irrigation facilities for fodder production and which fall in the milksheds of existing dairy projects. There is a mistaken impresjsion that a crossbred bullock out of exotic germ plasm is not a very satisfactory draught animal. There is sufficient evidence already that bullock for bullock the crossbred bullock with exotic germ plasm is sturdier and a more effective animal than the general level of bullocks utilised in the rural areas which are supposed to be of known draught breeds. Whilst action should be taken to improve the known draught and dual purpose breeds in the country by selective breeding, this is a long term process and considering the paucity of sufficient power for our agricultural needs as explained by the National Commission on Agriculture in its Report Vol. VII, page 62 the need is to add to the bullock power as quickly as possible. This means that crossbred bullocks with exotic germ plasm should be introduced in a large scale to meet the needs of power for agriculture. Unless sufficient propaganda to counter the thoughtless propaganda going on, that a crossbred bullock is not efficient, is done, the likelihood is that much of this bullock power will be lost to the slaughter houses.

Infrastructure for cross-breeding of selective breeding

10.74 The country has opted for the frozen semen technology for cattle breeding. In order to enable a quick introduction of this technique all over the country, a Central scheme for exotic cow farms and breeding bull farms of exotic bulls were to be established in all the major States of the country. This programme has been lagging far behind the schedule in al most every State. There is another programme for establishing a frozen semen bank to be based on the bull farm and this programme also has been lagging far behind schedule. In drought prone areas cattle wealth is an important wealth for the average householder. Any programme for rapid improvement of cattle wealth and thereby the income from cattle would be a most welcome addition to the poor economy ot drought prone areas. Hence there is a need for rapid introduction of the cross-breeding pro gramme. The Committee would, therefore, strongly recommend that the bases of exotic cow farm, breeding bull farm and frozen serssn banks should be brought up to a good level of efficiency immediately so that an active cattle development can take place in drought: prone areas.

10.75 One of the reasons given for the slow pace of spread of frozen semen technology is the lack of canisters for holding liquid nitrogen to keep the frozen semen straws in condition for insemination in the field. The Committee understands that the present demand for out-reaches available supplies in the country. The Ministry of Agriculture wi11 have to take a close look at the present programme of demand and supplies and solve the problem satisfactorily. Otherwise, this single factor may be serious deterrent to the rapid growth of animal hus bandry in the drought prone areas.

Sub-Humid and Humid Areas

10.76 Major emphasis will be on crossbreed ing of cattle with exotic breeds for enhancing milk production as these areas receive heavy rainfall and have fairly good irrigation facilities. Hence 62.5 per cent exotic inheritance may be introduced in local milch cattle. While decid ing upon the type of cattle to be introduced into an area, it should be ensured that the parti cular type would be able to adapt to the new environmental factors. According to NCA, Jersey, Holstein - Freisina, Brown Swiss and Red Dane breeds of cows could be used for cross breeding in heavy rainfall and high altitude areas, because grassland development and fodder pro duction could be augmented in these areas. Besides crossbreeding, other methods of breed ing would also play an important role in these areas.

Buffalo Breeding

10.77 Buffaloes in India are of the graded type. Vast majority of the buffaloes are un improved, non-descript animals varying greatly in size, body weight etc. All the buffalo breeds in the country have been evolved for milk pro duction. However, NCA has recommended that buffalo should be developed both as a milk and meat animal. Attempts at improv ing milk qualities should be confined to the two best milk breeds viz., Murrah and Surti.

10.78 In arid areas, because of extreme arid conditions, buffalo population is very low as compared with the population of cows. Murrah in Haryana and Mehsana and Surti in Gujarat are the high milk yielding breeds of buffaloes. These breeds have attained not only all India importance but also international recognition as important milk breeds of buffaloes. The following approaches should be followed for improvement of these breeds. Firstly, 'heir genetic potential for milk production should be im proved further through selective breeding in their native breeding tracts. Secondly, the sires of proven worth belonging to these breeds should be used for upgrading non-descript buffaloes in other areas through crossbreeding.

Graded murrahs are considered suitable to and are being distributed in arid and semi-arid tracts of drought prone areas.

10.79 A herd of Murrah buffaloes were built up from graded Marathwada buffaloes along with addition of a few pure-breds. It is claimed that the present herd excelled the average performance of Murrah breed and is comparable to any of the National Herds of Murrah buffaloes. The average milk yielded was 1835 kgs in 287 days of lactation with calving interval of 450 days is a breakthrough for a buffalo herd in this State. It is claimed that the encouraging results obtained here provide a direction for all out efforts to develop buffaloes as dairy animals.

10.80 In the absence of complete data, the Committee is unable to comment or make any positive recommendation in this regard. All that the Committee would like to bring out is that the necessity for milk production enhance ment being so great, all production potential should be actively exploited for obtaining the maximum possible use. This would require enlargement and strengthening of the existing programmes as also initiation of additional pro grammes. Carefully planned systematic breed ing programmes including progeny testing of selected bulls should be undertaken for pro gressive genetic improvement of the stock.

Health Cover

10.81 Livestock development programmes can not succeed unless and until a well organised animal health service is built up and protection of livestock against diseases, particularly against the infections ones is assured. The indigenous livestock are poor in productive capacity and, therefore, not profitable to rear. A massive cross-breeding programme to introduce exotic blood into the indigenous stock has, therefore, been undertaken in the country. It was, however, found that the exotic breeds of cattle and the crossbred animals are very much susceptible to infectious diseases. It is, threfore, necessary to build up an efficient animal health cover service in the country. At present most of the veterinary hospitals are poorly equipped, do not have modern aids for arriving at prompt and correct diagnoses of diseases and lack facilities for undertaking surgical operations. Even drugs for treatment of common ailments are in short supply. These problems are more acute in the drought prone areas. The Committee would urge that wherever animal husbandry programme is taken up, immediately steps should be taken to provide animal health cover.

ANNEXURE-1

Chapter 10

Livestock Breeds found in DPAP Districts

S. No.	Name of breed	Particulars	Areas where mostly found
1	2	3	4
		ARID ZONE	
(i)	Cattle		
	1. Gir	A milch breed. Average lactation yield in well maintained herd 3,500 lbs. Ears long and pendulous	Gir forests of Junagarh, Saurashtra tract of Baroda and Junagarh, Gohilwar tract

		with a notch near the tip.	of Pali, tanna, Baroda taluk of Pcrbcndar, Baroda hills and Halar of Wahkane and Chotilla hills of Morvi in the Bombay State.
	2. Haryana	Good milkers-yield 12 to 24 lbs. of milk per day. Long narrow face and flat forehead with a body prominence at the centre.	Rohtak, Gurgaon, Karnal and Hissar Districts of the Punjab and Delhi States.
	3. Hissar	Fair milkers. White or grey in colour	Hissar district of Punjab.
	4. Kankrej	Fair milkers-yields 8 to 10 lbs. per day. Grey in colour.	Along the Banas and Saraswathi rivers low lying country to the south-east of Rann of Kutch and in Ahmedabad district of Bombay.
	5. Nagore	Milk yield 8 lbs per day	Barmer, Nagore and Jodhpur districts of Rajastan.
	6. Sanchore	Good milkers yield 12 lbs. per day	Jodhpur district of Rajasthan chief centies being Malani, Sanchore, Seana and Dhat.
	7. Sahiwal	Good milkers. Good beaf animals. Large udder. Long & regular tests.	Banks of river Rani in Montagomery districts but now found in Haryana, tract of Punjab and north Uttar Pradesh.
	8. Tharaparkar.	Lyre-horned grey. Wild foreheads. Medium sized compact. Good milch and Drought animals. Yield 4000-6000 lbs.	Sind, Kutch, Jodhpur and Jaisalmer.
(ii)	Buffaloes		
	1. Jaffarabadi	Very good milkers—yield 30 to 40 lbs. per day. Butter-fat content very high. Large and massive in size. Black in colour with white markings on face and legs. Highly developed frontial bone and broad and flat horns.	Southern parts of Saurashtra principal area being the Gir forests and the neighbourhood of Jaffarbad.
	2. Murrah	Very good milkers-yield 14 to 28 lbs. per day Butter-fat contents very high. Very massive & stockily built animal. Black in colour. Short tightly curled horns.	Rohtak, Karnal, Hissar, Jind, Patiala and Gurgaon districts of the Punjab, Delhi and West parts of Uttar Pradesh.

(iii)	Sheep		
	1. Bikaneri Jungli or Buchni.	Mostly white with white tan, dark tan or black head and legs in colour, medium sized with compact body, average weight 55 lbs. per head, wool coarse & slightly brittle yet soft and long stapled, average yield of wool 3 lbs. per annum, do not fatten quickly, mutton of average quality.	Original home-dry desert of Bikaner district in Rajasthan State but found in adjoining areas of Punjab, Uttar Pradesh and other districts of Rajasthan State.
(iv)	Goats		
	1. Bikaneri	Black in colour, medium sized animals with poorly developed limbs, average weight per 45 lbs., she-goats—poor milkers average yield of milk per day hardly a pound or so, meat not very tasty, slightly greyish in colour and deficient in water content, skins of fair average quality.	In and around the Bikaner district of Rajasthan and the adjoining areas of Punjab and Uttar Pradesh States.
		SEMI ARID REGION	
(i)	Cattle		
	1. Amrit Mahal	Poor milkers, Medium sized. Grey colour with dark quarters.	The western & central parts of Mysore, especially in Tumkur and Chitradurga districts.
	2. Dangi.	Poor milkers. Black and white or red and white in colour. Medium sized.	Akola taluk of Ahmednagar Sonkhed taluka of Khandesh , Ghats of Nasik, Thana and Kolaba districts and in Bansda, Dharmapur Jawhar an Dangs in Bombay.
	3. Hallikar	Very little milk (poor milkers). Medium sized. Iron grey or black in colour.	Tumkur, Hassan and Mysore districts of Mysore and adjoining parts of Bombay and Madras States.
	4. Kankrej	Fair milkers-yields 8 to 10 lbs. per day. Grey in Colour.	Along the Banas and Saraswathi rivers, low lying country to the South-east of Rann of Kutch and in Ahmedabad district of Bombay.
	5. Khillari	Poor milkers, Medium sized	Sholapur and Satara districts and Satpura range of

			Bombay.
	6. Nagore	Milk yield 7 lbs. per day	Banner, Nagore and Jodhpur districts of Rajasthan.
(ii)	Buffaloes		
	1. Mehsana	Valuable early maturity persistence in milk yield and regularly in breeding. Black or fawn in colour with marking in head and tail.	Baroda and Mehsana districts of Bombay.
	2. Surti	Milk yield 12 to 16 lbs. per day. Regular breeding. Medium sized black in colour with a white pelt and white tuft on the tail. Flat horns.	Nadiad, Anand and Bersad taluks of Kaira district, Bombay.
(iii)	Sheep		
	1. Bakkarwal	Sheep, in Kotla and Rajori tehsils are predominantly in white but in and around Udhampur tehsil are generally coloured, large sized sturdy animals with 70 lbs. average weight wool long stapled but coarse, average wool yield per annum is 31/11 lbs. mutton of average quality skins of fafr average quality.	South-western parts of Kashmir State.
	2. Bhadrawah (Gaddi)	Usually white with white or brown face, medium sizsd hard animals with strong legs fit for climbing, average weight per sheep 55 lbs. wool lustrus coarse, and short-stapled can be grown up to 6 inches if allowed to attain its full strength. Average yield of wool 2£ lbs. per annum, mutton tough and deficient in fat, skins of average quality, also used as pack animals for transporting pashmina wool, salt, and borax, etc. between Tibet and India.	Udhampur district of Kashmir, Kangra and Simla districts of Punjab and Chamba and Mandi districts of Himachal Pradesh.
	3. Ballari.	Usually black, though grey white with black, face & even pure white soma times in colour, fairly large sizsd with square shaped compact body, average weight 60 lbs. per sheep, wool very coarse and	In and around Bellari District of Mysore State and Adoni, Alur, Konkuntla, Kurnool and Nandikotkur taluks of Kurnool district and Raidrug taluk of Anantapur district in

		straight, average yield per sheep 1-3/4 lbs. per annum, yield mutton average quality, skins very good in quality.	Andhra Pradesh.
(iv)	Goats		
	1. Beetal	Generally red tan, black or spotted in colour, mjdium sized with blossy and sleek coat, average weight per goat about 55 lbs. she-goats well developed udder and teats, average daily milk yield 3 lbs. per head, sometimes yield comes to 9 lbs. per day also, mutton tasty, skins fairly big in size and classed as 'Amritsars'.	Punjab and Jammu & Kashmir States.
		SUB HUMID REGION	
(i)	Cattle		
	1. Nimari	Poor milkers-yield 3 to 4 lbs. per day	Nimar (Khargaon) and Indore districts of Madhya Pradesh.
	2. Kenwariya (Kenkatha)	Small sturdy and fairly powerful breed. Grey to dark grey in colour. Short deep and compact body with strong pointed horns.	Along the river Ken in Banda districts of Uttar Pradesh and parts of Ajaigarh Panna, Bijaigarh and Charkhari of Madhya Pradesh.
	3. Khillari	Poor milkers. Medium sized.	Sholapur and Satara districts range of Bombay.
	4. Ongole	Good milkers-yield about 10 to 12 lbs. per day	Ongole tract in Nellore and Guntur district of Andhra Pradesh.
	5. Dangi	Poor milkers, black and white or red and white in colour, Medium sized.	Akola taluk of Ahmednagar, Sonkhed taluka of Khandesh, Ghats of Nasik, Thana and Kolaba districts and in Bansda, Dharampur, Jawhar and Danga in Bombay.
	(ii) Buffaloes		
	NIL	NIL	NIL

	(iii) SheeP		
	1. Nellore	White or white with black or fawn markings on the body light, brown red and red with white patches under the abdomen and on thighs, large sized animals with all body densely covered with short hair, average weight per sheep about 80 lbs. mutton of fairly good quality, skins of good quality.	Nellore districts of Andhra Pradesh and Ramanathapuram and Tirunelveli districts of Madras State.
(iv)	Goats		
	1. Surti	No definite colour, may be white, black, red, grey or blotched, medium sized average weight 50 lbs. per head, she-goats fairly capacious and compact udder, average daily milk yield 2-1/2 lbs. per head, some of them yield even 8 lbs. of milk per day; skins of fair average quality.	West Khandesh, East Khandesh, Surat and Nasik districts of Bombay State.
	2. Telligana	White, red, black or mixed in colour, tall animals, average weight per head 60 lbs. she-goats, not well developed udder and poor milkers, meat not tasty, coarse and grey in colour, skins of good quality.	(Tellingana) Eastern half of Andhra Pradesh State and Bastar district"of Madhya Pradesh State and Chanda district of Bombay State.
		HUMID REGION	
(i)	Cattle		
	1. Bachaur	Drought-breed, poor milkers.	Sitamarthi districts of Bihar,
(ii)	Buffaloes		
	NIL	NIL	NIL
(iii)	Sheep		
	NIL	NIL	NIL
(iv)	Goat		
	NIL	NIL	NIL

Source: Development of Drought-Prone Areas by N.K. Jaiswaland, N.V. Kolte—National Institute of Rural Development — Hyderabad pages 119—125.

ANNEXURE II

Chapter 10

Statement showing State-wise Cumulative Physical Achievements of Sheep Cooperative Societies established under DPAP District from April 1974 to March, 1980

SI. No.	State	1974-75 to 1978-79	1979-80	Cumulative achievement (from Apri 11974 to March 1980)
1.	Haryana	596	61	657
2	Uttar Pradesh	144	0	144
3	Rajasthan	119	23	142
4	Andhra Pradesh	69	6	75
5	Tamil Nadu	31	2	33
6	Gujarat	12	15	27
7	Karnataka	20	0	20
8	Maharashtra	20	0	20
9	West Bengal	4	0	4
10	Bihar	0	0	0
11	Jammu & Kashmir	0	0	0
12	Madhya Pradesh	0	0	0
13	Orissa	0	0	0
	Total	1,015	107	11,122

ANNEXURE III

Sheep Cooparative Societies Established under IDA assisted DPAP Districts during the year 1975-79

S. No	State	District	Year				Total
			1975-76	1976-77	1977-78	1978-79	1975-79
1	Rajasthan	Jodhpur	-	15	7	6	28 : 51
		Nagaur	-	7	13	3	23 :
2	Andhra Pradesh	Anantapur	9	11	25	-	45 :
3	Maharashtra	Sholapur	-	-	4	6	10 20
		Ahmednagar	-	1	3	6	10 :
4	Karnataka	Bijapur	1	7	5	5	18 :
		Total	10	41	57	26	134

ANNEXURE IV

Sheep Production Parameters (Sheep Societies Vs Village Flocks)

Average impact of the year 1978-79

SI. No	Particulars		Average impact of Rajasthan District[1]			Average impact of Deccan Plateau districts[2]		
			Sheep Societies	Village Flocks	Average Impact	Sheep Societies	Village Flocks	Average Impact
1	Lambs at birth Average weight							
	I. Male	Kg.	2.0	1.8	+ 0.2	2.7	2.2	+ 0.5
	II. Female	Kg.	1.9	1.7	+ 0.2	2.5	2.1	+ 0.4
2	Weaners (6 months) Average	weight						
	I. Male	Kg.	14.2	12.6	+ 1.6	14.3	12.9	+ 1*4
	II. Female	Kg.	13.4	11.7	+ 1.7	14.0	12.5	+ 1.5
3	Hoggets (12 months) Average weight							
	I. Male	Kg.	21.3	18.8	+ 2.4	22.0	18.3	+ 3.7
	II. Female	Kg.	20.0	17.8	+ 2.2	21.2	18.1	+ 3.1
4	Rams	Kg.	35.4	32.0	+ 3.4	34.1	30.9	4. 3.2
5	Breeding Ewes	Kg.	25.9	23.0	+ 2.9	27.4	25.7	+ 1.7
6	Mortality %							
	I. Lambs	%	8.1	15.6	— 7.5	6.9	13.9	— 6.2
	II. Adults	%	5.8	12.3	— 6.5	3.3	7.5	— 3'7
7	Lambing	%	67.7	62.0	+ 5.7	64.5	55.3	+ 12.1
8	Weaning	%	54.1	44.1	+ 8.7	60.3	56.6	+ 13.8
9	Wool yield (Kg/Sheep/year)	Kg	1.13	0.98	+ 0.15	0.80	0.60	+ 0.20

1 — Jodhpur and Nagaur.

2 + Anantapur, Sholapur, Ahmed Nagar and Bijapur.

ANNEXURE V

Sheep Production Programme—1978-79 (Sheep Societies Vs Village Flocks)[1]

District	Year		Lambs at birth		Weaners 6 months		Hoggets 12 months		Rams	Breeding Ewes
			M	F	M	F	M	F		
Jodhpur	1978	Sheep Societies	2.2	2.0	14.0	13.1	20.8	19.3	38.3	26.8
		Village Flocks	1.8	1.6	13.1	11.6	19.8	31.4	23.7	23.7
		Sheep Societies	2.2	2.0	14.4			20.7	36.6	
	1979					13.5	21.8			27.4
		Village Flocks	1.9	1.8	12.2	11.4	17.3	16.5	34.2	22.7
Nagaur	1978	Sheep Societies	1.8	1.7	14.8	13.5	22.3	19.5	31.5	24.8
		Village Flocks	1.7	1.6	13.6	12'5	20.7	18.5	30.0	23.3
	1979	Sheep Societies	1.8	1.8	13.6	13.6	20.1	20'2	33.2	24.4
		Village Flocks	1.7	1.6			17.6.	18.1	32.6	
					11.6	11.4				22.4

Average Rajasthan District	1978	Sheep Societies	2.0	1.9	14.4	13.3	24.6	19.4	34.9	25.8
		Village Flocks	1.8	1.6	13.4	12.1	20.3	18.2	30.7	23.5
	1979	Sheep Societies	2.0	1.9	14.0	13.6	21.0	20.5	35.9	25.9
		Village Flocks	1.8	1.7	11.9	11.4	17.5	17.3	33.4	22.6
Average Impact			+ 0.2	+0.2	+1.6	+ 1.7	+2.4	+2.2	+3.4	+2.9

1 — Data not collected prior to 1978.

ANNEXURE- IV - Contd.

Sheep Production Programme—1978-794 (Sheep Societies Vs Village Flocks)

District	Year		Mortality		Lambing%	Weaning%	Wool yield Kg/Sheep/ year	Wool Quality
			Lambs	Audit				
Jodhpur .	1978	Sheep Societies	5.3	4.9	84.5		1.08	
		Village Flocks	15.0	10.2	76.1		0'89	
	1979	Sheep Societies	9.7	7.3	69.0	60.9	1*12	
		Village Flocks	15.9	10.2	70.8	56.1	0'98	
Nagaur	1978	Sheep Societies	9.3	5.5	65.3	55.8	1.00	
		Village Flocks	17.1	12.0	60.6	41.9	0.95	
	1979	Sheep Societies	7.8	5.5	51.9	43.7	1.29	
		Village Flocks	14.2	16.6	40.4	36.4	1.08	
Average Rajasthan District	1978	Sheep Societies	7.3	3.2	74.9	55.8[2]	1.04	
		Village Flocks	16.1	11.1	68.4	41.9[2]	0.92	
	1979	Sheep Societies	8.8	6.4	60.5	52.3	1.21	
		Village Flocks	15.1	13.4	55.6	46.3	1.05	-
Average Impact			—7.5	—6.5	.i.5.7	+ 8.7	+0.15	

ANNEXURE V—Contd.

Sheep Production Parameters—1978-79— (Sheep Societies Vs Village Flocks)

Average weight (Kg.)

District	Year		Lambs at birth		Weaners 6 months		Hoggets 12 months		Gams	Breeding Ewes
			M	F	M	F	M_3	F_3		
Anantpur	1978	Sheep Societies	2.9	2.8	15.1	14.5	23.5[3]	21.9[3]	36.2	26.7
		Village Flocks	2.3	1.9	13.9	12.9	20.4	19.3	31.2	26.0
	1979	Sheep Societies	2.8	2.6	15.3	14.8	23.8	21.8	31.8	26.2
		Village Flocks	2.2	2.1	13.8	12.7	20.2	19.8	30.3	25.7

Sholapur	1978	Sheep Societies	2.9	1.8	13.9	12.4			32.0	26.8
		Village Flocks	2.1	2.0	11.9	11.3	--	--	--	--
Ahmednagar	1978	Sheep Societies	2.1	1.9	16.0	14.5	18.0	17.0	--	
		Village Flocks	1.8	1.6	14.5	13.0	16.0	14.5	--	--
	1978	Sheep Societies	2.7	2.4	13.7	12.1	22.5	21.0	35.0	28.0
		Village Flocks	2.5	2.2	12.5	11.5	18.0	16.8	30.0	25.0
	1979	Sheep Societies	2.5	3.0	12.5	14.6	21.5	23.0	36.0	29.0
		Village Flocks	2.2	2.6	11.6	12.8	17.0	19.0	32.0	26.0
	1978	Sheep Societies	2.7	2.2	14.7	13.4	21.3	20.0	34.4	27.2
Districts		Village Flocks	2.2	1.9	13.2	12.2	18.1	16.9	30.6	25.5
			2.7	2.8	13.9	14.7	22.7	22.4	33.9	27.6
	1979	Village Flocks	2.2	2.4	12.7	12.8	18.6	19.4	31.2	25.9
Average Impact			+ 0.5	+0.4	+1.4	+1.5	+3.27	+3.1	+3.2	+1.7

1 — Data not collected prior to 1978.

2— Average of one district.

3 — Weaners weight were taken at age of 4 months.

.. Data not collected or supplied by district staff.

ANNEXURE—V - *Contd.*

Sheep Production Parameters 1978-79—(Sheep Societies Vs Village Flocks)

District	Year		Mortality %		Lambing %	Weaning %	Wool yield (Kg/ sheep/ year)	Wool
			Lambs	Adults				
Anantpur	1978	Sheep Societies	4.8	1.6	64.4	59.6	0.63	Medium
		Village Flocks	6.6	4.2	56.7	50.1	0.43	Coarse
	1979	Sheep Societies	4.3	2.5	61.9	57.6	0.49	..
		Village Flocks	7.1	5.5	40.1	32.9	0.29	..
Sholapur .	1978	Sheep Societies	6.0	2.0	52.0	49.0	1.16	M: Medium
		Village Flocks	..	..	..	..	..	F : Coarse
Ahmad nagar	1978	Sheep Societies	8.0		72.0	75.0	1.16	Coarse
		Village Flocks	11.0	9.0	62.0	65.0	1.10	Coarse
Bijapur	1978	Sheep Societies	15.4	7.7	61.5	53.5	0.86	Medium/ Coarse
.		Village Flocks	25.0	10.0			0.55	Coarse
	1979	Sheep Societies	6.0	3.0	71.0	65.0	0.78	
		Village Flocks	20.0	9.0	62.0	54.0	0.55	
Average Decean Plateau Districts	1978	Sheep Societies	8.6	3.8	62.5	59.5	0.95	
		Village Flocks	14.2	7.7	59.4	57.6	0.69	
	1979	Sheep Societies	5.2	2.8	66.5	61.3	0.64	
		Village Flocks	13.6	7.3	51.1	43.5	0.42	

District	Year	Mortality %		Lambing %	Weaning %	Wool yield (Kg/ sheep/ year)	Wool
		Lambs	Adults				
Average Impact		—6.2	—3.7	+ 12.1	+ 13.8	+ 0.20	

1— Data not collected prior to 1978.

ANNEXURE VI

Sheep Development work on 100 hectares plots in Rajasthan

The scheme of sheep pasture plots is being taken up only in 4 Desert Districts namely Jodhpur, Jalore, Nagaur and Churu. The District-wise position is as under:—

SI. No.	Stage of Work	Name of the Districts				
		Jodhpur	Nagaur	Jalore	Churn	Total
1	Plots Indcntificd	39	37	27	27	130
2	Possession taken	39	37	25	26	127
3	Plots Fenced	39	33	24	25	121
4	Contour Furrows	39	33	24	26	122
5	Plots seeded	39	33	24	26	122
6	Tanks constructed	39	28	22	26	115
7	Sheep Sheds constructed	39	34	25	22	120
8	Huts constructed	39	34	25	26	124
9	Sheep Societies Registered	39	36	25	20	120
10	Sheep Introduced	39	33	20	22	114
11	No. of Sheep	5776	4742	2572	2282	15172
	(Present strength)	37	37	27	27	
12	Plots handed over to Societies as per Government	10	9	Nil	Nil	19

The income from each plots having 400 sheep is estimated (as per the actual performance) as under (annual):

1.	Income from wool	@ Rs. 18 per Kg. of 400 sheep.	7200.00
2.	Mutton	160animals@ Rs. 100 per animal.	16000.00
3.	Manure of grass seed etc.	400 sheep @. Rs. 120 per animal.	4800.00
	Total		28,000.00

The proposal for the functioning of these societies are as follows :—

The Cooperative Society should be asked to bear the following expenditure so that the expenditure may be done as per the income of the society:—

S. No.	Item	Monthly	Yearly
1.	Salary of the two Shepherds @ Rs. 210 per month.	420.00	5040.00
2.	Contingency	20.00	240.00
3.	Medicines		2000-00

4.	Maintenance of Structure 1% of cost.		1000.00
5.	Miscellaneous expenditure.	10.00	120.00
6.	Audit fee		500.00
7.	Part-time Secretary @ Rs.250 p.m.	250.00	3000.00
	Total		11900.00

Besides these expenditure Rs. 15625.00 would be needed for 30% dividend to the sheep breeders and 25% of the net income as reserve Fund, if we can bring all the expenditure i.e. (Rs. 11900.00 +Rs. 15625.00 = Rs. 27525.00). This expenditure is within the income expected out of the 400 sheep maintained on the plots.

Since the Government has invested the amount of about 1 lakh each plot for development, it is worthwhile to keep one S/A on the plots as departmental representative so that the scheme may run as per laid norms and yield expected results moreover the S/A also look after the health coverage of breeders and other animals.

Thus the total income of the plots is Rs. 28,000.00 and expected expenditure would be Rs. 23,619.00 and net results would be Rs. 4381.00 with a society annually.

I have observed in these plots that the pasture development work is not upto the mark due to continuous famine for last three years in these districts. Due to failure of rains, the required number of sheep were not introduced in the plots and we would not get the anticipated income out of the sale of animals, wool and other products of the plots.

I have also observed that in the scheme which was started from the year 1975-76 no provision was kept for plantation of some fodder trees on these plots. The economy of the sheep depend in the desert area mainly on these fodder trees which are the main source of the fodder supply from January to June.

It is too early to give any definite opinion about these plots because the required inputs were not provided and I think if some more time is given to the plots then these plots will be economically viable. I am enclosing herewith the details of expenditure and income of the 10 hectare plots handed over to the Society which will give an idea that time to come these plots will become economically viable units in future.

We have now taken necessary steps to provide the fodder tree in these plots by the Forest Department and after this coming monsoon we will start to derive to complete the required number of sheep in the plots. Due to financial limitations, this scheme has not taken to the other districts in DPAP areas m Rajasthan. However, only 5 plots in the Districts of Bikaner, Banner and Jaisalmer will be taken up in the year 1981-82.

In Nagaur and Churu Districts in five plots Chokla sheep have been introduced and in Churu Nail Breed of sheep have been introduced in the plots. The Sheep and Wool Department is going to take crossbreeding programme in 10 plots in Chum and five plots in Nagaur district. So in this way these plots will be a source of supply of good crossbreed rams to other breeders in the area. Due to shortage of exotic rams, this crossbreeding programme is going to be in limited area only.

(Sd.)
(R. K. RATH)
Joint Secretary,

Ministry of Rural Reconstruction
Government of India, New Delhi.

1979-80

Sheep and Wool Department

Statement indicating financial position of D.P. A. P. Plot District Nagaur which have completed four years, handed over to Cooperative Societies

S.

No

S. No.	Name of plot completed	Date of possesion	Total expdr. including Fencing, Kund, Huts, Yard & drafting completed plots	Year of animal in-troduced in develop ed plots	Total sheep introduc ed August, 1980	No. of Coop. Societies upto August, 1980	Total number including wool, manure grass, seed, sale of animal; etc. upto June, 80	Total expdr. labour, stationer y, water, food, fodder, etc.
1	2	3	4	5	6	7	8	9
1.	Gogelow	1975-76	82988	11/76	279	57	35062	7411
2	Khamiyad	17-4-75	73504	11/76	220	88	26108	20338
3	Ratau	10-10-75	67880	11/76	180	38	9379	7878
4	Nimi Jodha	19-10-75	64399	3/77	100	54	8032	6380
5	Baldu	5-4-75	67858	1977	112	67	7941	7504
6	Navarangap ura	25-4-75	76928	1977	127	103	9323	6868
7	Mundwa	26-6-75	90818	1977	185	39	9366	5352
8	Khajwana	28-6-75	69503	1977	194	50	19678	6458
9	Paladi Jodha	2-7-76	78975	1977	220	38	11394	4532
	Total		672853		1617	534	136283	72621

1979-80

Sheep and Wool Department

Statement indicating financial position of DPAP Plot District Jodhpur which have completed four years, handed over to cooperative Societies.

S. No	Name of Plot completed	Date of possession	Total expdr. including Fencing, Kund, Huts Yard & Drafting completed plots	Year of animal introduced in developed plots	Total sheep introduced 1980	No. of Coop. Societies upto 1980	Total income wool, manure grass seed sales of animals etc. upto 1-9-1980	Total expenditure, labour, stationery, water, food, fodder etc.
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Daipada Khichiya	1975-76	105431	2/77	198	31	21283	3674
2	Ghantiyala	1975-76	105974	1/77	231	104	16536	4716
3	Kasti	1976-77	100400	2/77	360	48	23747	6940
4	Ustran	1976-77	93997	3/77	326	48	26958	5843
5	Lohawat	1976-77	81449	12/77	141	50	2684	3676
6	Chirai	1976-77	99814	12/77	185	65	10268	4548
7	Bhawad	1976-77	94326	2/77	227	34	21086	3778
8	Melawas	1976-77	91221	12/77	168	27	9201	3785
9	Malar	1976-77	86067	12/77	115	31	2976	..
10	Denok	1976-77	92977	12/77	250	53	4633	6177
	Total		951656		2201	501	139372	43137

ANNEXURE VII

(Chapter 10)

Pasture Development Schemes in Rajasthan—Pre-Investment Study by ARD in January 1979

A Pre-Investment Study to assess the bankability of pasture development schemes in Rajasthan was conducted by Shri K. S. Suri (Deputy Director Tech) from 26th December, 1978 to 1st January, 1979. A detailed report on the need and objectives of pasture development programmes, research done under operational research projects of CSWRI, Avikanagar and CAZRI, Jodhpur, experience of the work done under DPAP project at Jodhpur and the noims to be adopted for working out the financial outlay and economics of scheme has been recorded by Dr. B. S. Sathe, Director (Tech) [Vide Head Office letter No. Tech. 29129/H(Raj)-78/9 dated the 20th January, 1979]. These aspects are, therefore, not discussed again in this note and only economics and bankability of such projects have been worked out on the basis of the norms indicated in the above report. However, before working out the economics, it is considered necessary to discuss certain management and organisational aspect of such programmes,

Organisational and frSanagement Aspects

2. There are two distinct proposals for undertaking such programmes viz.,

(i) Programme of pasture development on small plots; of individual farmers,

(ii) Programme for pasture development on Gochar/ Government lands owned by Panchayats/Government.

3. As regards programme to be undertaken on small plots of land owned by individual farmers, the study revealed that there was no much scope for undertaking such programme on such lands due to very poor response from the individual farmers.

In regard to Gochar /Government lands, the modus operandi for the implementation of such programme could be on pattern of DPAP pasture plots or through a State-owned corporation preferably Sheep and Wool Marketing Federation already set up by the State Government in the cooperative sector. Under the DPAP Project, a farmer who is a member of the Sheep Breeders Cooperative Society gives the sheen with a maximum number of 10 to the society and the value of the sheep is taken as farmers contribution towards the share capital of the society. The model by law of the societies ensure minimum dividend of 25 percent in the first year, 27 percent in the second year 29 per cent in the third year, 31 per cent in the fourth year and such percentage as may be decided by the society from the fifth year onwards. The alternative proposal for plots to be managed by a State owned Corporation/Sheep and Wool Marketing Federation envisages that the Corporation may purchase the animals on the basis of carrying capacity or a plot and such' expenditure is also to be reckoned tor the purpose of institutional finance under this programme.

4. Under the DPAP pattern of financing the far mers have to find out and arrange for grazing of the remaining flock (i.e. more than 10 sheep) and may- have to continue the practice of grazing under maera- tory conditions for such animals. Even in regard to the sheep given to the society the farmer does not have any involvement and it is more in the nature of investment with assured minimum return. In the alternative proposal too the farmer who sells the animals to the Corporation would not have any stake/involvement.

5. Before we decide the management pattern, the question arises as to what is the main objective of such programmes? The main objective of the pro gramme can be considered to be checking of migra tion of sheep over long distances, with a view to avoiding wastage of considerable energy in physical movements and taking advantage of availability of scientific inputs in order to have higher production of wool and meat as also finding of the programme viz., proper use of waste land, non-irrigable land and conservation of such lands against soil erosion etc. could be considered as supplemental to the main objective. As per national policy, considerable emphasis on sheep development programmes in semi-arid and arid areas of Rajastban is being given and for the purpose various schemes have been formulated or are under the process of formulation and the pasture development programme is to be mainly taken as a supporting programme for the successful implementation of such schemes. Thus, it may be obvious that the main objective is not achieved under both the proposals for implementation of such programme.

6. Now the question is as to what could be the better alternative to achieve the main objective of such programmes? It is felt that the farmers might be given full grazing facilities at least during the lean period of 4 to 6 months for a minimum number of sheep e.g. unit of 30 ewes, and a ram to a farm considered as an economic unit for the purpose of financing of sheep development schemes should be made available in pasture plots. It will ensure full grazing facilities for the entire flock of sheep owned by small and marginal farmers and

agricultural labou rers in the areas where pasture development are taken up. A limited benefit could also1 be made available to medium farmers if large pieces of land are developed under this programme and balance grazing capacity is available. If this propositio n is accepted there may not be any need for providing for operating costs on the salary of shephards and stockman and other over heads as envisaged for in the DPAP Project, except ing watch and ward arrangements for each plot. However, the responsibility of overall supervision of pasture plots, extension unit service, arragements for supply of inputs and providing necessary health cover etc., should rest with the sheep and wool Department and expenditure on the required staff and other over heads for the purpose should be met by the Govern ment. The beneficiary farmers will have to take care of their own flock and watch the grazing of their sheep in the plots allotted to/earmarked for them for the purposes. The economic charges for grazing of sheep and providing them other facilities will have to be decided on the basis of projected returns. This will provide gainful employment to such farmers and ensure projected returns under sheep development schemes and would consequently ensure repayment of bank loans. This would also ensure proper breeding facilities health cover and organised marketing of wool and meat through the sheep breeders cooperative society or the corporation as the case may be. Needless to state that the preference should be given to small farmers, marginal farmers and agricultural farmers and agricultural labourers availing of bank finance for purchase of sheep especially under the Antyodaya programme. If the above proposal is considered feasible a cash flow projection chart indi cating the total returns and apportionment of such income to the farmers and the_ corporation /society especially for the purpose of liqu'dating bank finance obtained by the beneficiary farmers for purchase of the sheep and bank finance obtained by the corpora tio n /society for the purpose of development of pas ture plots can be worked out.

7. It was observed during the course of field visits that there was great/resentment among the farmers for not allowing grazing of cattle in such pasture plots. The discussions with the research personnel in the CAZRI and project officials under DPAP Project, jodhpur revealed that there was scope for allowing scientific grazing by big animals especially when the grass grows taller and in the absence of such facility such grasses have to be burnt at harvesting of grasses and marketing the same for sale to far mers was not economical in view of the transportation and other costs involved. A selective basis of allowing cattle grazing and the charges to be recovered from them will have to be decided by the Governme nt on the basis of their experience and further extension work necessary in this regard.

8. It was also revealed during the course of study that there was scope for income from sale of grass seed and as a matter of fact out of the total income of Rs. 38,806, earned from some of the plots develop ed under the DPAP Project in Jodhpur District, the income from sale of grass seed was as much as Rs. 16,574 from plots developed during 1976-77 and 1977-78. The norms in this connection will have to be worked out for the purpose of projecting such income from pasture plots. It also transpired during the course of discussion that there was ample demand for grass-seeds. The income from the above item and grazing of cattle in such plots will be available fully for liquidation of bank finance obtained for develop ment of such plots.

9. The land for the proposed pasture development plot should be given to the implementing agency on a long term lease at least for the full period of loan, free of cost, since no returns are at present available to the Government/Panchayat due to over-grazing and management.

Financial aspects

10. The capital cost of the development of a 100 hectare plot (representative size) on the basis of norms arrived at during the study and indicated in the tech nical report are worked out in the following para graphs, pending the decision on the alternative pro posals suggested in the preceding paragraphs.

Capital cost

11. The capital cost for development of a pasture plot of 100 hectares including the cost of animals and operating costs capitalised for the first two years and insurance cost capitalised for one year aggregate Rs. 1.66 lakhs as under: —

Year	Amount*
I	70,000
II	40,000
III	21,000
IV	17,000
V	16,000
VI	2,000
Total	1,66,000

The detailed break-up of the costs is given in Ap pendix I. However, if the proposal made in para 6 is considered feasible, the total investment cost for development of pasture plot of 100 hectare would be Rs.70,000 only and there would be no need for capitalising other costs from second year onwards as given above.

Financial Assistance

12. The corporation/Society (implementing agency) would need financial assistance for investment expenditure during the first five years, sixth year's expenditure is quite nominal and can be met out of own resour ces. Debt equity ratio of 40:60 is considered desir able from the point of view of bankability of the project. Accordingly financial assistance works out as under :—

Year	Financial outlay	Equity contri bution of the Corporation Society	Financial assistance
	Rs.	Rs.	Rs.
I	70,000	42,000(60%)	28,000(40%)
II	40,000	24,000	15,000
III.	21,000	12,600	8,400
IV.	17,000	10,000	6,800
V.	16,00q	9,600-	6,400

However, if the animals are not purchased as per proposals made in paragraph 6, the financial assistance would be needed for meetng investment cost to be incurred in the first year alone and in that case a margin of 25% can be considered as adequate.

Economic and repayment period

13. Economics of a 100 hectare plot indicating the projected income and expenditure for 15 years is given in Appendix II. While working out these economics the following assumptions have been made:

(i) The optimum carrying capacity of sheep is about 580 adult equivalent sheep for 5th year onwards. Keeping this in view a herd projection for 6 years has been worked out in para 11 of the technical report. The number of animals available for wool and meat production has been worked out on the basis of herd projection as under:

A. Wool production	Number of animals product taken for wool production					
	YEAR					
	I	II	III	IV	V	VI
Ewes		180	270	380	475	10
Rams		4	6	5	475	138
Ewe Lambs		63	95	126	10	158
B. Meat Production	No. of animals taken production for meat					
	YEAR					
	I	II	III	IV	V	VI
Ewes		40	60	80	100	100
Rams		..	..	3	2	3
Male Lambs		63	94	126	157	157 + 17 ewe lakhs

The yield for wool production and the live weight for the purpose of meat production have been assumed as under:

	Wool Yield (in kg)		Average live weight of animals for the purpose of meat Production	
	II & III Year	IV Year	II & III year	IV year onwards
Ewe	1.2	1.5	20	25
Ram	1.5	2.0	35	40
Lamb	0.6	0.75	15	15

(ii) The average ineonie from sale of manure has been assumed at Rs. 10 per sheep per year on the opening stock of ewes and rams.

(iii) The price of wool has been assumed at Rs. 18 per kg. on the basis of the prevalent market prices, while that of meat Rs. 4 per kg. of live weight being paid by the State Sheep and Wool Federation.

(iv) The expenditure on insurance premium has been taken at 3.5 per cent per annum on the cost of opening stock of ewes and rams.

(v) The operating costs have been assumed at Rs. 2400 in the first year and Rs, 13,300 in the second year as per para 12 of the technical report, from 3rd to 5th year average increase of 10% per annum on the cost of the preceding year has been assumed.

(vi) The income and expenditure have been assumed to be constant from sixth year onwards.

(vii) No provision has been made for repairs of certain items of investment like fencing, sheep pen, water tank or other building etc. Again, no provision has been made for

receding, which will, of course be quite nominal. Similarly, the income from sale of grass seed, grazing of other animals or sale of grass has not been taken into account. Thus such expenditure could be easily off set by the other income not taken into account.

14. On the basis of the surplus available from 3rd year onwards it is proptosed to fix the repayment schedule as under:

Loan instalments issued in the first and the second year together with interest thereon capitalised for the first three years period can be recovered in 10 annual equated instalments from fourth year onwards. The loan instalment issued in third, fourth and fifth year can be recovered in seven annual equated instalments from fifth year onwards. However, interest on such instalments can be recovered in the same year or in other words there will be no holiday for payment of interest in so far as third, fourth and fifth instalments of loan are concerned. Accordingly the repayment schedule is given in Appendix III.

Recommendations

15. The pasture development programmes are of paramount importance for checking the migration of sheep and successful implementation of sheep develop ment programmes being taken up on large scale in the arid and semi-arid zones of Rajasthan State. Financially viable projects for undertaking such programmes on large plots of unirrigable and waste lands owned by Panchayats/State Government can be financed by Banks with refinance facility from ARDC. However, the main issues to be settled before taking up such projects for financing are:

(a) Which agency would be most appropriate to im plement these programmes and what should be the debt equity ratio?

(b) What should be the modus operandi of implementing such programmes i.e., whether on the pattern of DPAP Project or on the basis of outright purchase of animals by a State-owned Corporation/Sheep and wool Cooperative Federation or on the pattern suggested in para 6 of the report?

(c) Whether selective grazing by cattle could be allowed as suggested in para 7 of the report and if so, what should be the basis?

It is suggested that decision on the above issues may be taken in consultation wilh the State Government and Government of India.

16. After a decision on the above issues is taken, we may give broad guidelines suggesting the organisational and management pattern and technical and financial norms to the State Government for formulation of suitable pasture development projects for different areas in the State. It may be mentioned in this context that a project for development of some pasture plots on the left bank of Rajasthan Canal has been prepared at the instance of Irrigation Commissioner and is under consideration of the Sheep and Wool Department. This project, with such modifications as necessary, can be taken up for financial assistance on pilot basis.

Sd/-
M. C. BHANDARI
Deputy Director
14th February, 1979

APPENDIX I

Cost of pasture establishment under one hectare of land in the project area
(As per estimates of CSWRI, Avikanagar)

(A) Fixed Cost		Rs.
(i) Bunding around the field @ Rs. Rs. 5 per 100 cubic feet		268.00
(ii) Fencing with prosopic juliflora 20 kg. seed		
@ Rs.4per kg + one manday		80.00
@ Rs. 5		5.00
(B) Land preparation		
(i) Bush cleaning 10 manday @ Rs. 5		50 00
(ii) Disk plough Cultivation (one) ® Rs.75 per hectare		200.00
(iii) Ploughing with cultivator (one) Rs.75 per hectare		75.00
(C) Receding Pasture Grass		
(i) Seed Rate (Concherus and Clitoria) 16 kgs.		
Cost @ Rs. 4 per kgs.		6400
(ii) Sowing 10 mandays @ Rs. 5		50.00
(D) Plantation of Fodder trees		
(i) 100 plants/hect. @ Rs. 0.25 plant		25.00
(ii) Planting—5 mandays @ Rs.5		25.00
(E) Fertilisation		
(i) Urea 90 kg.		157.00
(ii) SSP. 144 kgs.		115.00
	Total	1104.70
Recurring Costs		
(i) Salary of the watchman kept for seven months (July to January of next year @ Rs. 4.50 per day for 182 mandays)		819.00
(ii) Harvesting of grasses		
25 mandays @ Rs. 5 per day		125.00
	Total	944.00

Income

(i) Fodder production (Green fodder) per hectare in one cuttings:

1st Year	2nd Year
95 quintals	118 quintals

Note: From February to the onset of rains plots were kept open for the grazing of livestock.

APPENDIX II

List of miscellaneous articles given to Stockman in pasture plot (100 hectare)

1	2	3	4
1.	Shovel	3	13.25
2.	Torch	1	18.50
3	Lamp	1	13.45
4	Pick-axe	3	22.50
5.	Bucket	2	18.00
6.	Tagari	3	14.80
7.	Wooden Box	1	103.00
8.	Ghada	2	19.00
9.	Lock	1	7.50
10.	Steel folding chairs	2	6500
11.	Drum (iron) for food	1	115.00
12.	Steel folding table	1	136.00
13.	Carpet (cotton)	1	65.00
14.	Tray (iron)	1	7.00
15.	Lamp (Post)	1	55.00
16.	Spring balance of weighing lamps	1	250.00
17.	Rain gauge	1	87.00
18.	Tarpauline	1	118.00
19.	Lota (mug)	1	18.00
	Total		1147.20

APPENDIX III

Repayment Schedule

Year	Loan Instalment	Interest capita-lised	Total amount for re-payment	III year	IV year	V year	VI year	VII year	VIII year	IX year	X year	XI year	XII year
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
I.	28000	10294	38294		9861	9861	9861	9861	9861	9861	9861	9861	9861
II.	16000	3714	19714										
III.	8400	—	8400	924	924								
IV.	6800	—	6800	—	748								
V.	6400	—	6400	—	—	4580	4580	4580	4580	4580	4580	—	—
	Total			924	11533	14441	14441	14441	14441	14441	14441	9861	9861

Large Sheep Breeding Farm	*Distribution of Rams*							*Production of Rams (1978-79)*			
	1973-74	*1974-75*	*1975-76*	*1976-77*	*1977-78*	*1978-79*	*Total*	*Exotic*	*Cross*	*Indigenous*	*Total*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
1. A.P. Hyderabad Mamidia Pally (9000 acres)	105	66	300	222			823	—	497	245	742
2. Karnataka — Chitradurga, Challakere (9000 acres)			67	41			255	—	638	78	716
3. J &K Anantnag Daksum (13,000 acres)	—.	213	229	250			942	572	—	—	572
4. Raj, Sikar, Fatehpur. (7,500 acres)	—	—	3	100			266	327	278	—	605
5. U.P. Varanasi, Bhaivsora	—	—	23	42	20	61	146	43	158	9	220
6. Bihar, Hazaribagh Chatra (2000 acres)	Established in the end of Fourth Plan or Fifth Plan.							--	55	--	55
7. Madhya Pradesh Shiv-puri (8,500 acres)								--	280	--	280

Hissar Large Sheep Breeding Farm in 7000 Acres

Distribution of Ram			Distribution of Rams		
Year	Exotic	Cross bred		1979 — 80	1980 — 81
1971-72	19	—	Exotic	877	868
1972-73	41	20	Crossbred	357	675
1973-74	14	11	Indigenous	13	10
1974-75	8	—	Total	1247	1553
1975-76	1060	15			
1976-77	241	169			
1977-78	546	55			
1978-79	353	172			
1979-80	205	> (Break-up not available)			
1980-81	661				
Total	3590				

11. PASTURE DEVELOPMENT AND RANGE MANAGEMENT

11.1 Pasture development in drought prone areas, apart from increasing fodder availability and thereby promoting development of animal husbandry, confers the benefit of providing grass cover on lands subject to wind and water erosion.

11.2 The major concentration of the hot arid and semi-arid areas in the country is in the States of Andhra Pradesh, Haryana, Karnataka, Maharashtra, Gujarat and Rajasthan. These areas usually suffer from long periods of total dry spell or scanty to uneven and erratic rainfall. Rainfed agriculture cannot be depended upon and is rather risky in these areas. The people of the area, therefore, have to depend onother sources of livelihood and animal husbandry is one of the programmes which sustains them during long periods of drought. Animal husbandry thus plays an important role in the rural economy of the drought prone area.

11.3 Improved breeding and animal health cover alone is not adequate for achieving the productive potential of the improved breed animals. Scientific feeding of livestock is of crucial importance for improving their production. Unless the livestock are fed adequately and with quality fodder to provide all the nutrients in required proportions, their productive potential is not realised in the form of increased production of milk and other animal products. No lasting improvement can be brought about by breeding alone, for improved breeds deteriorate rapidly if not fed properly. Adequate production and good quality of fodder and grass thus becomes a pre-requlsite for the success of animal husbandry programme, so vital to the economy in these areas.

11.4 The drought prone areas are characterised by the scarcity of fodder and grass for feeding livestock. The arid districts have less than 5 per cent area under pasture. Though the pasture areas in the other DPAP districts are larger, no district has above 14% of this area under pasture (Report on Integrated Agricultu ral Development in Drought Prone Areas, Planning Commission 1973).

11.5 The findings of the study made about the land utilisation pattern in arid regions of Rajasthan by the Central Arid Zone Research Institute, Jodhpur as analysed from the table are as follows :—

Livestock Population in different Agroclimatic Zones in Arid a districts Rajasthan and its Pressure on land

Agro climatic Zone	Total Area 000 per ha.	Area (000 ha) cultivation	Under grazing	Total livestock ACU nillions)	Land availabl e in ha. ACU			Shortage of forage during normal years
					Total	Cultivable	Grazing	
Zone 'A' Mean annual rainfall below 300 mm,	11498 (55.12)	36.10 (38.61)	5784 (67.56)	2.043 (30.34)	5.67	1.76	2.83	42.0
Zone 'B' .	9361	5741	2777	4.690	1.996	1.22	0.59	35.0

	(44.88)	(61.39)	(32.44)	(69.66)				
Mean annual rainfall above 300 mm								
Total	20859 (100.00)	9351 (100.00)	8562 (100.00)	6.733 (100.00)	3.09	1.38	1.27	35.1

Figures in paranthesis indicate percentages.

ACU — Adult Cattle Units.

11.6 It would be seen from the table that the area under cultivation is higher (61.39% in zone B) receiving average annual precipitation of 300 mm and above, while it declines (38 61%) sharply in Zone A with annual rain-f all "below 300 mm (Ahuja and Mann 1975) In district like Jaisalmer (with annual rainfall below 200 mm), the area under cultivation during normal years of rainfall is about 5%. Hence, most of the cropped land is mainly grassland—a source of livestock production for local economy. The shortage of forage for existing livestock population amounts to 42.0%, 35.0% and 35.1% in Zone A and B and total arid zone respectively. Situation becomes alarming during years of scarcity.

11.7 The uncropped lands and those falling under land capability class V and above are sources of devastation of nearby fertile agricul tural lands through erosion hazards. Range land or grass land may be defined as land from where agriculture cannot be sustained on sound footings due to hostile agro-climatic conditions (Ahuja, 1977). These are best suited for use as range lands, a good source of livestock sustenance. Due to continuous mis-use, these lands are deteriorating resulting in economic losses.

11.8 Notwithstanding the land resources con straint, these areas do offer considerable scopes for pasture and fodder development on the available areas if the latest technology for fodder crops and pasture developed evolved at the Central Arid Zone Research Institute, Jodhpur, the Indian Fodder Grassland Research Institute, Jhansi and other places is adopted appropriately. A summary of the important findings of the CAZRI and the Central Fodder and Grassland Research Institute at Jhansi with its five regional stations at Hyderabad, Ananta- pur, Rajkot, Rahuri and Jodhpur is given in Annexure 1 to V.

11.9 The Task Force on Rural Development (1973) appointed by the Planning Commission had recommended that the Government and the community waste lands which are as high as 30% in a number of districts should be deve loped into pastures. A portion of village common lands were to be developed to serve as a basis for fodder bank and the programme was to be supplemented for fodder crops around sources of irrigation.

11.10 The National Commission on Agricul ture had also gone into this question in great detail both in it's Interim Report on Desert Development and in the main report (1976). In its interim report on desert development, it had particularly drawja attention to the fact that there will be large areas having less than 500 mm of rainfall where supplementation of the preci pitation on the land by artificial means might not be possible and, if possible, may be limited. They have, therefore, recommended that in such areas, which cannot ordinarly support any worth while production of arable crops but are good for some grasses and trees, pasture economy is the only answer.

11.11 The National Commission on Agricul ture in its main report had laid great stress on the production of fodder to support the massive animal husbandry programme which the Commission has considered feasible and recommended to be attempted. The broad

recommendations of the Commission (para 6.1 of the main report) on this aspect are as follows :—

> "The vast majority of cattle and buffalows in India are maintained! on the agricultural byproducts consisting of roughages of law nutritive value. While the growth of roughages of low animal population is almost unrestricted, the available feed resources for these animals have not kept pace with the increase in their number. The country has embarked on a massive crossbreeding programme to enhance production of milk and other livestock products. Increasing attention is also being given for improved animal health cover but feeding and nutrition requirements of the animals have been grossly neglected in the past and even now feed and fodder development programmes are receiving comparatively little attention. The available feed resources, being limited, must be distributed appropriately and in such a manner that these are put to best use for increasing production of milk, meat, wool, eggs etc..
>
> Green fodder production is the most important single factor on which will depend the success of the animal husbandry programmes. By 2000 AD, the total requirement of green fodder will be of the order of 595 million tonnes besides that obtained from grazing. The area under fodder crops will, therefore, have to be increased from the present 6.19 Mha to 16.5 Mfia in order to support and build up the country's animal husbandry. In order to cover the area required for fodder production, there should be a strong research base for undertaking an effective programme for the evaluation of high yielding, nutritionally superior and disease-resistant varieties and the standardisation of package of practices as are applicable to different agro-climatic regions. There should also be massive farmer-oriented extension programmes on fodder crops, both for production as well as conservation, and efficient arrangements for the production, from breeder to the certified seed stage, distribution and timely supply of seeds high yielding varieties to the farmers".

11.12 Separate figures of expenditure under DFAP, on pasture development alone are not readily available. As regards the physical achievements, it has been reported that 80,805 hectares have been covered during the period 1-4-1974 to 31-3-1979. This is exclusive of the area covered under social forestry by the Forest Department. The evaluation studies of the three districts (Kurnool by NIRD, Jhabua by Shri U. K. Srivastava published by Abhinav Publications 1978 and Panchmahals by the Operations Research Group, Baroda—all published in 1978) have brought out that the financial allocation for pasture development in Jhabua district was only 4.57 per cent of the total DPAP outlay for the district. Another important problem in the implementation of pasture development was lack of seeds of suitable grass species in adequate quantities. The new varieties of grass put into the field by the Forest Department were obtained from Dehradun Research Institute. There were problems of adoption of these varities. The allocations for the animal husbandry sector in Jhabua were nominal and hence no fodder development activities were undertaken. In Kurnool district, on the other hand, fodder and pasture development schemes such as fodder demonstrations, fodder seeds distribution, sheep pastures were planned but the progress was not satisfactory. The same was true in the case of Panchamahals -district also. It is thus necessary to plan the pasture and fodder crops development properly and implement a package of technical recommendations within the watershed frame for the success of the programme.

11.13 DPAP have also taken up another programme in IDA assisted districts to develop 100 hectares plots of degraded communal grazing lands along with the sheep development.

Summary of the evaluation studies of this programme by the Ministry of Rural Reconstruc tion is given in Annexure VI. As this programme is linked with the development of sheep, the Committee has examined it in great detail in the chapter on 'Livestock Development'. A pre-investment study to assess the bank ability of pasture development programme in Rajasthan was conducted by the ARDC in January 1979 alongwith the development of sheep. This has also been discussed in the Chapter on 'Livestock Development'.

11.14 The National Commission on Agricul ture (Volume VII) (page 398) had referred to the report of the Committee on Livestock Feeds and Fodder, 1974, Ministry of Agriculture and Irrigation, which had estimated the requirements of different feeding stuffs for providing suitable rations for all categories of animals and com pared the figures with the amounts available as follows :—

Requirements and availability of different feeds in 1978-79

(Million tonnes)

Type of feed	Requirements	Available	Deficit
1. Concentrates	25.445	16.640	8.981
2. Dry Fodder	353.000	300.540	52.460
3. Cultivated Fodder	388.070	261.000	127.070

Separate estimates of requirements and availability of feed stuffs for drought prone areas are not readily available. The above figures of deficit, however, give an idea about the grave problem of feeding livestock in the country. The magnitude of the problem increases further if we take into consideration the situation in drought prone areas. For example, in Panch-mahals district, the total requirement of green and dry fodder was 47.26 lakhs and 14.22 lakh tonnes respectively, while the availability was 5 and 10 lakhs tonnes only. Again according to the report of the Task Force on Rural Development, the forage requirements in the districts of Western Rajasthan were estimated at 16.2 million tonnes while the available supply in a normal year was 10.7 million tonnes. This shortage of over 35 per cent in a normal year gets further aggravated in a drought year.

11.15 The recommendations of the National Commission on Agriculture (referred to in paragraph 11.10) postulates a deliberate policy to increase pasture lands from 6.19 Mha to 16.5 Mha by 2000 AD through a phased programme of development. This large increase in area is necessarily to be achieved by reserving all available grasslands still with Government for intensive fodder development. It also means that all marginal lands which are now deterio rating by wrong use for agriculture should be brought out back to their proper role of sup porting pastures and development of green fodder. A conscious policy fixing annual targets in the various States for an existing grassland development and marginal land development is the answer. The identification and allocation of areas, should be based on the regional expectations of development of types of domestic animals and their quality as have been postu lated in the recommendations of the National Commission on Agriculture.

11.16 Grasslands under the control of Government are available not only in the village limits where they are recorded as grazing lands for the community, but large areas as to date exist in several States in the grey area between the reserve forests and the village boundaries. These large areas are generally available in the zones where the former Princely States existed. In addition, forests preserved by the Forest Departments under various categories have very little tree cover over a large area, as pointed out by the National Commission. Much of these lands may be of the marginal varieties where pasture deve lopment is the ready

answer. Immediate action should be taken to identify all these three classes of available potential grasslands. It will be seen that substantial parts of all such available lands are in the "Drought Prone Areas".

11.17 For planned grassland development leading to intensive fodder production, the area has to be kept out of the nomadic grazing by scrub animals that goes on endlessly in all these lands by scrub animals. Two types of fencing have been experimented within the country. In Rajasthan where pasture development was experimented for some years now, CAZRI has estimated that fencing with iron poles and barbed wire will ultimately be the cheaper, in case larse areas have to be broueht within the fence. In the old Community Development Programme, pasture development of 50-100 acres in compact areas had been attempted with "a cheaper tyne of fenc ing where the soil is reasonably hard. In these experiments which were successful, a ditch and embankment method, with a controlled entrance to the fodder reserve, has proved highly successful and also cheap. The nature of the soil in the grasslands that have been identified will enable the planners to decide which parti cular type of fencing will have to be "used and what will be the minimum area of land that would be economically maintainable. This exercise will have to be done simultaneously by each State, while identifying the grasslands.

11.18 The above programme of identification of grasslands and intensive development can generally be followed without much difficulty in areas reasonably away from the village sites. Where such lands are close to the village and in the areas demarcated as grazing lands within the village boundry, the strategy of development will have to adapt itself to the people's need. Even if these lands have no fodder of any sort and are carrying unwanted and toxic bushes unsuita ble for animal cropping, the local community will strongly object to any fencing of these areas for intensive fodder development. It is suggested that in these areas, initially, only a part of the range be fenced by the cheapest method and intensive fodder development done. The fodder so developed be fed by manual harvesting and feeding to a certain number of sheep and cattle of the poorer sections of the community. A demonstration of this nature will convince the community that by allowing gradual expansion of intensive fodder areas, their domestic animals will ultimately gain very substantially. This is not a one shod affair but a continuous adjustment of the programme. The Committee would recom mend that this sociological approach is very much necessary.

11.19 The National Committee on Agriculture had in its report on Desert Development recom mended intensive programme for sand-dunes stabilisation in the desert areas of the country. Sand-dunes fall across government lands and private lands. Unless the sand-dunes stabilisa tion is done on a compact area basis and on a drainage basis, the sand-dune stabilisation will not take place. The stabilisation process naturally leads to vegetative cover of the sand-dunes. It has also been recommended that this cover should be established by suitable grasses. There is a temptation for the nomadic cattle and sheep breeders to drive their cattle and sheep over these sand-dunes stabilisation systems, Under the garb of private rights. In the interest of the commu nity's welfare, the Committee would recommend some legislative measures to ensure a complete fencing of all the land and ensuring and preventing direct grazing on such sand-dune stabilised areas. The grass will have to be harvested by manual labour and fed to the cattle and sheep.

11.20 Naturally, grassland development cannot be taken up all over the area identified for such development. It is recommended that it would be desirable to take up the development work initially in areas where reasonable accessi bility to water facilities are available so that the stabilisation of the grasses and fodder can be accomplished quickly so as to demonstrate

the benefit from the new method to the people before they lose patience with the reservation. Once the potential is established in any region, if will be easier than to move to the area where grassland stabilisation will take a longer time.

11.21 In the desert areas, CAZRI has esta blished that there are large amounts of unwant ed bushes which will hinder the growth of the grasses that are specially to be developed in the grasslands. These bushes are in the nature of weeds. Grubbing of such unwanted bushes has to be an essential part of grassland development and the expenditure should be provided for. Grubbing and replanting would have to be simultaneous.

11.22 The utility of fodder trees and syste matic management of fodder trees to maximise yield has been established by the Bharatiya Agro Industries Foundation through its pro gramme of kubabul (Lucasis Leuco Cephala) development. Verious fodder trees are already in use in various parts of the country, but mostly in a pollarded stage by indiscriminate cutting. In the grassland ranges if the soil profile will allow for it, the margins of the fenced area can be developed with either fodder trees or fodder shrubs to act as a further protection against intrusion of cattle. Such fodder can be harvested manually and fed. These fodder belts round the fodder farm will act as a wind brake in areas where hot summer breezes shrivel the grasses. :

11.23 On range lands with shallow soils and rolling topography different soil conservation measures, viz., contour furrows, contour bunds and contour trenches should be provided. Cost of such works is about Rs. 150 per hectare and can be covered through increased forage produc tion in 3-5 years period (Ahuja 1977).

11.24 The Committee has recommended an intensive sheep breeding and got breeding programme in the country. Both sheep and goat are part of the nomadic economy. The grass lands away from the village settlement that are developed either in the government areas or reserve forest areas will have generally to be protected against indiscriminate grazing. In nomadic sheep rearing, the problem of improve ment of the breed through artificial insemination or direct cover becomes difficult unless the flocks can be brought together to a fixed place during the breeding season. These large grass reserves can be utilised as such centres for bringing together the sheep flocks of nomadic breeders at the time of breedfng. Later, when the lambing takes place, the ewes and the Iambs can also be kept in the settlement round the grassland with permission to utilise grasses inside the reserve. Thus, active improvement of breed can be done. There is scope for this approach, particularly in the States of Rajasthan, Gujarat, Haryana and Maharashtra where sheep breeding is even now sufficiently large. It can be usefully introduced in the Southern States to extend the flocks rapidly where mutton breeds will be the order of the day.

11.25 All nomadic cattle and sheep rearing suffer periodically from lack of fodder, during serious droughts in their area of operation. There is already an established system in Rajas-than and in some parts in Maharashtra and Gujarat to have fodder reserves of dry fodder for utilisation during the crises. Once organised grasslands are developed throughout the country, it will happen that for maximisation of yield there should be periodical harvest of the crop. There may be excess supply in certain parts of the season when the nomadic flocks can find natural ranges. It should be general practice to harvest such surpluses and maintain reserve in the large grasslands of the country for utilisation during serious droughts in the areas surrounding. The necessary technology for hay making with necessary equipment should be part of the grassland development programme.

11.26 Grassland development programme will have to be on a package basis, with a link up of research, extension, infrastructure development, input supply and control. The Committee would re-emphasise what the National Commission on Agriculture has stated:—

"In order to cover the area required for fodder production, there should be a strong research base for undertaking an effective programme for the evolution of high yielding, nutritionally superior and disease-resistant varieties and the standardisation of package of practices as are applicable to different agro-climatic regions. There should be also massive farmer-oriented extension programmes on fodder crops, both for production as well as conservation, and efficient arrangements for the production, from breeder to the certified seed stage, distribution and timely supply of seeds of high yielding varieties to "the farmers".

ANNEXURE I

Technologies recommended by the Central Arid Zone Research Institute for development of Grassland and Pastures

1. Identification of grasses and legumes for different habits

Habitat preferences like well drained soils for C. ciliaris, C. Setigerus, Panicum antidotale light sandy soils for Lasiurus sindicu and medium to heavy textured soil for Dichanthium annulatum have been determined.

2. Improved strains/cultivars of grasses

The strains/cultivars identified are: —

Cenchrus ciliaris

Nos. 231, 214, 220, 358 and 1227 (dry matter yield 5.1 to 10.2 t/ha).

Cenchrus setigerus

Nos. 411, 569 and 296 (dry matter yield 3-3 to 5.5 t/ha).

Panicum antidotale

Nos 28, 627, 384, 617 (dry matter yield 4.6 to 8.6 t/ha).

Pasturus sindicus

Nos 553, 319, 317, 314 and 323 (dry matter yield 6.8 to 10.0 t/ha).

Dichanthium

Nos. 495 484, 408, 436 and 298 (dry matter yield 6.5 to 8.9 t/ha).

3. Improved strains of legumes

Annual legumes viz., guar (Cyamopsis tetragonoloba) moth (ghaseolus acentifolius) and cowpea (Vigna Un-guiculate) biennial legume like Dolichos lablab. and perennial legume like Cliioria ternatia have been identified for grass legume mixtures. Recommended varieties of these legumes are: —

Guar	Durgapura safed and FS 277.
Moth	T3, T-23 and Z adia.
Cowpea	FS 68 and HRC 42.1.

Dolichos lablab war, lignosus strain 144.

4. Pasture agronomy

Agronomic practices like tillage, time of sowing, method of sowing, depth of sowing, and seed rate etc, have been standardised.

5. Pasture management

(a) Based on grand growth period, the optimum time for harvesting grass to obtain not only good dry matter yield but also preserve its nutritional value has been worked out.

(b) Inter-cropping grasses with legumes increase the forage yield by 20-30% of pasture.

(c) A water harvesting device 'CAZRI pitting Diskef developed at the Institute has been found very effec tive in soil and water conservation whereby the forage yield increased bv 84% and 52% in natural and culti vated pastures respectively.

6. Silvi pasture

(a) P. cineraria is most suitable tree for silvipastoral programme while P. juliflora has been found to be unsuitable.

(b) The winter forage production of L. sindicus can be enhanced when longer cutting intervals are followed during the monsoon growth,

(c) Application of nitrogen and sulphur to desertic ranges may not be necessary as these nutrients are added in sufficient quantities in the soils of desert re gions through rainwater.

7. Pastiase Utilisation

(a) In sown pasture three sheep/ha can be main tained on year round basis without deterioration of the pasture, in comparison to natural pasture which can sustain only one sheep/ha.

(b) Mixed pasture of C. Ciliaris and C. Setigerus is suitable for maximum growth weight (17.5 kg) in ram lambs born in July-August in average 100 days.

(c) The animals fed on cultivated pastures give higher percentage of dressed meat (46.8) and muscle protein (5.80) than those grazed on natural one (43.2) and (4.36) respectively. Besides, the fat percentage of selected muscles and haemoglobin percentage of select ed muscles and haemoglobin percentage of blood was also higher in the former cases.

(d) Performance of weather on sown and natural pastures fed with supplementary ration like 200 gm guar +50 gr. moong +50 gr. bajra +200 gr. pala per animal per day was better than the animals which were given no supplementary food.

ANNEXURE II

Highlights of the research work done by the grassland Research Institute, Jhansi under DPAP/DDP Programmes of the Ministry of Rural Reconstruction (Source : Ministry of Rural Reconstruction)

The highlights of the research work done at the five centres with regard to pasture development are as below: —

(i) The performance of stylosanthesis Hamata has been outstanding at Hyderabad, Anantapur and Rahuri and produced 4.4 tonnes DM /ha.

(ii) The performance of S. Scabra and S. Visposa has also don© very well at the above centres but not so good at Jodhpur and Rajkot. The yield has been over 5.5 tonnes of DM /ha while at Hyderabad S. Scabra yielded 5.2 tonnes DM/ha from one cutting after 65 days growth.

(iii) The production oi S. Humilis was 3.9 tonnes DM/ha. in another experiment, at Hyderabad, a mixture of Sirato S. Humilis, S. Hamata, S. Scabra, S. Viscosa. Cenchrus and Urochloa resulted in good establishment. Similar results have also been achieved at Rajkot, Rahuri and Anantapur.

(iv) Two promising perennial legumes viz. Dolichos Lablas (strain No. 144) and Clitoric Teranation have proved to be suitable for arid zone pastures. A combination of Citoria Ternafia and L. Sindicus gave a better yield, even upto the third year of testing, whereas Dolichos Lablab yielded the same in the first year and was eliminated in the subsequent years of testing. Clito-ria Ternatia also proved to be good in combination with other grasses like Cenchrus Ciliaris and Cenchrus Setigerus.

(v) A good nucleus of high yielding and palative perennial grasses such as Cenchrus Ciliaris and Lasires Sindicus is available in the Northwestern parts of Rajasthan and Dicanthium anniultum Sehlme nervosum and Chrysopogon fulves in the South-Western Rajasthan.

(vi) The maximum dry forage yield of 5.8, 3.4 and 3.0 tonnes per ha. have been obtained from Dicanthium annulatum, cenchrus spp. and lasiurirus Sindicus respectively in well established reseeding strip of high perennial grass spp. Reseeding has not succeeded in saline soils, salt tolerant spp. like sporobolus has given forage yield of 210 tonnes per ha.

On the basis of the progress achieved so far in all the 5 centres, the Expert Team has suggested the following spp. for different climatic areas: —

(i) Stylosantheses spp. shows great promise of establishment under soil and moisture constraints prevailing in the drought prone areas of the Deccan Plateau. These legumes could also enhance the quantity of the forage available per ha.

(ii) These spp. seed germinate profusely and indications are that they could be sown through broadcasting, even on unprepared and unfenced lands.

(iii) Cenchrus and Styles can be grown in conjunct tion with each other. A mixture of grass, Pani-cum, Urocholoa and stylosanthes can provide adequately nutritious pasture for livestock development.

(iv) Limited work with chemical fertilisers and micro-nutrient application has not yet yielded any conspicuous results.

(v) The Stylis spp. are very susceptible to frost and cannot, therefore, be grown separately in western Rajasthan.

(vi) Preliminary yield estimates in some DPAP districts vary from the lowest of 0.2 tonnes per ha. dry matter in drought period to about 3 tonnes/ ha. In excellent seasons great differences in yield exist between individual range land sites.

(vii) Total production of dry matter of grass and legume spp. per ha. may be seen at Annexure III.

The grass and legume spp. suitable to different rainfall conditions may be seen at Annexure IV.

Grass and legumes adaptable for different land forms and habitats in the country are at Annexure V in a condensed manner.

Most suitable species for the State of Rajasthan are: Buffel Gayndah, Buffel Bioela and Buffel Molopo and the Legume spp. are Siratro, Rongaidolichos and S. Hamata. All the above grasses and legume spp. have been assessed as good except Siratro which is very good. The overall assessment of exotic grass and legume spp. in the Deccan Plateau have been found to be in the categories of good and fair. The list hereunder explains the performance in descending order:— Cenchrus Ciliaris (local strains), Callida Rhodes Buffel Biloela, Buffel Molopo, Buffel Gayndah, Rhodes Grass, Sabi grass and Green panic. Stylo San-theses Scabra, S. Hamata, Dolochos Species, Siratro and Stylosanthesis humilis.

ANNEXURE III

Total production of Dry Matter of Leguma Species and Grasses (in tonnes per hectare)

Grasses and Leguma Species	Total Production dry matter (tonnes/ha.)	Remarks
Grasses Species		
1, Dichanthium annuiatum,	5.8	CAZRI, Jodhpur
2. Cenchrus Spp.	3.4	do
3. Lasiurus Sindicus	3.0	do
4. Sporobolus	2.0	do
Legume Species		
1. Stylosanthes Scabra	5-5	Hyderabad
2. Stylosanthes Scabra(40205)	5-2	Hyderabad
3. Stylosanthes Hamata	4-4	Hyderabad
4. Stylosanthes Humilis	3-9	Hyderabad

ANNEXURE IV

Grasses and Legumes Adaptable indifferent rainfall conditions

Rainfall (mm)	Grasses	Legumes
300	1. Lasiurus sindicus	1. Laichhardi dolichos
300-500	1. Cenchrus Ciliaris	
(arid and partly semi-arid areas]	(a) Buffel Gayndah (b) Buffel Bioela (c) Buffel Molopo	
	2. Cenchrus Setigerus	
	3. Panicum Antidotale	
500—700 (semi-arid areas)	1. Cenchrus ciliaris (a) Buffel Gayndah (b) Buffel Bioela (c) Buffel Molopo 2. Panicum Coloratum varimakari kanence 3. Rhodes grass 4. Callide Rhodes grass 5. Sabi grass	1. Dolichos Beans or Dolichos lablab 2. Styloantheses Humilis 3. Styloantheses Hamata 4. Siratro (macroptilium atropurpurium)
750—1000 (Dry-Sub-humid areas)	1. Cenchrus Ciliaris 2. Rhodes grass 3. Sabi grass 4. Guinea grass (Panicum maximum) 5. Plicatulum (Paspalum Plicatulum) 6. Setaria	1. Desmodium silvery leaf 2. Glyeine 3. Archar Dolichos 4. Stylosanthes Hamata
1000 and above (sub-humid and rainfall areas)	1. Green Panic 2. Signal grass	1. Glyeine 2. Stylosanthes-quyanesis (township Ville style)

ANNEXURE V

Grasses and Legumes Adaptable for different Landforms and Habitats in the Country

S. No.	Name of region	Forage grasses		Legumes	
		Black soil	Red/Alluvial soil	Black soil	Red/Alluvial soil
1.	High hills of J & K, HP and UP	Lolium Spp.	Dectylisglomerate Pestuea arundinacea	Trifolium pratense	Trifolium repens Lupinus hirsutus
2.	Estern Haryana, High hills	Loloum spp.	Dsctylis glomerata Festuca spp.	Trifolium Pratense Russian Chounoulier	Trilolius repens, Luphl-nus hirsutus
3	Low rolls of J & K, HP and UP.	Dichanthium annuiatum, pennisatumpedi-cellatum	Chrysopogon fulvus, Cenchrus Ciliaris	Pueraria Rirsuta.Stu-zikibium deringianum	Phaselous astrcpuf pureus, Stylosanthes Humalis.
4.	Estern low hills	Dichanthium atinulan-tum	Pennisetum Polysta-chyon	Medicago Sativa,	Vigna sinesis Glycine, javanica

S. No.	Name of region	Forage grasses		Legumes	
		Black soil	Red/Alluvial soil	Black soil	Red/Alluvial soil
		panicum maxi-mum		Stylosanthese gracilis, Doliches Lablab	Desmcdium Intortum
5,	Southern Plateau	Dichanthium spp. Panicum Antidotale	Sehima, nervosum, chrysopogon fulvus Cendhnus ciliaris C. Setigerus	Dclichoslabla b Doli-chosanillaris	Stylosanthes humils, stylosanthes scarbra stylosanthes hamata, Phaseclus atropur purium
6.	Southern hills	Dichanthium annu-latum Pennisetum purpureus Panicum maximum	Sehima nervosum Pennisetum Pedicel-latum	Stylosanthes gracilis	Stylosanthes Desmo-dium intortum.
7.	Eastern plains	Brachiaria mutica Setaria sphacelata	Pennisetum Polysta-chyon P. Pedicellatum Cynodon dactylon	Medicate sative Phaseolous Calcaratus	Dolichos, lablab Javanica
8.	Dry regions of Raja-sthan Gujarat and UP, Haryana	Dichanthuium annu-latum Pancicumanti-dotale	Cendhrus ciliaris C. Setigerus Lasiurus sindicus	Phaseolus antropuro ureaus	Stylosantheshi mill's
9.	Coastal region	Setaria Sphacelata Panicum maximum Brachiaria mutica	Cenchrus ciliaris C. Setigerus Panicum Antidotale	Dolichos lablab Medi-cago sativa	Vigno Sinesis Glycine Javanica
10	Water logged area	Brachiaria mutica Iseilema Laxum Di-chanthium spp.		Sesbania, aegyptica	—
11	Usar Soil	Sporobolus spp. Chlo-ri. spp. Dichanthium annullatum, Cynodon Dactylon etc.	Bothricholoa Pertusa Cenchrus spp.	Cassiators Rhyncasia minima	Alysicarpus Rugosus Desmodidum spp.

ANNEXURE VI

Evaluation of Pasture Programme Performance in IDA assisted Districts

Source: Ministry of Rural Reconstruction.

An evaluation of pasture programme performance was taken up in the IDA assisted DPAP districts of Jodhpur, Nagaur, Sholapur and Ahmednagar based on plant growth of grasses and legume spp. The performance of the plots assessed can be categorised into six categories:

S. No.	Category	Marks (10 marks)
1.	Failure	0
2.	Poor	1-2
3.	Fair	3-4
4.	Good	5-6
5.	Very good	7-8
6.	Excellent	9-10

Table at Annexure VII gives the performance of pasture species in the IDA assisted DPAP districts during the year 1978-79.

A summary of the pasture production estimates for the year 1976-79 in respect of IDA assisted DPAP districts is given at Annexure VIII. The annual average dry matter in kgs. per ha. varies from 453 as the lowest in respect of Sholapur during the year 1976 to the maximum at Nagaur as 3247 kgs. during the year 1977.

ANNEXURE VII

Pasture Species Performance—Summary of Evaluations IDA Assisted DP AP districts 1978—79

S.	Districts	Grasses Species	Scores		Legume Species	Scores	
No	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Jodhpur	Buttle Gayndah (C. ciliaris)	6.3	Good	—		
		Buttle Biloela('C. ciliaris)	6.3	Good			
		Buttel 'Molopo (C. ciliaris)	5.9	Good			
2.	Nagaur	Buttel 'Gayndah (C. Ciliaris)	4.9	Good	Siratro	7.4	V. Good
		Buttel 'Bileola (C. ciliaris)	4.8	Good	Rongai Dolichos	4.9	Good
		Buttle 'Molopa (C. ciliaris)	4.6	Good	Stylosanthes hamata	2.0	Poor
3.	Average of Rajasthan districts.	Battle 'Gayndah (C. ciliaris)	5.0	Good	Siratro	7.4	V. Good
		Battle 'Biloela (G. ciliaris)	4.9	Good	Stylosanthes	2.0	Poor
		Buttel 'Molopa (C. Ciliaris)	4.7	Good			
4.	Anantapur	Buttel 'Molopo (C. ciliaris)	1.7	Poor	Stylosanthes hamata	3.5	Fair
		Buttel 'Gayandah (C. Ciliaris)	1.6	Poor	Siratro	3.2	Fair
		Buttel 'Bioela (C. ciliaris)	1.6	Poor	Stylosantheses	2.5	Fair
		Rhodes grass (chloris gayamej	1.4	Poor	Dolichos humilie humilies spp (Mix)	2.5	Fair

S. No	Districts (1)	Grasses Species (2)	Scores (3)	(4)	Legume Species (5)	Scores (6)	(7)
		Green panic	0.9	Poor			
5.	Sholapur	Buttel 'Biloela (C. ciliaris)	6.6	V. Good	Doliches Spp.	6.5	V. Good
		Buttel 'Molopo (C. ciliaris)	6.6	V. Good	Stylosanthes scabra.	5.9	Good
		Buttel 'Gayandah (C. ciliaris)	5.6	Good	Siratro	5.6	Good
		Buttel "Rhodes' (Chlorsis gayama)	5.5	Good	Stylosanthes Lamta.	5.5	Good
		Green panic Rhodes grass	5.3	Good	Stylosanthes Lumilies.	3.3	Fair
			5.2	Good			
6.	Ahmednagar	Cencurus Ciliaris (local strains)	5.7	Good	Stylosanthes Hamata.	5.1	Good
		Buttel 'Bioela (C. ciliaris)	5.5	Good	Dolichos species (mix)	5.1	Good
		Buttle 'Molopo (C. ciliaris)	5.2	Good	Stylosanthes Scabra	4.4	Good
		Buttle 'Gayndah (C. ciliaris)	5.1	Good	Siratro	4.3	Fair
		Callide Rhodes (Chloris gayama)	4.0	Fair	Stylosanthes lumilis	3.9	Fair
		Green panic	4.0	Fair			
		Rhodes grass (Chloris gayamma)	4.0	Fair			
		Sabi Grass.	3.5	Fair			
7.	Average of Dsccan Plateau Districts.	Cenchrus ciliaris (local strains)	5.7	Good	Stylosanthes Scabra	5.2	Good
		Callide Rhodes (Chloris gayamma)	4.8	Good	Stylosanthes hamata	4.7	Good
		Buttel 'Bieoela (C. ciliaris)	4.7	Good	Dolichos species	4.7	Good
		Buttel 'Molopo (C. caliaris)	4.5	Good	Siratro	4.4	Fair
		Buttel 'Gayndah (C. ciliaris)	4.1	Fair	Stylosanthes	3.3	Fair
		Rhodes grass (chloris gayamma)	3.5	Fair			
		Sabi grass	3.5	Fair			
		Green panic	3.4	Fair			

Scoring Assessment:—

Failure	: 0	Good	: 5—6
Poor :	: 1—2	V. Good	: 7—8
Fair	: 3—4	Excellent :	: 9—10

ANNEXURE VIII

Summary of Pasture Production Estimates 1976-1979) (IDA Assisted DPAP Districts.

District	Annual average. Dry Matter Yield (kg./ha).			
	1976	1977	1978	1979
Jodhpur	1769	2179	1535	1503
Nagaur	—	3247	1403	987
Average Production of Rajasthan Districts.	1769	2713	1469	1245
Anantapur	—	853	1443	955
Sholapur	453	497	912	1044
Ahmednagar	1587	1350	1195	1488
Bijapur	—	—	934	1042
Average Production of Deccan Plateau Districts.	1020	900	1121	1132

12. HORTICULTURE DEVELOPMENT

Arid regions present a special agro-climate enabling production of some of the finest quality of certain fruits. In the Bible, the arid lands are epitomised as the land of vines, fig trees, pomegranate and honey. The worlds oldest civilisations developed in arid lands with indigenous techniques of~fruit growing.

12.2 There is considerable scope for increasing horticultural crop production, parti cularly in Rajasthan, in the large areas being served by the Bhakra and Rajasthan Canal Systems. Ganganagar District has already nearly 6,000 hectares under fruit, vegeta bles, etc. In fact, it has been established that wherever canal irrigation water and good quality water from other sources like wells and tubewells is available, almost all the fruits and vegetables for whioh climatic conditions are suitable can be grown. The extremely dry conditions enable the production of a fine quality of papaya without the undesirable latex odour in its pulp. The extremes in day and night temperatures help in the development of the characteristic red pigment in the Blood Red Malta, e.g. in Sriganganagar. The low rain fall conditions make the arid regions the only possible location in India for the production of dates which hitherto being exclusively imported, mainly from the Middle East countries. The climatic conditions of the districts of Jaisalmer, Barmer, Bikaner and Kutch are the best available conditions for the production of dates in India.

12.3 For fruit growing, the depth of the soil and the nature of the sub soil are of more important than the texture of the surface soil. The soils in the Rajasthan Desert are generally sandy, structureless and poor in fertility. The water storage capacity of the soil is low. The infiltration rate is high (9 om/hr.) They are often shallow and are underlaid with a layer of carbonaceous concretions at a depth of 0.2 to 1.5 m. The thickness of this layer varies. This is hard to penetrate for the roots of many fruit species and, therefore, limits the depth of soil profile upto which their roots can scavenge for water. Such fruits are not likely to be drought tolerant and would have more irrigation water requirement. The trees adapted to these regions strike their roots across this layer and develop an extensive root system. They survive droughts. Ber roots were found 4.5 m deep in soils having 1 m thick hard calcareous layer at a depth of 1-1.5 m. Pomegranate and guava also develop fairly deep root system in these soils. Custard apple does not require deep soils and can withstand hteh amount of lime. However, the soils should be well drained.

12.4 Varieties of Vitis vinifera are deep rooted. The root system extends 6-10 feet or more deep in soils if its penetration is not obstructed. Ideally soil structure that favours extensive root development is preferred if they are well drained. Light soils are ideal. In California, Perlette and Thompson Seedless varieties are grown in hot desert—the Borrego, Coachella and Imperial valley—on sandy or sandy loam soils as these soils induce early ripening. Most vinifera grapes tolerate high concentrations of lime in the soil—50-70 per cent carbonate. The soil conditions of arid zone are, therefore, quite suitable for viticulture. When grown in light shallow soils adequate attention must be paid on its balanced nutrition. Recently, the problems of barrenness and decline of grape orchards have tended to reach alarming proportions in Western Rajasthan. One reason of this undoubtedly is loss of vine vigour due to deficiencies of some micro-nutrients. The deficiencies develop after few years of planta tion and sometimes partly due to recurrent over feeding with selected macronutrients.

12.5 Sandy soils are ideal for citrus growing provided they are well drained and well supplied with nutrients. One of the finest date palm gardens in California is in deep sandy

loam soil. It can do well in coarse sand as well but would require excessive fertilisation and irrigation. The soils underlaid with more reten tive layers somewhere in the first 1.5 m would reduce leaching of mineral nutrients.

12.6 Arid Zone soils are poor in moisture storage capacity and dry out quickly. Moisture conservation by careful management is, therefore, one of the essence of success. The structure less character of the surfpoe soils which often acts as mulch offers a unique opportunity for this. The main portal of moisture loss to the atmosphere from such soils is transpiration through the vegetation. Keeping the orchard soil completely weed free, assumes great impor tance in these regions.

12.7 The Central Arid Zone Research Insti tute has already established by not only experi menting on its farms but also on the farmers fields the suitability of the follo wing fruit plants as ideally suited for the arid areas :

(a)	Under rainfed conditions	Ber
(b)	With supplemental irrigation	Sour lime, amla and, goon da (nas udha).
(c)	With assured irrigation facilities	Papaya, datepalm sweet orange, mulberry, phalsa etc.

12.8 The development of new technology for Ber propagation cuts short the time from more than a year to four months lor raising the Ber orchards. The grafted plants are raised in polythene tubes in which root stock is ready to receive scion in 90 days. The new polypack device by CAZRI containing bare rooted plants with sphagnum moss soaked with nutrient solution weighs only about 100 grams and is handy for transport. Another technology established by the CAZRI is to improve the inferior quality of wild ber. At the Seminar for the development of arid and semi-arid areas, it was brought out that ber propagation in the arid areas had proved to be a very remunerative and one hectare of ber orchard has given on an average Rs. 9,000 profits per hectare.

12.9 With irrigation resources, commercial seed production of vegetable crops, e.g. lady finger, cucurbits, tomato, potato, juteseeds, chillies, brinjal, peas, cumin, coriander, etc. can be taken. Large scale production of vegetables for fresh market and for preservation factories also has enormous scope. Gardening of vegetables like cauliflower, tomato, potato, car rots, onion, garlic etc. can be highly profitable.

12.10 Brackish water which is unfit for crop production is, however, quite suitable for fruit crops like date palm, pomegranate, ber and guava which can tolerate brackish water at various levels of salinity and alkalinity. Date palm, in fact, is the most hardy of the plant types (to salinity) and can withstand as much as 15,000 ppm of chlorides. Even Anwala and mulberry can tolerate salinity. Research work is in progress at the Central Arid Zone Research Institute, Jodhpur, and Haryana Agricultural University, Hissar, to further identify the plant types of and cultivars within these fruit crops which can withstand salinity without detrimental effects on their productivity. The results of this research should be pursued further. Some of the vegetable crops like spinach, beat, cabbage, brinjal and some root crops are tole rant to salinity.

12.11 Under rainfed situation, fruit growing is possible only by following the watershed management concept of *in situ* run off concen tration and by efficient moisture conservation. In fact, the technique of watershed management has been used by mankind since antiq uity. The people in the arid regions, particularly in the deserts, have used this technique for

growing trees and crops. In the Middle East, the practice seems to be centuries old. The *khadins* or *kharins* in Jaisalmer which are low lying basins collecting run off from surrounding hard per (rocky) catchments (maga) for culti vation are believed to be about 300-500 years old. There are presently 377 khadins around Jaisalmer. These were, however, abandoned about 100 years ago but are being received again in recent years. Even in the extremely arid agroclimate of Jaisalmer, fruit trees like mango, citrus, cordia, etc. can be seen growing in the khadins. Fruit trees are also found growing in the watersheds in Mandore and hilly and rocky areas surrounding Jodhpur.

12.12 The in situ run off concentration technique is most suited particularly for the fruit crops because (i) once established they continue to produce for many years and (ii) being deep rooted they are able to utilise the moisture stored in lower soil layers and can produce optimum crops even in a low rainfall year. In recent years, extensive research has been carried out in Mexico, Israel, Australia and USA to increase horticultural production by efficient management of watersheds. In India, such work is in progress at the Central Arid Zone Research Institute, Jodhpur. Somq of the indigenous plant types can be planted even without follo wing this technique e.g. kair (Capparis decidua) Cordia myza (lasoda), custard apple, etc. Their productivity will, however, increase if due consideration is also given to watershed management.

12.13 A proper selection of suitable fruit and vegetable types and their cultivars is most important for success in the hostile arid environ ment. As in hot arid zone, the rainfall is not only very low but is confined to the period from July to September, with 9 to 21 rainy days out of 12 to 30 rainy days in the whole year. The fruit crops selected for cultivation in these regions must be such that their maximal growth period falls during the period of maximum water availability in the soil and low vapour pressure deficit in the atmosphere. Ideally, the most part of their reproductive cycle, i.e. the period from flowering to fruiting, must also fall during this period and the fruit ripening must be com pleted before the onset of the dry summer. Fruit crops ; e.g. the ber, pomegranate, guava, custard apple, wenla and karonda conform to this pre-requisite. While selecting cultivars of a particular fruit tree, care should be taken to choose the early ripening ones so that they make maximum use of the residual soil water from the monsoon rains.

12.14 Among the vegetable crops, the most hardy types belong to the cubitaceous and solanaceous groups. Besides, these coupea, gourd, early cauliflower and okra are also suffi ciently hardy. There is, however, need to grow the drought hardy cultivars of these vegetable crops for rainfed production. Research work is in progress for the identification of such types, Kharif vegetables can be successfully produced by following interplot water harvesting technique. For the adoption of such techniques, only the area with over 250 mm rainfall would be suitable except where special structures similar to khadins are available.

12.15 After the selection of proper fruits and vegetables', their suitable growing plan would depend upon the. geomorphic land group and the extent and distribution of rainfall.

12.16 A large percentage of sandy areas fall in regions with rainfall lower than 250 mm. Most of these would be considered unfit for both fruit and vegetable growing except with irrigation or wherever favourable conditions exist. Fruit and vegetable production with water harvesting techniques is possible in rest of the areas. The Israel workers have however, been able to grow fruit trees by this technique even under 50-100 mm rainfall conditions. Here again, it must be mentioned that the effect of a low, rainfall occurring in low evaporative conditions of winter in Israel is not comparable with similar quantity of rain occurring in high

evaporative summers in India. In view of this, the problems related to runoff utilisation are difficult under agro-climate of arid zone. Ramakrishna and Singh (1974) have reported that even under 250-300 rainfall distribution in Western Rajasthan, the runoff is about 25% and it is more than 40% in flood years with 400 mm rain. It is, therefore, possible to conserve water vis-a-vis the water requirement of the crop using an appropriate size and geometry of a catchment.

12.17 For determining the size of the micro-catchment for a tree species, various factors will have to be kept in view. Every fruit tree has a water requirement for its optimum production. This must be met by the local precipitation plus the run-off from the micro-catchment. It is also related to the characteristics of root depth and spread. These factors determine the volume of the soil profile which would supply water to the roots. The runoff water should be concentrated for storage in this profile. This would also mean that the runoff from the micro-catchment at one recharge should not ordinarily exceed this moisture storage capacity.

12.18 Investigations were initiated during 1974 at the Central Arid Zone Research Institute, Jodhpur, to work out a runoff concentration technique for the rainfed production of ber. The catchments were provided on two sides of the tree row so as to provide runoff supplements ranging from 200 to 400 mm, in addition to the input of about 360 mm rain. The results obtained have revealed that a catchment size per tree of 54-72 m with a slope of 5% gave the best results. (O.P. Pareek of the CAZRI).

12.19 In vegetable crops also, optimum production is possible by adopting techniques of moisture conservation and runoff concentration. Bottle gourd, sponge gourd, round gourd, longmelon and guar can be sown during early July with the onset of monsoon so that flowering and fruiting takes place during the period from beginning of August to end of October. These crops can be grown even when the rains are delayed upto early August. With further delay in rains, there is very little possibility of their rainfed production. Bitter gourd, melon, kachri, okra and cow pea can be taken if monsoon starts by the middle of July. The vegetable crops like tomato, brinjal, chillies, cauliflower and onion can also be taken in dry-lands by runoff concentration techniques provided the seedlings are kept ready in the nursery 109 for transplanting in the field with the onset of rams in early July. The nursery, however must have irrigation facility. After plantation m the field, irrigation may not be required except m case of an extremely drought year. The effect of bentonite clay as soil amender has been very effective in increased production of some cucurbitea (Singh, 1975). The treatments haying bentonite (2 kg/pit) at 60 cm the higest given 49%, 133% and 138%, higher , yield (over control) of tinda (Citrullus vulgaris var fistulossus), kakri (cucumis saliva) and matira (Citrullus lanatus) respectively. A technique has been developed at the Central Arid Zone Research Institute wmch requires micro-catchments of inverted 'V' shape with slope (6%) made in such a manner that the vertical runoff from the catchment culminates into a pit (Mann 1974). The catchment area of each pit (75 cm deep with 30-35 cm diam.) is 4.5 m2. The deep percolation losses of water is cut down appreciably by bentonite clay layer provided at the bottom of the pit.

12.20 In the sandy arid regions, Citrullus cok> cynthis (tumba) is a parennial natural vegetative cover which is extremely drought hardy. Its seeds yield about 15% oil which is used for soap making, growing of this plant should be encouraged, wherever possible.

12.21 Hilly rocky areas and pediment plains in the and regions can be used for fruit growing m two ways: (1) systematic plantations of traits like custard apple, pomegranate and cappans

decidus (Kair) can be made wherever possible and (2) runoff water from these spots can be diverted to the adjoining plains where rruit crops can be grown.

12.22 Abichandani and Yadav (1974) have estimated that about 25002m of the area under rugged high and low hills, rocky plateaus and pediment plains and eroded land surface exposing kankar beds in Jodhpur district (with an average rainfall of 350 m) can yield 10,000 ha. m. of runoff water even in a drought year 30000 ha.m in a normal rainfall year. About 11.6% the area of the arid zone of Kajastnan is barren and uncultivated. A large proportion of this area is with rockv and gravelly surface. The runoff water from these facii could be profitably utilised by making suitable micro-catchments for growing fruit trees.

12.23 Land in 250-350 mm rainfall group and m the 350-500 mm rainfall group, which are saline and stagnated, and are unfit for other purposes can be most usefully utilised for the plantation of date palm.

12.24 The findings of the Central Arid Zone Research Institute equally hold good for soils and climates in the drought prone areas The majority of rural families in the drought prone areas, as also in the arid areas, depend heavily on dryland farming. Considering the marginal nature of the land in many cases, and the nonavailability of adequate moisture and the risk involved in successfully raising foodgrain crops, great importance would have to be placed on opportunities to diversify rural economies away from crop production, to the extent possible, into activities that are less dependent on the vagaries of rainfall. Horticulture is one of the excellent opportunities which could provide a greater income to the farmers in such lands which are not good for crop production. In the IDA assisted projects, it has been established that Ber, Mango, Jack fruit, Lime, Spota, etc. are some of the fruits which can provide very good income to the farmers. As a commercial venture on irrigated lands, mixed orchards have turned out to be quite attractive. A mixture of some or all the suitable fruit trees could be planted alongwith vegetables. It has been estimated that the cost of fencing etc. could be offset by the production of vegetables alone.

12.25 The Committee would strongly urge that horticulture should be taken up as an integral part of the package approach to the development in the drought prone and desert areas. All essential steps would have to be taken. Extension support is the first essential item. This would not, however, be enough by itself unless suitable varieties are identified, seeds and cultivars provided when needed.

13. AFFORE STATION

For centuries, individuals and communities have been able to live in harmony with their environment but during the past few decades, rapid growth of population and the higher expectation have led to an increase in the use of forests to such an extent that forests in many areas have become degraded if they have not been raised to the ground.

13.2 So far as the drought prone areas are concerned, forests assume an added importance as they constitute an important component of the ecosystem for beneficial effects on conservation of both soil and water resources and also act as a barrier to surface erosion by retarding runoff and generally prevent development of aridity and desertification in these areas.

13.3 Soil and wind erosion is very a serious problem in drought prone areas. Taking the country as a whole, 50% of the total land area is seriously affected by water and wind erosion. While no exact statistics are available about the areas affected in drought prone areas, its incidence in the drought prone areas is bound to be far more than the national average. Again, taking the country as a whole, displacement of fertile top soil is around 6,000 million tonnes a year. The magnitude of this loss can be imagined when it is noted that it has taken Nature over a century to make one cm. of the top soil.

13.4 Excessive deforestation is considered one of the main causes of aridity and desertification in DP areas in India and elsewhere because deforestation coupled with subsequent soil and moisture loss result in higher temperatures, lesser humidity and erratic rainfall. There is evidence to show that the areas which are affected by drought and deserts today were once very pros perous and flourishing civilisations. Thus, due to serious and unchecked interference by man over several centuries, natural balance was impaired and we are faced with possibilities of catastrophics in near future if this process of biotic interference continues unchecked. Need less to say that development of drought prone areas should begin with measures to arrest further deterioration of this ecological balance as stressed and recommended by the Task Force on the Rural Development (1973) and the National Commission on Agriculture (1976).

13.5 In arid areas, the ecological conditions being what they are, afforestation is very vital to contain wind velocity, spread of sand on roads, railway tracks and agricultural lands, to improve supply of fuel and fodder and the aesthetics of the desert. At present, areas classified under permanent pastures, cultivable wastes, barren, uncultivated land and forests are overgrazed and denuded. Hence, not only the development but protection and management of the forest and plant cover also assume considerable importance. It is necessary to provide for the requirements of fuel and fodder so that the people are not tempted to cut trees indis-criminately and inhibit the process of afforestation.

13.6 We have already dealt with the role of afforestation so far as the sand dune stabilisa tion is concerned in the arid areas of the country in Chapter 14. In this chapter we propose to deal with afforestation programmes in non-arid areas. The drought prone areas do not have adequate forests resources. The forest areas varied from 40-52 per cent in Sidtv, Palamau, Boudh Phulbani and Doda Districts (Integrated Agricultural Development in Drought Prone Areas, Planning Commission, June 1973). But in most of the arid districts the forest areas were less than one per cent and a few had upto two per cent area under forests. Again, none of the DPAP districts had more than 14% area under pastures. These figures provide evidence of imbalance between land use pattern and the requirements of human and animal population,

as also the conservation and optimum utilisation of resources. During the Fifth Plan, therefore, afforestation schemes were undertaken as a part of DPAP to restore the ecological balance in DP areas.

13.7 As per the statistics (1978-79) publi shed by the Ministry of Rural Reconstruction, under the DPAP the area covered under affores tation is 1,96,913 hectares and under social forestry 33,932 hectares from 1-4-74 to 31-3-79. The expenditure incurred during the period is reported to be Rs. 41.29 crores which also includes expenditure on pastures. The offores-tation schemes comprise farm forestry, tank foreshore plantations, canal bank plantations, sheep pastures, rehabilitation of degraded forest, avenue plantations, etc. Unfortunately, these schemes were not by and large planned and implemented on a watershed basis resulting in the dilution of the desired impact.

13.8 Some evaluation studies conducted by the National Institute of Rural Development, Hyderabad in Kurnool District, the Operational Research Group, Baroda in Panchmahal District and another one in Jhabua District Published by Abhinav Publicationh (Shri U. K. Srivastava in 1978) on planning and implementation of DPAP in these districts have brought out that the programmes suffer due to several factors such as inappropriate approaches, inappropriate techonlogy, poor educational activities among the people and so on.

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Social Forstry

13.9 Social forestry or forestry for community development is forestry creation outside the traditional Reserve Forests, management and utilisation of goods and services generated therefrom for the benefit of society. It aims at utilising the idle land, labour and water resources to the best interests of the society, in such a manner that the requirements of the community for firewood, fodder, small constructional timber and fruits are met optimally besides protecting the soil against the wind and water erosion on a sustained basis. It calls for various combinations of the forestry with food and horticultural crops, fodder trees and grasses to feed livestock for meat and dairy. Such composite utility of the solar energy through vegetative growth promotes material growth and ensures the protection of local environment and ecology.

13.10 The National Commission on Agriculture for the first time fixed the dimensions of

social Forestry and also gave in detail the type of programmes that will constitute Social Forestry. In the words of the Commission :

"In the Interim Report, the Commission stressed the socio-economic importjance of Social Forestry in the rural community as well as in the management of forest resources. It was stated that by taking up the programme of raising of trees, grasses and fodder in the farmer's own lands, village commons, wastelands and degraded forests close to habitations it would be possible to meet the requirements of fuelwood, fodder small timber for rural housing and agricultural implements, thorns . for fencing etc. It was also stated thai at the same time these programmes would remove a serious impediment in the practice of production forestry. We adopted the following as the objectives of social forestry, being the basic and economic needs of the community aimed at bettering the conditions of living :— (i) Fuelwood supply to the rural areas and

replacement of cow-dung, (ii) Small timber supply, (iii) Fodder supply, (iv) Protection of agricultural fields against

wind ; and (v) Recreational needs.

Accordingly, the scope of the social forestry programmes was defined by us to include farm forestry, extension forestry, reforestation in degraded forests and recreation forestry".

13.11 The programme of social forestry, has two main components (i) farm forestry and (ii) rural forestry which are relevant to the DPAP. The rural population depend on the forests and tree lands for their fuel and small timber. The cattle and sheep and the goats which are the animal wealth of the village folk, depend for their fodder substantially on the, forest resources.

13.12 The programme of tree planting has to be taken up on areas in and around agricul tural fields and other areas where wood lauds cannot be created. Planting can be carried out (i) on and along bunds arid risers, (ii) marginal or peripheral bunds, (iii) field and property boundaries, (iv) village paths, (v) foreshores of tanks, (vi) irrigation channels, (vii) institu tions like schools, hospitals, pancnayat bhavans, places of worship etc., (viii) banks of small streams and any other available place.

Farm Forestry

13.13 The concept of farm forestry comprises the technology of advantageously combining agriculture and forestry. .Its purpose is to have an integrated approach to land use in place of conventional separation of agriculture from silviculture. In India, cowdung is utilised as fuel in place of firewood which means, a conti nuous depletion of phosphorous, potash and nitrogen from soil. It is estimated that over 458 million tonnes of wet dung is diverted annaully to the rural hearths of India, As five tonnes per hectares, this dung would fertilize 91 million ha. of land. Assuming an additional yield of five quintals of food per hectare, the annual loss of food is estimated at 45 million tonnes worth Rs. 36,000 million.

13.14 The release of cowdung for its legiti mate manurial uses in the fields and the creation of firewood resources within the farm itself is the main objective of the farm forestry. In addition, farm forestry aims at diverse benefits to the farmers:

(a) building up his balanced economy and self-sufficiency,

(b) providing firewood, small timber and fodder, and

(c) extra sources of revenue. ;

13.15 It is necessary to educate the farmers about the importance of tree planting on farm land. As the first step towards farm forestry, the farmers can confine their activities to grow their own, timber, fuel and fodder trees along field bunds and marginal land where cultivation is uneconomical and not possible but the soil allows it. He can plant the trees of his choice and suited to his economy in consultation with the forest department.

13.16 The National Commission first debunded the idea that farmer cannot grow trees on the field ridges without spoiling the crops. By now, several States have persuaded the farmers to take to it. All over the drought prone areas of the country, the farmers leave a third to a half of their land fallow every years, whether big or small, because they cannot possibly cultivate the entire land. It had been recommended that they may put part of their land under permanent intensive pastures and take to a subsidiary occupation of animal husbandry. There is a case for putting part of the land under tree lands and plant trees. In Gujarat and Punjab, already such an approach has been taken up by farmers and so in the South.

13.17 Suitable species of different regions < o{ India as also the improved techniques of affores tation have since been compiled in the JForesI Research Institute Publication entitled.

"Hand book of Afforestation Techniques". The selec tion of species suitable for a particular area would necessarily have to be governed by the following considerations:-

(i) Objective of planting viz., fuel, small timber, fencing, bioaesthetiic, erosion control, top feed production, etc. and

(ii) Locality factors viz., climatic odaphic, topographic and biotic parameters.

The other criteria for selection of trees species are—(a) Farmers' preference, (b) deep root system, (c) light down, (d) bird repellant, (e) ease of establishment, (f) fast growth, (g) resistance to drought/frost/fire, (h) multiple use, coppicing, adaptability and compatibility etc.

13.18 This is a programme which requires to be given full encouragement. What is required is a strong extension forestry organisation which has yet to develop. There is no problem of funds. ARDC has already got a model which can be used. Farmer owned plantations will yield much more fuelwood than the departmental forests which are not fully immune from pilfe rage. The Committee would strongly recom mend that this programme should be taken up as a massive programme and should be backed with full political support.

Rural Forestry

13.19 Also called extension forestry, it encompasses forestry on community land and panchayat lands, degraded forests, road and railway sides, canal banks etc. for meeting the needs of the rural people by raising (a) fuel, (b) fodder, (c) fruit, and (d) multi-purpose trees. It also includes restoration of derelict areas bearing scars of quarrying, mining, road construction, brick manufacturing, lime burning etc. The objectives of rural forestry are similar to farm forestry in meeting the needs of rural masses. There is, however, one impor tant difference, that is with regard to the owner ship of land resources. In farm forestry the ownership of the land is ordinarily with the individual whereas in the case of rural forestry land is community-owned or owned by Govern ment Departments. This ownership poses pecu liar protection problems and needs the involve ment of community as a whole for the effective implementation of the projects.

13.20 A number of cottage industries can develop with the aid of trees, viz., honey, sports goods, silk, oil from seeds of mahua, neem, kanji's paper from sajan wood, household furniture from sisam, babul and eucalyptus, dairy industry from fodder and others.

13.21 As separate data on idle land resources in the drought prone areas are not available the data for the whole country is presented below as these are also relevant for drought-prone areas. At present, among others, the idle land resources consist of :—

(i) Road sides (length over 12,24,00 kms.);

(ii) Sides of rail track (59,790 kms.);

(iii) Canal banks (1,50,000 kms.), and

(iv) Drainage channels (20,000 kms).

These alone offer 9,02,000 ha. of land that could be profitably planted. Other waste lands are river banks, degraded areas in villages, ravines, swamps, cremation yards and compound of schools, colleges, hospitals, buildings. In India 43 million ha, has been

classified as other non-cultivated nonagrioultirral and barren land. The bulk of these areas are amenable to the replanting of trees. At the same time there are about 220 million people mainly in the rural areas who are living now below poverty line because they are either unemployed or underemployed. These idle land and human resources can be productively employed, given appropriate technology, choices of suitable tree species and a moderate investment, to create forest resources in rural areas. Forestry does not require much investment, high skills, sophisticated machinery etc. to generate the much needed rural employment and income.

13.22 Broadly speaking, one hectare of plantation activity, depending on the area, species selected and spacing adopted, generates 150 to 500 mandays of employment in the rural areas during the first three years (study made by NIRD). Later, the harvesting of the forest crops provides employment at higher level of income for almost twice the number of mandays, harvesting in the 6th and 10th years provides scope for greater employment. Subsequent periodic thinning operations generate more employment possibilities. Roadside plantation activity can be as labour intensive as demanded by the local conditions, the technique of planting, etc. The total employment generally will, however, rest on the socio-economic conditions prevailing and the coopration of the rural masses in any particular locality.

Village and Panchayat Forests

13.23 In every Indian village, traditionally a portion of the land was reserved for the village forest. This was common property to be managed by the village elders for the benefit of all the villagers. The first to be affected by the rush for forest material by the expanding population was the village forest. Except is the very interior areas, village forests are now bare earth wherever the land has not been encroached upon. Rehabilitation has to start here. The National Commission on Agriculture made the following recommendations in its interim report, as condensed in the final report:

(i) Any programme of mixed forestry in the village waste lands and panchayat lands should be such as is acceptable to the village population.

(ii) The programme should be andertaken only in such areas where the incidence of waste lands in a village or a group of villages is sufficiently high so that a part of it can always be kept apart for the satisfaction of the rights of villagers.

(iii) The programme should take into consideration the need lor a quick yield of such products as are the villagers' immediate concern, as such, fodder and grass should be an important component of mixed forestry to be taken up with optimum input and technology; and

(iv) Income from mixed forestry should be divided equally between the Panchayats and State Governments. In addition, in the disposal of the produce from these forests there should be an element of preferential treatment including price preference to the villagers.

13.24 Some States have taken up this programme haltingly. Considering the magni tude of our requirements, the village forest and waste land area wherever they are available in manageable patches, as advised by the National Commission on Agriculture, should be actively afforested. The forest departments will have to do the afforestation and watching of the forests on agreement from the Panchayat or village community. . It is suggested that this may be a fifty per cent funded Centrally Sponsored Scheme. Otherwise, this difficult programme has the least chance of being done.

Roadside, Canalside etc. Lands

13.25 These plantations have proved a great success. Particularly, States like Punjab and Haryana where the forest areas are very small, have found that this approach increases their forest resources. The scheme is economically viable when concentrated on fuelwood. Forest departments can get the funds from the ARDC provided they form Corporations for the purpose and the lands are leased out to them on very long lease till the money is repaid. A debt equity ratio of 2:1 is acceptable.

Degraded Forests

13.26 Degraded forests are those forest areas of various kinds supposedly under somebody's supervision and control which, being near to human habitations, have over the years been denuded of any tree cover worth the name and often even any grass. These are B class reserves, protected forests, zamindari forests and a class of unspecified forest areas in the ex-princely states areas, mainly in Orissa and Madhya Pradesh. The Zamindari forest areas 4 are mainly in the States of Bihar and Uttai Pradesh. These, even though maintained as forest reserves at the time of the zamindari abolition and taken over early in the fifties of this century, were devastated by the zamindars before the take over. All these areas run into millions of hectares. It has already been suggested that these areas should be replanted intensively with fuelwood species and fodder trees so as to meet the requirements of the village population. These areas should, therefor, straightaway qualify for our fuelwood plantations.

13.27 Meanwhile technology has been deve loping which allows for better use of the de graded forests with a substantial attack on the problem of 'Social Justice'. Even in low rain fall areas like Kutch in Gujarat (10 cm per year), two acres planted with Kubabul, a fodder trees, and irrigated in the root area only with water from wells, can give regularly enough fodder to maintain a cross-bred heifer giving 10 litres of milk. In higher rainfall areas, an acre or half a hectare will be sufficient with watering only in the summer.

13.28 Work carried out at Bellary (black cotton soils) very clearly indicated the useful ness of such works. It was observed that by proper protection and supplementing natural regeneration with artificial regeneration, weeding etc., income from marginal lands could be impro ved from nil to almost Rs. 800 per ha. per year over a 30 year period and this would far out weigh income from agriculture, i.e. Rs. 360 per ha. per year (figures are for 1966). The National Commission's suggestion for growing fodder in these areas is answered by the fodder trees which are more remunerative.

13.29 Trees are planted close and regularly pruned into bush form so that leaves and twigs are maximised instead of timber. Some fuel- wood will be available annually in the prunning of the twigs. In the interest of social justice, it is suggested that the poorer landless families near the forests may be allowed half a hectare each of such land and helped to grow the fodder trees or Tassar culture or lac growing. The latter two will be' beneficial mainly to the tribals who naturally do Tassar culture and lac culture now on forest trees. In discussions held by the then Member (S) Planning Commission in the regional conferences, the forest departments of the States have accepted this preposition, the labourer enjoying the leaf usufruct whereas the trees are still the property of the forest depart ment. It is necessary, therefore, to divide the programme of degraded forests between fuel- wood plantations by the forest departments and trees for leaf formation for Tassar, Lac and fodder by the poor landless families allotted right on trees on land for the purpose.

13.30 It may well appear that the demand for forest areas is far in excess of the known forest areas. The Ceintral Forestry Commission had indicated forest areas in 1970-71 as 74.8 million hectares whereas the agricultural statistics indicate 66 million hectares. It was admitted that probably the unclassified forest areas may be outside this. The village forests and waste lands suitable for forestry are, it is presumed, outside this. Out of there areas, reserves for timber and pulpwood requirements should be buHE up to 47.8 million hectares; but this is to be achieved for timber and plywood by planting 2 lakh hectares per year for 60 years to establish a cutting rotation of 60 years. Similarly for hardwoods an annual plantation of 4 lakh hectares has been suggested for a period of 75 years to establish a 75 years cutting rotation. So large areas of the forest land will not come under the regular plantation routine for decades and much of this will be degraded forests. So the programme suggested here for fuelwood and leaf exploitation can well be put through without difficulty. The fuelwood plantation in degraded forests is to be harvested after 15 years at the start because the land is of poor quality having lost all nutrients. But future cuts can be once in 10 years because the land would have regained its fertility in the first rotation of 15 years. Thus a plantation of 4.2 million hectares per year less one million in farm forestry per year in a 15 year rotation will take 48 million hectares in the first round tapering off to 32 million hectares after 25 years from start. If part of the plantations can be irrigated, area required will go down further. Technology will surely find ways and means of increasing productivity, to link demand with supply. For the leaf programme it is annual harvesting of leaves. It is suggested that a programme of 5 lakh hectares per year may be taken up in the next twenty years. This will over the time help 20 million poor labour families near the forests to get a decent living.

Mixed Forests

13.31 The National Commission on Agriculture has deliberately called the planting of fuelwood etc., for the use of the rural population as mixed forests. These plantations should not be merely mono-crops of fuelwood varieties. Everyday trees are not necessarily trees with only fuel value. Trees yielding many varieties of minor forest produce and trees giving fruits on which the tribal population live and also earn some money by collection, are also being devastated. One of the main objectives of the tribal development programme is to ensure that these benefits are not lost to the tribals but augmented. So in all these plantations it should be a rule that trees giving minor forest produce like Mahua, Karanj, Neem etc., and fruit trees like mango, tamarind, jack and others are suitably interspersed. Mainly large scale plantation of eucalyptus should be avoided because they upset the ecological balance of fauna and flora very badly.

Fodder Trees

13.32 Intensive fodder development is necessary if the devastation of forest areas and plantations by all types of cattle is to be avoided. It is not only on forest areas that fodder trees can be developed. Both agriculture departments and forest departments much jointly build up a massive fodder tree development programmes to meet the needs of the parallel animal husbandry programmes that are being launched in the plan particularly to help the poorer sections of the population. The following programmes are already in operation and have to be intensified on a proper judgement of the developmental need:—

(i) When farmers keep good milch cattle or cross-bred sheep or exotic pigs, they must be persuaded to put a part of their land under intensive fodder tree cultivation. This development is already taking place on a large scale in Gujarat, Punjab and Haryana and needs intensification in the other States.

(ii) In the Drought Prone Areas and Deserts, it has been explained that a third to a half of the land and in desert areas much more is left uncultivated in each year because of the rainfall pattern and pressure of time. A part of the land can go under fuelwood and a part put under permanent fodder tree.

13.33 The National Commission on Agricul ture had recommended that tongiya cultivation of vegetables, pineapples, pulses and oilseeds can be grown in gaps between the tree lines for the first three years till the tree canopy shades the grounds. Tongiya cultivation is not very popular with the foresters because they always have a lurking suspicion that population will lead to their losing the lands to cultivation permanently. During the Sixth Plan large scale afforestation will be going on in social forestry including village and panchayat lands and degraded forests. If the community interests can be sought and maintained by the Forest Department in these program mes, it should not be difficult to introduce a tem porary tongiya cultivation programme in these areas without any fear of the lands going out of the control of the forest department. There is opportunity here for giving temporary employment in cultivation for three years in these areas to the poorer sections of the village community. This approach is recommended.

13.34 The Sixth Plan contemplates large scale commercial plantations and rehabilitation of reserve forests. Many of these areas of deve lopment will lie in drought prone areas. Tamil Nadu has initiated a programme of growing fodder in all the areas of development where the tree cover has not yet shaded the forest lands. They also allow the village cattle nearby to graze these areas on payment of a very reasona ble fee. It is suggested that if they can give preference to the poorer families owning sheep and cattle and particularly those who have taken to improvement of their breeds, it may give substantial benefit to the poorer sections towards their economic improvement. Other States can also follow this very useful approach to fodder addition for the villages near the reserve forests and commercial forests.

Organisation and Manpower Planning

13.35 The forest department in the States, as at present organised, are not in a position to undertake such large scale programmes. The National Commission on Agriculture had drawn attention to the need for training forest officers in Extension Forestry. This was a new art to the traditional forest staff who had all along only concentrated on conservation. Report with people had to be developed and the department had to get the confidence of the people and also get their help in getting the work done. Where fuelwood plantations are expected to be paying proposition in future and a commercial approach has to be developed, the forester is not attuned to this approach. Training in commercial forestry is, therefore, also important. A National Training Centre for training the foresters in extension and commercial forestry was agreed upon and a start made with a small unit at Ahmedabad. It is necessary to put through the basic concept of a National institute with sufficient capacity at once. A necessary start of our massive programme of social forestry will depend entirely on the speed at which we get this base laid and recruit the necessary order of staff. The present strength of the forest departments in the States is very much unbalanced. The lower level staff like forest guards, rangers and junior officers are anything but equal to the massive task before them. Forest service has traditionally been one where ail their staff at all levels have been trained to the job after selection to the service. There are not enough training colleges at present to train all those that have to be added to the staff in a crash programme. This problem of manpower requires; immediate attention.

14. SAND DUNES STABILSATION IN AND AREAS

Sand dunes which cover nearly 32,000 sq. km. or a little over 9% of the geographical area ol the country, are an integral part of the hot arid zones. Sand storms and sand dunes are spectacular features of the desert and indicate predominant wind action. Wrong use of marginal lands" unsuited for agriculture for plough cultivation leads to rapid wind erosion of the exposed surface. This is a major contribution to sand accumulation. The movement of sand by wind takes place by the processess of suspension, saltation and surface creep. The soil formation in the arid zone is more a physical than a chemical process. Because of almost complete absence of alluviation and other soil forming processes, the profile shows little sign of horizon development. The scanty eroplytic vegetation has contributed almost nothing to the organic matter of the. soil, and, as such, the soil is sandy and loose, and therefore, susceptible to severe wind erosion. It is estimated that about 58 per cent of the arid area of Rajasthan (this is the only State for which figures are readily available) is covered by sand dunes of various forms, sizes and orientations. Unless managed with caution and foresight, sand from the dunes is likely to be transported to fertile land, and on to the road and railway lines causing widespread deterioration.

14.2 Stabilisation of sand dunes is the most important necessity in the hot arid zones primarily for checking the growth of desertic conditions and protecting productive agricultural lands in the neighbouring areas from the on slaught of moving sands.

14.3 Any sand dune stabilisation programme has to bear in mind the special characteristics of the region, namely, low and erratic rainfall, large temperature variations, high evaporation, scanty vegetation, rodent infestations, absence of perennial rivers, subsistence agriculture, sparse and nomadic population, and dependence of rural population on animal rearing.

14.4 The National Commission on Agriculture ifs interim Report on Desert Development had observed as follows :—

> "The desert may not be advancing north and north-eastwards as suspected at one time, but the sands in the desert certainly move with strong winds. Over millennia the desert sands have formed sand dunes. Most of these are stable though their stability is now being threatened by the over-exploitation of the vegetable cover Regulated grazing, as proposed earlier, would go a long way to improve the condition of these dunes. The more recent sand dunes are unstable and are composed of freshly deposited loose sand which is easily blown over by the wind. These pose a threat to habitations, roads and arable lands within their reach.
>
> The Forest Department of Rajasthan and the Central Arid Zone Research Institute have undertaken some pilot schemes to evolve techniques for sand dune stabilisation. Results so far are reported to be good for the short period the experiments have been underway. Treatment of an area is estimated to cost around Rs. 680 per hectare over a period of 5 years. Half the cost is for fencing and mulching. As the young plants have to be watered 5 to 6 times in a year, each time with about 18 litres of water per plant, that is a major item of cost. It is reported that the treated area is expected to bring economic return in a period of about 15 to 20 years.
>
> It would require an enormous sum of money to stabilise the shifting dunes in the vast desert area. With more pressing claims on the limited financial resources, a large scale programme of sand dune stabilisation cannot be contemplated at this stage.

But stabilisation of such dunes, pose a threat to large towns, roads and railways should be taken up. An assessment of the requirement of funds for the purpose should be made so that priorities may be considered. Of course, all shifting dunes in the canal command area shall have to be stabilised to prevent sand casting on arable land there".

14.5 A special study of the problem in the Rajasthan desert (Tirath Gupta, Indian Insti tute of Management, Ahmedabad March, 1980) indicates that the major and minor irriga tion projects in hand are expected to benefit about 11 per cent of the agricultural lands of the regions, and there does not appear to be much scope for further expansion of man- made irrigation facilities. Implicitly, the productivity of lands placed under annual crops would largely remain a function of rainfall which is low and erratic. The annual rainfall in the arid districts varies from 25 to 45 per cent of the average for the whole state which is less than 60 cms. Furthermore, an analysis of time series data for a period of over 70 years for two arid districts Bikaner and Jodhpur, showed that the coefficients of variation in rain fall were 48 and 53 per cent respectively.

14.6 According to an FAO land-use capa bility classification, only 21 per cent of the area in the region can be considered suitable for raising annual crops. Contrary to this, nearly 60 per cent of the region's land area is currently under such crops. A more alarming fact is that, over a period of time, tfie area under annual crops has been on the increase while the already low productivity per unit of land has been on the decline. A vicious circle of declining land producivity and placing more land under these crops has set in. The average yields of the two most important crops of the region, jowar and bajra, which cover nearly 85 per cent of the cultivated area for some of the arid districts, have been reported at 15 and 23 per cent of the national averages, respectively. In the year 1978-79, the hot arid Zone contributed 30 and 48 per cent to the total production of cereals and pulses, respectively, in this State.

14.7 Forests cover less than 6 per cent of the reporting area of Rajasthan and 1.2% of its arid zone (1977-78). Ecological restoration of this tracf requires more area to be placed under afforestation. Besides ecological imbalan ces, the region faces the problem of rising fuel-wood shortage. One estimate is that the recorded and unrecorded fuelwood production in the State accounts for only 5 per cent of the total needs. In the country, as a whole, the fuelwood prices have been rising and the sources of supply have been dwindling.

14.8 Efforts in sand dunes stabilisation, if they have to be effective, have therefore to be carried out in the wider context of scientific management of the total land resources in the region. With the predominance of (i) marginal agricultural lands, and (ii) land based enter prises as the mainstay of the people, this region will continue to be at an absolute disadvantage in comparison with those endowed with better quality of soil and water resources. At the same time, this region has certain "comparative" advantages over the others in respect of some land based activities. A number of alternative land uses can be conceived.

14.9 The Central Arid Zone Research Insti tute have developed and demonstrated silvi-pastoral technology for stabilising the bare sand dunes as they pose immense threat to human habitation and agricultural field areas. They recommended that technologies should consist of:

(a) Protection of shifting dunes from biotic interference;

(b) establishment of micro-wind breaks on the windward side of dune in 5 m parallel strips or 5 m chess boards, and

(c) sowing of grasses and transplanting (with the onset of monsoon) of adapted trees and shrubs raised in earthen bricks on the leeward side of micro-wind break.

Economic analysis of this stabilisation has indicated that the average cost of Rs. 750 per ha will be repaid after the end of the 13th year. It has been found that about 50 to 70 mm of moisture initially present within a metre depth of unstabilised dunes helps in the seedling establishment. Moisture received in monsoon is adequate for seedling establishment for subsequent growth. Soil analysis, after few years of establishment, indicates that the technique influences the organic matter build-up in the sand dunes.

14.10 CAZRI has further recommended, on the basis of detailed work and experiments, the following standardised techniques of sand dune stabilisation:

(a) The areas, unsuitable for agriculture, and where wind erosion is an acute problem, should be put under grasses, trees or a mixture of both.

(b) The areas which are suitable for agricul ture should be protected from wind ero sion by following such practices as addi tion of organic matter, pond sediment etc. so that there is development of soil structure which make the soil more resistant to erosion.

(c) Such practices as, leaving crop residues and stubbles in the field, providing surface cover of mulches etc. should be followed.

(d) Cultivation and planting of a dry soil leads to breaking of clods and more erosion and, therefore, should be avoided.

(e) Crop barriers and shelter belts should be used for checking wind erosion and reducing the effect of desiccating winds.

(f) Strips cropping techniques, perpendicular to the direction of wind, should be followed.

14.11 Vegetative cover is the only answer for stabilising of sand dunes. So far as pasture and range management are concerned, these are dealt with in Chapter 11. Here, we are dealing with afforestation etc. only,

14.12 The Rajasthan Gove rnment, realising the importance of sand dunes stabilisation, have undertaken afforestation programme, during the Sixth Five Year Plan, under which 7,000 hectares of active and semi-stabilised sand dunes are to be afforestated. The technique consists of (i) protection against biotic interference through fencing with angle iron posts and barbed wire (ii) iho treatment of shifting sand dunes by fixing barriers in parallel strips or in a chess board design using local shrub material starting from the crest down to the heel of the dunes to protect the seedlings from burial or exposure by blowing of sand (iii) revegetating by trans planting seedlings at 5mx5m spacing (iv) planting grass-seedlings and sowing of grass seeds on the leeward side of brushwood barriers at 30 cm intervals and (v) continuous after care for a period of 4 years thereafter. For sand dune stabilisation major tree species chosen is Acacia tortilis with other spp. comprising prospis cineraria, Acacia nubica, zizyphus mquritiana calligonum polygonoides, Acacia Senegal and Dichrostachva nutans. Among the grasses, Lasiurus sindicus and Cenchrus species are used.

14.13 The physical targets achieved during 1979-80 and 1980-81 under this programme are as follows:—

SI. Name of the scheme No.	Unit	Physical targets achieved
1. Farm Forestry	No. of plants in lacs	12.08
2. Silvi pastoral plantation	Hac.	8544
3. Village Fuelwocd & Foddei Plantation	"	2842
4. Sand dune stabilisation	"	8066
5. Shelter belt plantation	Row Kilometer	4304
6. Fodder Banking (Grass collection)	Quintals	71000

In spite of severe drought conditions prevailing both in 1979-80, results of plantations are generally very good at most of the sites. Overall survival of plants in plantations raised in the most arid district of Jaisalmer has been over 75 per cent so far. One year old Acacia tortilis plants on sand dunes have attained maximum height of 2.5 m while the average height is 1.5 m.

14.14 In addition, a special afforestation programme in the Rajasthan Can Project area which envisages protection of canal, roads and farm lands from shifting sand dunes and sands is being implemented in the Rajasthan Canal Project area since 1962-63, although this was taken up only in right earnest in 1974-75 when the World Bank Project was sanctioned. Total physical targets achieved under different programmes of this area since 1962-63 tn 1980-81 are given below:—

Sl. No.	Name of the Scheme	Unit	Physical targets achieved
1	Canal side plantation	Hectare	12560
2	Road side plantation	"	1670
3	Village Fuelwood plantation	"	3570
4	Sand dune stabilisation cum pasture development	"	62000
5	Supply of plants to farmers (scheme initiated in 1980-81)	No. of plant s in lakhs	6-5

14.15 The first priority for sand dunes stabi lisation is obviously in areas surrounding villages, townships and fertile lands where the sand dunes are threatening to engulf the area. The extent of sand dunes of this nature will not be so substantial that a phased programme of sand dune stabilisation over the next ten years with state investment cannot answer the problem. This by itself will not be enough to stabilise large areas of sand dunes in the arid zones, which if left without improvement and control will soon add to the problems in other villages, townships and agricultural lands. On a priority basis a programme of action for stabilisation of sand dunes which may cause difficulties should be taken up on a phased basis. The land use survey which is being carried out by CAZRI will be able to identify the priority of sand dunes areas. These dunes, it is often found, are not on lands completely in the control of Government but also cover existing ryotwari tracts. The pattern is mixed. Sand dune stabilisation has to be done on a watershed basis. Any programme, therefore, will have to include both government and private lands. The programmes identified are listed in paragraph 9. It has also been pointed out in paragraph 9 that the average cost will be repaid at the end of 13th year. The programme, therefore, is commercially viable. Fodder requirements and fuel wood and small timber requirements for an expanding human and animal population is certainly welcome. Sand dunes stabilisation gives large areas which can be usefully put under pastures or small timber and can be expected to give returns on a commercially viable basis. The Committee suggests that two types of approach would be useful. In taking up large

scale programmes of such sand dune stabilisation on the principle now followed for afforestation of Panchayat lands, sand dunes stabilisation of areas selected comprising both government and private lands can be put under the sand dunes stabilisation organisation which will do the entire investment and development of the area. The return from harvesting' of the usufruct when it is ripe will go to the government from the government lands and on the private lands a sharing formula can be developed. It is suggested that a 50:50 sharing will be reasonable* If this community approach is not possible in any area because of factions, a master plan for sand dunes stabilisation can be worked out with those who are willing to agree to do the necessary stabilisation work on their individual fields. If the lack of agreement by any of the farmers prevents work on his lands, if the work is absolutely essential to prevent deterioration of the rest of the work, some statutory provisions can be made for compulsory execution and. recovery of investment. The Soil Conservation Act which already provides for such works can be invoked wherever available. The A.R.D.C. and how the proposed National Bank for Agriculture and Rural Development (NABARD) have suitable programmes of refinancing which can be availed of for this purpose if an integrated large scale programme is taken up.

14.16 In the Rajasthan Canal area, all shifting dunes in command area must be stabilised by planting with grass cover to prevent sand casting of arable land. Grazing of livestock on dunes should be restricted so as not to disturb the soil but people may be allowed to cut grass on payment of moderate fees. In the canal cultivated area suitable shelter belts and wind breaks should be established to minimise the effect of hot winds and reduce sand castings. Advantage should be taken of spare water in the early stages of development in command area for growing trees on a massive scale. This programme should receive the top most priority in the Rajasthan Canal area.

14.17 Incidentally, it has come to the Committee's notice that a tree (Leueacena leucucephala) popularly known as "IPIL-IPIL" in Phillipines and SEHMOO in Thailand has got great potential not only as supplying fodder and shelter but also fuelwood. It grows to a height of 65 ft. in five years in the deep soil. The secret of its growth is the capacity of the roots to penetrate quite deep in the soil, to' suck the nutrient and water lying deep down in the soil and beyond the reach of other trees. This tree is prolific producer of leaves, flowers, pods, buds and twigs, all of which are relished by the cattle. The annual yield of dry fodder is 6 to 10 tonnes per acre, depending on the quality of the soil and irrigation facility. Its leaves and tender buds can'be used as vegetables, its seeds can be ground and the flour used for making bread. It gives a good yield of fuelwood. It can be harvested continuously for long periods for fuelwood. Its calorific heating value increases with age often. The wood is strong, dense and attractive and has easy machining properties. It can have a diameter of 8 to 15 metres at breast height in 8 to 15 years and can be used to manufacture plywood, pulp etc.

14.18 The Inspector General of Forest, Ministry of Agriculture, has stated that he had imported 2£ tonnes seeds of this tree from Phillipines and distributed to all Chief Conservators of Forests with a view to try its suitability in the various climatic regions of the country. He is further of the view that this species would be worth trying in Rajasthan Canal area where water would not be a problem and if it can succeed, it would give very good results. The Ministry of Agriculture is again intending to import 3 tonnes of seeds of this plant this year. The Committee would recommend that this species may be tried in the Rajasthan Canal Area and in such other areas where underground water is known to exist.

15. SOLAR ENERGY AND WIND POWER UTILISATION

The Government has accorded high priority to the energy sector during the Sixth Plan period. All our development activities depend on the availability of increasing amounts of energy in suitable forms. With the very low per capita consumption of energy in India, it is clear that we would have to enhance its consumption and, therefore, its production from all indigenous sources, on a massive scale. Continued and increasing use of energy in the present fashion in rural areas can only result in deforestation and desertification, and destruction, of what would otherwise be valuable organic manure. In addition, a very large part of our country is not as yet covered by an electrical transmission network. We, therefore, have to make energy available on a decentralised basis to our predominantly rural communities. Furthermore, for the urban, as well as rural areas, there are increasing pressures in supplying energy from fossil fuels and central power grids. The Government has, therefore, accorded high priority to the development of appropriate technologies for harnessing new and renewable sources of energy for a wide range of applications.

15.2 Indian arid and semi-arid areas since generally receive solar insolation and therefore where conventional sources of energy are not easily available, harnessing of solar energy is worthy of serious consideration. The arid and semi-arid parts of the country receive the maximum radiation. Hence, there is a vast potential for utilising the solar energy in these regions.

15.3 The total solar energy received by our land mass annually is about 60xl013MWH. There are between 250-300 days of useful sun shine per year in most parts of the country. Over 3000-3200 hours of bright sunshine are received every year over Rajasthan, Gujarat, West Madhya Pradesh and North Maharashtra. During the year as a whole, more than 2000 kwh/m2 global solar radiation is received aver Rajasthan and Gujarat. In the dry months of the year, the maximum direct solar radiation exceeds 200 kwh/m2 over Rajasthan, Gujarat and North Maharashtra.

15.4 Some of the problems generally en countered in the cold and hot arid and semi- arid zones include low humidity, shortage of water and fuel shortage. In cold arid and semi- arid zones temperature remains very low in winter, whereas in hot arid and semi-arid zones, the temperature is high in summer. In view of the advanced technology, many of these problems can be solved by utilising solar energy and wind power which are available at the place of use.

15.5 The first efforts to harness solar energy in India began in the early fifties. Work was carried out in a few institutions such as the National Physical Laboratory, New Delhi, Central Salt and Marine Chemical Research Institute, Bhavnagar and the Central Building Research Institute, Roorkee on various problems including water heating, distillation, drying, cooking and space heating. The work was however scattered and sporadic. Policy was defined for the fir§t time when the panel on Solar Energy constituted by the National Committee on Science and'Technology in 1973 studied the entire problem and came up with several programmes. Since then, R&D efforts have been initiated in a number of orga nisations and financial assistance provided on a rapidly increasing basis.

15.6 Among the solar thermal systems, water heating units have now reached the stage of commercial production and utilisation. Flat plate collectors capable of delivering water at temperatures up to 90 degrees are now being made commercially and marketed by several firms in India. Booster mirrors have also been added to enable generation of temperatures up

120°C. Collectors are made- mostly of galva nised iron coated with black paint or selective coatings. Efforts are underway to improve the performance of the collectors by developing materials for selective coating suitable for high temperatures, by developing improved techniques of fabrication etc. Other types of collector systems such as vacuum tube collectors, collec tor with fibre glass bodies, etc. are under deve lopment. Work is also underway on the deve lopment of parabolic and paraboloid concen trating systlems and tracking systems for use with the concentrators. It is expected that these systems will idejliver .hot/ wateir and low and medium grade steam for various industrial applications.

15.7 Development work on other solar thermal applications such as pumping, refrigera tion and airconditioning, motive power and small scale power generation has also been undertaken. Current work on pumping includes systems based on the Ranking cycle and the Stirring cycle.

15.8 Solar energy which is freely available at the site of use is a boon to the hot-arid and semi-arid zones of our country. The availability of solar energy varied considerably from one region to another. It is reasonable to assume on an average availability of 3 to 3.5 kwh per sq. m. per day in zones between 60° and 40° latitude and 6 kwh per sq. m. per day between 40°N and 40°S. Roughly on the North's surface one sq. m. of horizontal area receive about 1 kw of solar energy per hour under clear sky conditions. Thus, on the earth's surface in a year, the energy received by a surface of 1 sq. m. will be about 2500 kwh which may vary with the amount of actual sunshine hours and the latitude of the place. This energy is more than sufficient for household work like cooking, water-heating, drawing, air-conditioning, refrigeration e~fc. as well as for agricultural operation like water pumping crop drying etc. provided the right type of technology is made available at a reasonable cost. The main technical snag, however, is the storage of the power to be utilised according to the necessity during the day and particularly in the night.

15.9 Recently the Department of Science and Technology have brought out a consolidated brochure giving the present position about work carried out in this regard by various institutions all over the country. ("Renewal Energy in Action" published in June 1981 by the Com mission for Additional Sources of Energy). These are presented in the succeeding paragraphs.

Solar Cooking

15.10 The Solar application, though simple in technology will be of considerable value in fuel scarce regions where the tendency is to burn agricultural and animal waste for cooking purposes, thereby robbing the soil from poten tial fertilizer. Solar cookers are generally of two types:

(a) A box type closed cooker with glass, a cover and extfra mirror surface, which provides concentrated radiation into the oven and traps heat within the small space in which the food is placed.

(b) A cooker based on concentrating solar energy by a paraboloid mirror reflector which directly heats the cooking vessels.

An inexpensive solar cooker made out of bamboo can with an aluminium sheet as the reflector surface has also been developed. Recently, Central Arid Zone Research Institute, Jodhpur has undertaken a project dif development of a suitable solar cooker. Two of them

would be of hot box type and the third and fourth would be using flat plate collector and reflector respectively.

15.11 The results of the cooking trials of the solar cookers developed by Central Arid Zone Research Institute, Jodhpur are shown in the Table given below:

Table

Sr. No. Type of food Cooking Time (MTS)

1. Cooking

(a) Rice (1 kg. in water) . . 45

(b) Potatoes (1 kg. in water) . 50

(c) Arhar Dal (I kg. in watar) 75

(d) Other vegetables (I kg. in

water) 60

2. Roasting

(a) Potatoes (1 kg.) ... 60

(b) Chicken (1.5 kg.) . . 60

(c) Fish (1 kg.) ... 20

3. Baking (a) Cake (1 kg.) ... 50

4. Boiling

(a) Tea (4 cups) ... 25

(b) Milk (1 litre) ... 45

(c) Water 45

15.12 The solar oven developed by CAZRI has been found to be the best. The oven can be maaually tilted and oriented towards the sun. A cradle-like cooking platform is made in the oven which helps keep the vessel containing food horizontal, irrespective of the position of the sun. Few such solar ovens fabricated at the Institute have been installed in villages for demonstration-cum-test purposes and perform ance has been found satisfactory. On very clear days the maximum plate temperature in the oven reaches 350°C in summer and 250°C in winter. Almost all food preparations like cooking, roasting, baking and boiling can be done within 30 to 90 minutes under clear sky conditions, food even remains warm for a few hours after sunshine. The main raw materials required for the oven are aluminium sheet, wooden plank, aluminium and M.S. angle iron, looking glass sheets, castor wheels etc. all of which are locally available. Several designs of solar cookers are being marketed at costs between Rs. 200-600. The main advantage of this solar oven lies in its high efficiency because its

performance is unaffected by wind. Further, there are no chances of dust falling into the cooking pot, a problem commonly encountered in the arid zone of India.

Solar Water Heating

15.13 There are three types of solar water heaters normally used:

(i) Natural circulation system;

(ii) Forced circulation system;

(iii) Collector-cum-storage types solar water heater.

The first two types of water heaters are very expensive and are not economical for rural areas. The third type of heater is of low cost and a village carpenter can fabricate it with locally available materials. This heater performs the dual function of absorbing the solar radiation and storing and heating water. A rural model of collector-cum-storage type water heater has been developed at CAZRI, Jodhpur. This heater can supply 90 litres of, hot water upto 50-60°C in summer afternoon. By providing 5 cm glass wool insulating cover in the night, temperature of water may be maintained upto 40-45 °C till next day morning.

15.14 Present costs of various types of fiat plate collectors range from Rs. 800-1200. A solar collector area of 1 m2m can provide about 75 litres of hot water at about 60°C on an average sunny day. Flat plate collectors can also be used to provide space heating. In a typical space heating system, hot water obtained by using an array of flat plate collectors is stored in an underground storage tank. This hot water is circulated through fan coil units at the desired rate. The blower in the fan coil unit blows air over a heat exchanger coil through which hot water is circulated. The air exchanges heat and the warm air thus provides space heating. Hot water systems have relevance too for many agricultural and village industries such as for handloom fabrics, sericul ture, leather tanning and hand-made paper.

Solar Stills

15.15 In arid, semi-arid of coastal areas, there is abundant sunlight that can be used for covering brackish or saline water_ into potable distilled water. A solar still consists of a black bottomed shallow basin which holds brine and is covered with a slanting sheet of glass. The sun's rays pass through the glass sheet and are absorbed by the blackened surface of the basin. As the water gets heated its vapour is condensed on the underside of the cooler glass sheet. The distilled water runs down into the channels which form the water framework of the still, and which take it to the storage tank. Excess brine that has not been evaporated is run to waste and more brine is supplied to basin. Solar stills can produce 3-5 litres of distilled water per square meter on an average sunny day. The solar distillation technology to con vert brackish or sea water into potable water is simple, and small solar stills can be fabricated locally in rural areas. The cost of a solar still may vary from place to place depending on the cost of construction materials, but on an average it costs about Rs. 150-200 per sq. m.

Solar Crop Dryer

15.16 Post-harvesting technology, aimed at improving the quality and reducing the losses of foodgrains is a very important factor. The usual method of sun drying of crop in out-country involves spreading the products to be dried in a thin layer on the ground. However, this exposes the products to wind, rain, insects, birds etc. and the quality of the product does not

improve. Several simple solar drying systems in which solar heated air is blown through packed products in protected surroundings have been developed. These reduce spoilage and improve the quality. Fuel/electricity consumed for dehydration is also saved. A simple cabinet dryer consists of a box insulated at the base, painted black on the inside, and covered with an inclined transparent sheet of glass. Ventilation holes are provided at the base and at the top of the sides of the box to facilitate a flow of air over the drying material, which is placed on perforated trays in the interior of the cabinet base. Large drying systems for grain, paddy, maize, cash crops like ginger, cashew, pepper, etc. spray-drying of milk; timber and veneer drying; tobacco curing; fish and fruit drying etc. have been developed.

Solar Cold Storages

15.17 The existing cold storage facilities for agricultural and other food products in pur country are not adequate to meet the present demand. It is estimated that about 30% of the produce is lost due to lack of suitable cold storage facilities. Moreover, food production centres are often situated in remote and isolated areas where electrical power supply for running large refrigeration plants is not always avail able. Solar refrigeration, therefore, provides an effective solution, particularly in subtropical and tropical areas of the country, where match ing between the cooling load and the solar insulation is generally very good. " There are two methods of solar refrigeration:

(a) Vapour absorption refrigeration systems that utilise low grade thermal" energy obtained from flat plate collectors with a little modification.

(b) Concentration collectors to supply heat at a higher temperature to a heat engine, which then drives the compressor of a conventional refrigerator.

Solar Pumps

15.18 For more than 4000 years, canals have been in use for supplying water for irrigation and drinking purposes. Even today, villages depend upon human and animal muscle power to fulfil their needs for water. Age old techni ques are used for this purpose—the most com mon being the persian wheel, the rope and pulley and a water shovel. A number of pump ing systems based on solar thermal energy have been developed. These systems essentially deploy Sat plate collectors for the low energy range, Winston concentrating collectors or line focussing parabolic through collectors for the medium energy range, or a paraboloid dish for the high energy range. Suitable prime movers, working fluids, storage systems, etc. are being investigated towards evolving suitable designs for sola r thermal water pumps.

Wind Energy

15.19 The primary requirement of energy in arid zones is for supplying water for drinking and irrigation and also electricity to small farmers. Wind is, of course, a free and in-exhaustable source of energy but its econo my and practical potentialities depend upon the cost of harnessing it. When an object is placed in the direction of the wind it exerts a pressure cylinder from PVC pipe. The present cost of this windmill is about Rs.10,000.

The Sail-type Windmill — The sail-type 10 m rotor diameter windmill has 6 canvas sails supported on tubular steel spares and nylon ropes. Canvas sails have been chosen because this windmill is primarily intended for use during the Rabi season, and, so requires a larger diameter to be able to utilise low wind speeds. The sails can be wrapped up when the windmill is not in use. The windmill has been found to pump 9,000 litres of water per hour

against a head of 7 m in wind, speeds of 12 km/hr. The cost is presently estimated at Rs. 12,000 if made in batches of 100 units. A few other proto-types of water pumping windmills have also been developed such as the sail-type savonius rotor and fixed orientation sail rotor. These are designed for relatively smaller output. Wind energy generators for supply of electricity are also being developed.

Incentives Available

15.22 Commercial use of renewable energy technologies in the initial stages depends a good deal on the support that the Government extends by way of fiscal and other promotional incentives. The initial cost structure of the devices and systems has an important bearing on market penetration on a large scale and its adoption for wide-spread commercial use. At present only a few firms in the public and private sector have initiated manufacture of some renewable energy devices. However, these are not being produced in sufficiently large numbers to make an impact. Moreover, there is a poor market; demand because of the high initial costs of these devices. The Government has, therefore, decided to introduce a scheme for incentives, so that such barriers to rapid commercialisation of renewable devices for utilising energy sources can be overcome. Government has already announced an enhanced depreciation allowance at 30% on machinery or plant installed for manufacturing renewable energy devices and systems; and a similar enhanced depreciation allowance on renewable energy devices or systems used for business or profession. Government has also exempted from excise duty, devices and systems designed to use solar, biomass and wind energy. Financial institutions have agreed to treat institutional credit for the manufacture and installation of renewable energy systems on the same terms and conditions as are applicable to the priority sector. These eligible under the Differential Rate of Interest Scheme can also avail of the facility of institutional finance for using renewable energy appliances for productive purpose. This ensures that financial institutions will provide loans on suitable terms both for manufacturers and for users, who wish to instal such equipment. Further, like any other industry, this industry will also be eligible under the existing deferred payment schemes of financial institutions.

15.23 The research in utilising solar energy and wind power for replacing the deminishing sources of energy is a national issue. It will be noticed that quite a lot of research is now going on. Before the research can be applied in the field, more proper cost-benefit studies will have to be done on location specific studies so that the technology can be suitably given to the people for adoption. The Committee would, therefore, recommend that in all these researches in development of equipment and in running of systems for utilisation of solar energy and wind power, the research should define clearly limitations of use of the equipment and the cost-benefit of the utilisation. We tried to get this data, but unfortunately, it is not fully available.

15.24 The main problem in solar energy use is the storage of power to be utilised according to the necessity during the day and particularly in the night. World experience shows that the technology for such phasing of use is costly at present. When we are considering the problem of backward area development, the technology can be useful only to the exfent that costs are low and are comparable with the alternative sources already available to the people. From this aspect, utilisation of solar energy will have at present very limited uses in the backward areas.

15.25 The equipment so far designed for cooking and for providing hot water for family use is well within the means of a family with modest means in the rural areas. The limitations of

the technology are that the cooking can be carried out only when the sun is reasonably high in the sky. This means that what can be cooked is the mid day meal and it can be done only round about noon hour. In many rural areas where the family works in the field, the main meal of the day is the mid-day meal normally consumed sometime in the afternoon. So, for these families the technology is most convenient. The Central Arid Zone Research Institute (CAZRI) will have to develop brochures explaining this and giving the cost-benefit data so that the extension workers can straightway adopij this programme in the rural areas.

15.26 Hot water will be available during the day. In hill areas and in the desert areas also, it is a commodity most welcome during the day for bathing in winter. Of course, this facility will be used more by middle class and that too in the semi-urban and urban areas. A suitable brochures may be developed by the CAZRI for this purpose also for utilisation by extension workers.

15.27 Drying of various vegetable and food products and preservation of food in seasons when supplies are large, are generally problems of the rural areas. Use of solar energy can be suitably designed to provide for drying facilities. There may be many uses for such drying facilities in the rural economy. Where this will be useful will have to be studied and suitable brochures developed by CAZRI.

15.28 Wind power is spasmodic and at present will probably be economic only in lifting water to a tank or a reservoir. Urban water supply schemes and minor irrigation schemes can possibly be designed utilising wind power. The parameters have yet do be developed. Whichever organisation is attending to this research, will have to develop suitable brochures giving the cost-benefit) and also explaining the limitations so that the extension organisations can see whether they are adaptable for their local problems.

Annexure I

Monthly average wind speeds in km/hr

Area	Jan.	Feb.	Mar-ch	Ap-ril	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annu al
Inland Locations													
Eastern Region (Calcutta)	4.1	5.1	8.4	13.0	16.2	12.4	11.5	10.0	8.4	5.0	3.9	3.5	8.5
Northern Region (Mukteshwar)	11.0	12.3	12.9	14.9	16.7	15.4	12.1	10.1	10.0	10.2	10.3	10.5	12.2
Central Region (Indore)	9.9	10.8	13.0	15.5	24.4	27.0	26.2	21.7	18.5	9.8	7.5	7.1	15.9
Western Region (Phalodi)	10.0	8.8	12.9	14.1	20.7	25.6	23.6	19.4	16.6	11.6	11.8	8.3	15.3
Southern Region (Coimbatore)	10.3	10.7	12.0	14.7	23.0	32.6	31.0	30.8	20.2	16.3	9.5	10.1	18.9

16. STRATEGY FOR TRANSFER OF TECHNOLOGY

In the preceding chapters, we have attempted to indicate the present position about improved technology related to different sectors relevant to watershed development programme and the gaps therein. It is quite clear that a large number of technological innovations are available with research stations. The major problem is the transfer of appropriate technology to the people in the specific watershed for promoting rational use of land, water and other national resources.

16.2 In the process of applying science to achieve specified goals, technology is the tool or knowhow. Science is knowledge which is more or less universal, or technology is determined by the nature of the goal to be achieved.

16.3 Effective transfer of appropriate techno logy for watershed development would involve the following activities:—

(i) ascertaining the present level of techno logy in use in the related sectors;

(ii) identifying the type of technology needed and suited for the felt needs of the population of the watershed in general;

(iii) based on such feed-back, need for adoption or adaptation of available technology for improving the productivity of the area and preventing the ecological deterioration;

(iv) testing the suitability of new specific technology in different agro-physical and climatic regions requiring a large number of adaptive field trials and operational research projects under different geographical and socio-economic conditions; and

(v) strengthening the linkages between research and field personnel.

16.4 The main goal of the research in agri culture and allied sectors has so far been the maximisation of production under ideal resource conditions. In the drought-prone areas, both the economic condition of the peo ple and the present level of technology there, are so low that the improved technology in dryland agriculture, dairy or animal husbandry appears to them too complex to manage. Added to these factors, risk and uncertainty in the use of improved technology in the drought prone areas is quite high. Another factor is the large variations in the environmental conditions obtaining in different drought prone areas. The main objective of dryland agriculture technology is to cope with the erratic climatic conditions and specific soil characteristics. Some technology may have wide applicability like improved seeds for dryland conditions, but farming system technology involving new soil management practices is highly site specific. Such technology requires large number of operational research projects and adaptive trials. This equally applies to social forestry and farm forestry, pasture development and water management in the small ayacuts of minor irrigation projects in the drought prone areas.

16.5 The Committee has dealt with the present status of the research findings in various fields in the relevant chapters. It has to be noted that the development of appropriate technology for the drought prone areas requires an effective feedback mechanism. The research has also to give priority to the development of low cost technology. A careful analysis of the methods of agriculture, animal husbandry, etc. in these areas might indicate that a few modifications in

the existing practices could yield better results instead of introducing new innovations which may not only be costly but may also require lots Of effort before the farmer could be pursuaded to take them up. It is, therefore, essential that the research should aim notl only at evolving new technologies but also on improving upon the existing ones. More important than anything else is the need, as pointed out earlier, to bring about a multi-disciplinary approach in our research. The Committee, even at the cost of repetition, would like to reiterate that dry farming research is much more complicated than research in "irrigated" agriculture, The number of disciplines that have to come together for proper dry fanning research are many. Uni-disciplinary research now generally prevalent in the Agricultural Universities and parallel research being carried on in various institutions— Central and State—in various aspects of the sciences has to be brought together in multi-disciplmary applied research programme in order to solve the Specific problems of drought prone areas. The establishment of regional research dentres on a multi-disciplinary basis is essential.

16.6 The next in importance is the provision of necessary inputs and support including credit, marketing and infrastructure to enable the farmers to take up the new technology and also reap the benefits of it. This requires a proper organisation. The Committee has dealt with in Chapter 18.

16.7 What are the factors responsible for either non-adoption or low level adoption of improved practices so far identified by various research establishments. Some of these apparently are:

(a) New technology may not be known to the farmers despite efforts of the extension workers. Or the farmers may be in touch with the extension workers but the methods of extension employed may be unsuitable or ineffective.

(b) Farmers may have heard about the new technology, but the comprehension of whatj it can do or its effective utilisation may require fresh knowledge and skills on the part of the farmers which they do not have.

(c) Probably a serious cause of resistance to change is the unprofitability of the new technology, as seen by the farmer. Often, the new technology requires the purchase of additional inputs to achieve higher productivity. And when the farmer compares the expected output plus its associated income with the addi tional cosfe of the inputs, the balance sheet employing new technology is found adverse.

(d) Often new technology is embedded in a physical item such as seed, pesticide, fertiliser or equipment. But unless these inputs are readily available to the farmer in adequate quantities and at the time when he needs them, knowledge of their potential contribution to his agricultural production, will not result in the adoption.

All these factors related to the client groups need to be taken into account while deciding the strategy of transfer of technology.

16.8 What are the important steps necessary for transferring appropriate technology to rural areas, particularly the drought prone areas. The obvious answer is the field extension and far mers' training, supply of information, literature, audio visual education, field demonstrations, etc. Training of extension workers would also be necessary. These are discussed in the suc ceeding paragraphs.

16.9 The pace of agricultural development, by and large depends upon the efforts Extension Service can put in transferring the techno logy to the farmers field and channelise their problems to the Subject matter Specialists and scientists for practical solutions. Thus, there is need for gearing up the process of extension to transmit the technology to the fields of the farmers. Lack of effective Agriculture Extension for transfer of technology to the farmers fields is one of the major constraints impeding the efforts for increasing agricultural production. Steps required for reorganisation and strengthening of Agricultural Extension in the States have been examined by various High Powered Committees and Commissions in the past and lately by the National Commission on Agriculture. They have emphasised the need for gearing up the Agriculture Extension set-up all along the line with a view to maximising agricultural production. For this purpose an effective approach for Agriculture Extension known as T&V System has been evolved on the basis of experience gained in the pilot projects set up with the World Bank assistance in Rajasthan Canal Areas, and Chambal Command Areas in Rajasthan and Madhya Pradesh and Command Areas in Andhra Pradesh. Since this methodology is reported to have yielded encouraging results, Reorganised Agricultural Extension Projects, based on this approach, are operating in 13 States. Similar Projects for Uttar Pradesh and Andhra Pradesh are in varying stages of formulation and the remaining States are expected to be covered under the System in the course of time.

16.10 The most distinguishing characteristic of the new methodology is that the Village Level Workers and the Agricultural Extension Officers are utilised in an intensive time-bound management system under a fixed programme of training and visits to the farmers' field regularly every fortnight. The training has a direct focus on specific agricultural practices and recommendation related directly to farm operations during a given fortnight. The system is labour intensive and in the initial stages the thrust is on simple and low cost technology such as selection of proper seed, preparation of seed-bed, fine sowing, proper transplantation, weeding, etc. involving no additional investment and entailing no risk to the farmers. As the farmer confidence in the system and his income increases, more sophisticated and capital oriented technology can be recommended. The system is sought to be implemented through a revitalised agricultural extension service which stipulates more effective utilisation of existing manpower and other available resources. The main ingredients of the re-organised agricultural extension approach under the Training and Visit system are:

(a) Agricultural Extension Exclusively — Extension personnel at the field level namely, VLWs are single purpose workers' and devote all their time to agricultural extension work, they are not assigned regulatory or administrative work.

(b) Single line of Command — The most essential principle to be followed is to establish a single line of command from the governmental agency responsible for agriculture to the field-level extension worker. Unless this agency also has full administrative control of the extension service, it is not possible to carry out extension systematically and effectively. Administrative and technical direction thus emanates only from one source, viz. the Agriculture Department so that there are no duplicate or conflicting orders which tend to confuse the workers and detract their efforts to extension.

(c) Area Jurisdiction of Extension Workers.—The number of VLWs required is determined by the total number of farm families in the area to be covered and the number of farm families one VLW can reasonably reach depending, among other things, on the density of population, roads, the intensity and standard of cropping etc. This has the effect of confining the jurisdiction of extension workers to manageable limits, both in terms of area and workable number of farmers to be covered.

(d) Unified Extension Service.—All Agri cultural Extension activities are com bined into a unified extension service. Any staff engaged in special crop or area-related schemes is merged into the regular staff.

(e) Linkage with Research.—Extension Ser vice cannot function effectively unless it is backed by an effective research pro gramme. There is usually no effective link between extension service and the research institutions. The system pro vides for formal arrangement whereby research workers come into direct con tact with extension workers more frequently and vice versa.

(f) Training — Presently training of Extension workers is inadequate, outdated and general in nature. The basic requirement of the system is for specific training relevant to the situation, and at frequent intervals as per fixed schedule. It offers better opportunity to extension workers for deve loping professionalism and acquire skills and confidence.

(g) Supervision.— The system ensures better supervision of work at all levels, through fixed programme of training and visits, provision of transport for mobility of staff as also residential accommodation in the places of their work.

16.11 Each Village Level Worker is required to serve 500 to 800 farming families depend ing upon the intensity of cropping, size of holding and other factors. The norms of 500 families has been found satisfactory for an area of major irrigation system. For a group of 8 village level workers there is one Agricultural Extension Officer who guides and supervises their work. An Agricultural Sub-Division covering about 3-5 Blocks with 80 to 120 VLWs is the basic unit for management of the system. It is headed by a Sub-Divisional Agr. Officer and supported by a team, of Subject-matter Specialists especially in the fields of Agronomy and Plant Protection along with one Training Officer. At the district level, additional subject-matter specialists are provided in the field of specialisation not covered by the existing specialists and which are specifically required for the particular area. The extension service is placed under a whole-time Additional Director of Agriculture (Extension) with supporting state-lev^ Subject-Matter Specialists under the overall control of the Director of Agriculture.

16.12 The new Agrl. Extension methodology aims at ensuring transfer of know-how avail-able at the Agricultural Research Stations to the farmers fields through an effective time-bound management system. This is being achieved ttirough a systematic schedule of training of Extension workers, to equip them with the latest know-how. The transfer of technology from Extension worker to the farmers is ensured through a fixed programme of visits every fortnight. The VLWs are given training by the Subject-Matter Specialists for a full day once every fortnight so as to equip them step by step with the latest technical know-how. The training is concentrated on 2-3 selected crops and is confined to a few critical practices in respect of these crops which require attention during the coming fortnight. This training is a mix of theoretical and practical work and is normally conducted at the research stations or at farmers fields. The competence of the subject-matter specialists in turn is built-up, through monthly training workshops of two days' duration organised by the resource persons and research scientists of Agricultural Universities. Thus the system is based on high degree of professionals ation of extension personnel at all levels. The farmers are divided into 8 groups and are covered under a fixed fortnightly schedule in the mornings and afternoons from Monday to Thursday every week. Each of the 8 groups is further sub-divided into small sub-groups of about 10 farmers. A contact farmer is identified in each sub-group and the VLW concentrates his efforts on his field while the other farmers in the sub-group are encouraged

to meet him and follow these practices on their own fields. Experience has shown that the smaller farmers are able to imbibe the know-how, pasture, animal husbandry, etc. The methodology followed in the existing set up can be adopted in the DPAP areas also but what would be essential is that the extension personnel working in these areas must be provided training in all the disciplines for which the area has the best potential and support is called for.

The Committee has described the present reorganised set up of the extension system in most countries. Advantage could certainly be taken of this system but it has to be pointed out that this system primarily has confined itself to agricultural sector. What is necessary is to provide extension, not only in agriculture but afforestation.

16.13 The objective of the T&V programme is limited. It tries to replicate proved methods of crop production in the field. It is not concerned with the problem of preventing environmental deterioration and maintenance of ecological balance. The technical capacity of the VLW in the programme is limited to agricultural development only. On the other hand in the watershed management approach which is basic in DPAP the main thrust is firstly in restoring ecological balance and then maximising soil and water conservation for increasing crop productivity. The technical expertise for doing this work has to be spelt out carefully.

16.14 In the present T&V programme only the farmer and his holding is' concerned. In watershed management, the Government and community lands in addition to the farmers holdings, comprising the entire spread of the watershed is concerned. Whereas the T&V approach can be suitably modified to suit the farmers programme in D.P.A.P., it will not satisfy the requirement of the handling of the Government and Community areas and the other vital programmes explained above. Soil deterioration has to be rectified in the entire watershed and maximum water conservation has to be planned and executed for the entire watershed. For both these, Government and Community lands have to be brought within the planning and the execution of the programme. As Government and Community lands are generally in the higher contours of the village lands, these have to be treated fully first before one can get down to the farmers. The Committee, therefore, recommends that the planning and execution of the soil and water conservation programme for the Government and community lands should be done by a suitable organisation in the Project. This work obviously cannot be done under the present T&V programme. For this, the Committee suggests the following approach. Once priority watersheds have been identified in the Project area for watershed management, technical teams of the soil and water conservation experts in the project technical group must prepare the soil and water conservation programme for the Government and community lands with such help as may be required from the higher technical echelons for the individual watersheds. This plan must be implemented in full in the first year of the watershed programme as without this protection to the higher reaches, the farmers programme will not be fully productive. The soil conservation organisation in the District should be given the responsibility to get the work done on schedule. The funds should be provided by the DPAP.

16.15 Before the second year of the programme starts, a plan of action for the farmers holdings for soil and water conservation should be drawn up by the technical team in consultation with the farmers involved. In case a few farmers non-cooperate, statutory provisions should be availed of to get a programme done for the watershed so that lack of attention to one part does not jeopardise the entire water shed programme. Along with soil and water conservation programme the experts should identify the holdings or part of the holdings where the cropping system will have to be modified to prevent soil deterioration and

improve the soil condition. Between the ICRISAT and the Coordinated Dry farming research programme, various kinds of soil and water conservation methods have been identified. The technical team of the project helped by such higher level expertise as is necessary will have to decide for each watershed the particular pattern to be followed. ICRISAT has established that landshaping can be done on an individual holding basis without serious loss of effectiveness and if there is difficulty in group action, individual field plans can be done without trying a comprehensive watershed consolidation and land shaping programme. Whilst persuading the farmers to cooperate in a comprehensive programme one can start on the individual holding basis as long as there is sequential action in the various holdings to ensure that there is no conflict. The landshaping programme on the holdings of all the farmers participating should be completed in the off season before the start of the second cropping season. The technical support for this will have to come from the soil and water conservation experts in the project, helped by the VLWs who suitably trained in advance will follow the T&V method to get the programme implemented in time.

16.16 Where a change of cropping is essential in any holding to prevent wrong use and consequential soil deterioration, the technical experts in the project should identify the hold ings and the changes necessary. The VLWs should then be used in the T&V programme to get the changes done by persuasion.

16.17 In the T&V method there is a backup by a Technical Group which trains the VLWs every fortnight during the cropping season for the programme to be put across in the field in the next fortnight. This technical group is expected to keep itself in tune with the season by being based on a demonstration farm where they will be replicating the programme and using it for training also where necessary. This back up technical group with a base experi mental area is crucial for watershed programme. Besides the technical disciplines involved in the T&V, a soil and a water specialist will have to be included. It is preferable that this "group is based at the project centre, for each D.P.A.P. project area. The base area should be a suit able watershed of the same size as the water sheds chosen in the project and should be close to the project centre. In this watershed the technical group will personally supervise all the aspects of the intended programme that they are going to introduce during the year in the pro ject. The base will be a demonstration centre for the project and a training centre for the field personnel. Higher level technical experts in the district must visit these demonstration areas and correct mistakes and solve special area problems that may arise. Selection of such back up areas should be done carefully so that substantial people backing in the watersheds is available and the farmers are prepared to experiment. Such watersheds should get all the subsidies and help that demonstration centres get under the State Plan so that this will be an additional attraction for people's participation in a new venture with some risk.

16.18 Whilst the above technical group will meet the requirements of all aspects of soil and water management and agronomy, the water shed programme has subsidiary production lines in animal husbandry, horticulture and forestry. According to the importance of, each of these programmes in the project area, the project will have the necessary'espertise in the Project Technical Group under the Project Administrator. These experts' should organise their part of the programme in the watersheds under the overall coordination of the project. The phasing of this cooperation would have been decided every year by the project autho rity in the Plan phasing.

16.19 In paragraph 16.3, the Committee has pointed out the need for identification of avail able technology for improving the productivity of the watershed and preventing ecological deterioration. The technical team back stop ping the watershed programme will have to

decide for each watershed the present status of available technology suitable as a first step to improving the traditional cultivation practices and land use patterns by marginal changes to improve the productivity and prevent deteriora tion of the ecology. This programme will then be put across as already explained in para graphs 16.14 to 16.18.

16.20 The most important stage in transfer of technology will be the testing of the suita bility of specific technology in different agro- physical and climatic regions so that introduc tion of the most modern technology can be done in the location specific conditions. This requires a large number of operational research projects and a follow up by adaptive field trials. The national demonstration projects carried out under the aegis of the ICAR aim at demostrat- ing the best laboratory technology to the farmers so that they can accept the technology and improve their productivity. At present, these projects are limited to the high-yielding varieties programmes. The concept, however, does take into its fold multi-disciplinary area deve lopment like the watershed management approach here the latest technology in various disciplines can be built together to achieve overall productivity of the watershed and at the same time, prevent ecological deterioration. It is necessary for the ICAR to expand the national demonstration concept to include a large number of national demonstrations of the latest technology for handling the watershed approach in drought prone areas. There must be at least one demonstration per project area so that the various types of soil and water and climatic conditions are suitably dealt with at the highest technology level.

16.21 The ICAR has introduced a lab-to-land programme in 1979 aiming at transferring of technology generated in the research institu tions among 50,000 families of small and marginal farmers. It is evident that transfer of technology to individual farmers in drought prone areas is not going to achieve any subs tantial benefit to the farmers unless an overall watershed management is also in-built in the programme. The ICAR may examine early how best the lab-to-land programme can be modified to suit the requirements of a watershed approach.

16.22 Whilst the attempt to get the commu nity interested and educated in the watershed management programme goes on, one should not forge the need for setting right the present traditional methods of agriculture which leads to soil deterioration and gradually reduces pro ductivity. Education of individual farmers about! the right crop to grow on hi s field and the correct agronomic practices along with the minimum soil conservation and water conserva tion practices on his holding should be the main plank of the T&V programme in the initial stage. This means that the technical back up to the programme at the start will be to find the best method of improving the traditional practices by adjustments to reduce encroachments, deterio ration and increase productivity by marginal changes. The level of inputs should at this stage be kept fairly low so that the risk factor does not worry the farmer. In our anxiety to do the best we may be attempting the impossi ble in one jumping from a poor traditional technology, high cost high productivity techni ques to (perfection) at one jump. This has to be avoided. The next stage would be a gradual change over to the new approach _ of watershed management introducing the various steps in such a way that there is acceptance and adoption of the changes gradually. Wherever the technologist can get things done as on government lands and community lands, this should be done in one shot. On farmer's field, the gradual process has to be followed.

16.23 Operational research projects were initiated by the ICAR *o try out laboratory results on an area and community basis so that the scientists can identify what are the factors other than the laboratory technology which affect finally the productivity of the laboratory Iheory in field application. Many socio-econo mic problems are invovled and in many cases

problems of input supply and support by other institutions. The operational research project is supposed to identify the various parts of the problem, not only the technology but the social and the economical so that the field programme can be a package of practices including techno logy. In these projecis are technical experts, multi-disciplinary experts including economists and sociologists. The concept is very well suited for handling watershed approach problems. The Committee, therefore, recommends operational research programmes in large watersheds should now be taken up by the ICAR.in the various DPAP zones so that the technologists may refine and improve upon the package approach to make it location specific to the various DPAP zones in the country. The operational research project will be a necessary back up to the national demonstration programmes.

16.24 The Government of India provide assistance to the State Governments through the Centrally sponsored schemes to strengthen the efforts of the State in the transfer of appro priate technology to the rural areas. The main components of the Centrally Sponsored Schemes are :—

(a) providing technical staff for transfer of technology evolved by research to the farmers through demonstrations;

(b) strengthening seed production pro grammes to ensure supply of quality seeds; and

(c) expanding the plant protection umbrella to provide adequate plant protection cover.

16.25 This scheme has been functioning since 1961 but is at present largely functioning in 3.1 G&S covered by high yielding varieties programme. The Committe would strongly recommend that the assistance provided under this scheme should be available for extension support in the drought prone areas.

16.26 In the drought prone areas, the bene fits of a new technology accrue only if a number of complementary improvements such as water harvesting and conservation, altered cropping patterns and animal husbandry and afforesta tion practices are adopted together. Adoption of such a comprehensive package of practices is difficult for the individual farmers, especially the small and marginal farmers in these areas where the terrain is harsh, the improvement complex and the economic facilities meagre.

16.27 Moreover, effective conservation and water harvesting is difficult to accomplish indi vidually as there are community problems re lated to the physical characeristics of watersheds. Therefore, any package of technology having the potential to provide attractive benefits to the farmer requires community approach coopera tion for its successful adoption.

16.28 The group or community approach for transfer of technology in the drought prone an-'as is also quite relevant in view of the indi vidual risk bearing capacities. Past experience in the transfer of technology shows that when the technology is transmitted to small groups of people having a common background, characteristics and resources, chances of its acceptance are greater. The group discussions on improved technology would help indivuduals to get a realistic assessment of the risks involved arid also familiarise them with the actions to be taken to minimise the risk. Approval of the group also legitimises the farmer's individual decision about which he might be in a dilemma.

Commamty Participation

16.29 The long term objective of restoration of ecological balance in the drought prone areas through measures like soil conservation, afforestation, restructuring the cropping pattern, dryland technology and water harvesting cannot be achieved unless the people feel the responsibility for the development of the area and for the maintenance of the old and newly created assets. But, at present, Government departments seem to have taken complete responsibility for changing the eco-system of the area. Studies on Drought Prone Area Programmes revealed that the people were not involved in the identification of problems, planning and implementation of the programme and maintenance of the assets created. They remained only passive beneficiaries of the development programmes. Thus, the dependency of the people on government has increased. Due to lack of understanding, sometimes, there is also deliberate vandalism in cutting across protective structures thoughtlessly, thereby making the system ineffective.

16.30 In the drought prone areas, drought has become a part of the way of life and the people have developed a fatalistic attitude to wards it. They have their own ways of fighting the drought. They either try to escape the situation by migrating to such areas where they can get employment or starve in their area with the hope that weather might turn favourable in the future. One of the common features during the drought and scarcity conditions has been that families are forced to take loan for susten ance and during the favourable years utilise whatever surplus is generated for repayment of the principal and interest. Thus, it is a constant subsistence economy, often deteriorating fur ther, as ecological conditions deteriorate.

16.31 The people of the area consider that the only way for improving the situation is by creating assured irrigation facilities. During times of distress, the people of the drought prone areas expect some relief grants from government, inilch cattle, sheep or bullock carls or land to the landless labour, etc. Thus, they think that the basic force for fighting the drought lies with the Government and not with them. The style of working of the DPAP authority and the collaborating departments also reinforces such expectation as the government seems to be doing everything for the people without involving them in the planning and execution of the programme. The central element in the stra tegy for development of the drought prone areas should be the process of improving the capacity of rural people to control their environment by motivating them to make maximum utilisation of their own capabilities and the local resources. For long term development of drought prone areas, the first attempt should be to create awareness and consciousness among the people of the efficacy of both short term and long term measures. A study of the working of the DPAP by NIRD revealed that not a single respondent residing in the village covered by this programme was aware that there could be long term measures for proper use of land and water which could help in reducing the adverse effects of drought. Apparently, there was lack of proper extension a activity for creating this realisation among the people.

16.32 Most of the activities relating to long term objectives like arresting soil erosion or improving the vegetation cf the area will require a group and the community approach. This stance is generally accepted as desirable but discarded as non-feasible. But to work with local initiative is as important as new techno logy for drought prevention.

16.33 At the planning wge priority should be given for the assesment of villager's need and their priorities. A villager residing in the watershed is not interested in abstract genera lities about the importance of watershed deve lopment for the nation or the area but is con cerned with his own priorities of survival in his own village. Listing of village priorities is not difficult. The villager's needs like drinking water, village paths, fodder for his animal, fuel for

his kitchen and seed the main crop may not be that significant for the watershed planners as construction of contour bunds and long gesta tion afforestation programmes, but these are important for the immediate survival of the people whose cooperation is sought in the water shed programme. The conventional approach towards the conservation of resources will not work. The administration and technologists might think the people have destroyed the ecological balance by their short-sightedness. But they should also realise that they are creating a disequilibrium in ignoring the problem of their survival and suggesting of long gestation plans.

16.34 The way of living of the people in the watershed cannot be changed merely by the changed thinking of the planner. If people's participation has to be enlisted, such interventions to which the villagers will rationally respond have to be identified, short gestation income generating programmes without further deterioration of the ecology for the people in the watershed have to be started and only then the long term conservation or regenerative programmes can be pushed ahead.

16.35 There is need to discuss at the level of operations details of the micro-watershed plan with the residents of the watersheds to avoid any mutual conflicts and secure their active participation. This could be done either through general meetings of all the residents or through the local Panchayat or watershed cooperative, if it is formed. Although this type of approach will take time, one thing is clear that unless each and every resident of the watershed who knows the plan, and the reasons for the different components of the plan and approves of them, his cooperation will not be forthcoming.

16.36 Watershed development programme is essentially a programme for the development of an area. Under this programme, one has to im prove the land belonging to all sections of the people, the big land-holders and the small land holders. With the current emphasis on the development of the poor, one may tend to neglect the big holders completely, but one thing is clear that unles the big land-holders cooperate, the watershed programme cannot be implemented nor the assets maintained over time. Under the watershed approach, every piece of land requires some special treatment whether it belongs to a big holder or small holder, though the big holders may not qualify for subsidy. The land of the big holders has to be treated not because they belong to power group, but because it is a technical necessity for the development of the watershed.

16.37 Similarly, we cannot think of excluding programmes for the landless in the watershed development programme. If the marginal or surplus lands are being distributed among the landless, the watershed project should provide for the development of pastures or horticulture on these lands, with guaranteed employment in secondary and tertiary sectors during the waiting period. This should also be specifically pro vided as part of the plan to achieve a partici patory process.

16.38 Some of the classic and tried methods of interesting the people in the programme need reiteration. Motion pictures describing the case studies on completed successful watershed may help in this direction, as also taking opinion leaders and key communicators on tour to such places where the watershed programme has been successfully completed. The watershed budget should have adequate provision for the extension education programme of the people of the area before the watershed programme is undertaken.

16.39 It is quite well understood that resto ration of ecological balance in the drought prone areas is a long term process and this programme may have to continue for at least 25 to 50

years in order to improve the eco system and stabilise the gains on permanent basis in all parts of the district. In this context, it is obvious that the future citizens of the area (i.e. children and youth) should be educated about their roles and responsibilities with reference to the long term development of the area. Functional groups involving the youth have to be fostered. Further, it would be desirable to introduce relevant themes in the school curriculum so that the students could learn what factors cause deterioration of the soil and natural vegetation, what factors intensify the severeties of the drought, what measures could be taken for the development of the drought prone areas and what role the citizen of the area has to play in this regard. Their involvement with some of the programmes like farm, forestry, contour bunding, dry farming, etc. will increase their interest in this programme. The long term objective of development of the drought prone areas should formulate some plan for educating the children and youth of the area so that when they grow up they understand their responsibilities as a citizen for mitigating the effects of drought.

17. NOMADS AND NOMADISM IN DESERT AREAS

Man has been one of the most important and active agent of biotic interference in the fragile eco-system of arid zone of Rajas-than. An important social problem of the arid region is of the nomads, historical, political and cultural factors combined nomadic life. The socio-economic surveys undertaken by the CAZRI among the settled population provide details about the population characteristics, social and economic correlations of various caste groups, households structure, rural working force, class of farmers and holding size, animal-human-vegetarian-relationship, form of settlement, historical perspectives of land use, cropping pattern, rural crafts, indebtedness, etc. Intensive studies on socio-economic aspects related to desert spread and desertification in the arid zone of Rajasthan included study of bioitc factors and the macro para-meters. The opinion polls and desertification were employed to delineate the factors effecting desertification.

17.2 Nomadism is an extreme case of a human society's adaptation to an unfriendly natural climate and is spread over large parts of the desertic tracts of the world (Berque 1959). The nomads of the old world have been studied by different social scientists. Tursunbayev and Potapov (1959) described some aspects of the socio-economic and cultural development of about 10 million nomadic population in the USSR. They stated that these people are leading a nomadic or semi-nomadic life with extensive livestock-breedings as their main economic activity. Planhol (1959) described geography, politics and nomadism in Anatolia. He stated that in the age of classical antiquity and in the Byzantine era, there was no true nomadism in Anatolia and wandering shepherds of the hill side grazings or the steppe sheep walks of the table land were almost entirely peasants from the valley settlements or paid hands employed by the city-dwellers. Nomadism was a result of the mass influx of Turkish pastoralists from the end of the eleventh century onwards. Abou-Zoid (1959) studied the nomads of the western desert of Egypt and discussed ways and means of seden-tjarisation. The Somali nomad studied by Silber-man (1959), the Bedouins of Saudi Arabia by Helaissi (1959), Muhsam (1951), (1955, 1959) and Elath (1945), the nomads of the Sahara by Monteil (1952, 1959) and the nomads in the Arab Lands of the Middle East by Awad (1962), Krader (1959) stated that the nomadic pastoralism in the arid parts of the Old World was the resultant of the coalescence of its components, nomadism and pastoralism. They appeared long after the neolithic period with demestication of plants and animals. In India, nomads are largely concentrated in the arid and semi-arid zones of Rajasthan. The nomads of the arid-zones are not a separate ethnic group.

17.3 In India, nomads are largely scattered in arid and semi-arid zones of Rajasthan and also to some extent in Gujarat. The nomads of the arid zones are not a separate ethnic group and do not have a separate territory with ex clusive rights and economic framework. The resource use being the decisive factor of the pattern of their living, the nomadic groups of the arid zone may be broadly grouped into four categories, viz. (a) the pastoral nomads (Raikas, Sindhia, barihars, billochs, etc.), (b) the trading (baiyaras, ghattiwala, jogis and gawarres), (c) artisans nomads (the gadoliya lohars, sansis and sattias), nomads and (d) miscellaneous types of nomads (nats, kaibeliya jogis), (Malhotra, 1971).

17.4 Pastoral nomads make indiscriminate use of the meagre available water and grazing resources and destroy the local soil-conserva tion measures. The opening up of the means of communication has reduced the importance of distribution activities by the trading nomads. The shrinkage of grazing lands in some areas due to the extension of cultivation has created

difficulties for the cattle-breeding nomads. Villagers are no longer dependent upon these nomads who once rendered specialised services.

17.5 Studies made by the CAZRI have shown that sedentry population in general do not welcome the nomads for various reasons. The table below indicates the response of settled population to the visit cf different nomadic groups (Desert eco-system and its improvement, published by the Central Arid Zone Research Institute, Jodhpur, 1980) —

Nomadic Group	Want %	Do not want%	Indifferent?	Total %
Raikas	4.7	92.0	3.3	100.00
Sindhi cattle breeder	12.5	83.0	4.5	100.00
Banjaras	32.1	64.5	3.4	100.00
Gawariyas	62.2	33.5	4.3	100.00
Ghattiwala Jogis	60.9	34.8	4.3	100.00
Gadolya Lohars	61.2	34.9	3.9	100.00
Sansis	1.7	95.7	2.6	100.00
Sattias	18.3	78.6	3.1	100.00
Zats	6.3	90.3	3.4	100.00

17.6 The disadvantages to the settled population from the visits of nomads are indicated in the table below which gives the reasons of sample household heads:

Type of response	Raikas	Sindhicattle breeders	Banjaras	Gawariyas	Ghatti-walla Jogis	Gadoliya Lohars	Sansis	Sattias	Nats
Their livestock destroy standing crops	82.9	69.5	80.2	4.1	8.0	2.8	0.6	0.7	3.3
Their livestock exhaust local grazing resources	84.3	68.3	79.3	3.6	6.7	2.1	0.6	0.7	2.5
Their livestock exhaust iocal water resources	28.9	25.6	36.1	1.4	0.9	0.1	0.1	0.1	0.9
Their livestock bring diseases and infect village livestock	11.6	5.8	9.8	0.6	0.1	0.5	0.1	0.1	0.1
They commit theft of livestock	1.5	2.3	2.3	2.2	0.1	2.3	0.5	63 .3	32.7
They commit theft of crop" and other articles	0.1	0.9	0.1	0.1	4.6	0.8	81.2	20.1	41.7
They commit other types of crime	0.3	0.6	—	0.6	2.8	0.1	14.2	10.7	6.9
They are immoral	—	0.5	0.1	0.i	1.5 8.8	0.1	2.7	17.6	3.6
They cheat the village folk in				12.4		0.1	4.5	2.5	5.3

transactions									
They beg and are a nuisance			0.1	1.2	4.4	0.1	0.3	1.9	9.6
Other	1.2	0.2	0.4	0.1	0.8	1.0	0.6	2.9	1.1
No. harms	10.3	20.9	21.1	79.8	79.9	85.7	7.1	51.9	37.8

Most of the respondents felt that the visit1 of pastoral nomads and trading nomads with large herds 'of cattle results in the destruction of standing crops and exhaustion of local water and grazing resources thus imposing hardships on the livestock of the settled population. The problem has been aggravated on account of shrinkage of grazing lands and the extension of the area under cultivation. A significant greater percentage of respondents consider that the visit of Goeolya Lobars, Gawariyas and Ghattiwala Jogis is not disadvantageous to the settled population, some however, feel that the livestock kept by them as pack animals cause damage to crops and exhaust water and grazing resources. It is also alleged that they charge higher prices for low quality goods. Sansis and Nats are commonly believed to be associated with the thefts and other criminal activities. A significantly greater percentage of respondents felt that the visit of Sattias does not result in any harm to the settled population. An appreciable number, however, feel that they are associated with thefts, crimes and immoral activities.

17.7 The data show that most of the respondents feel that the settled population does not get any benefit from pastoral nomads, Sansis, Sattias and Nats. About the visit of Banjaras, two-third of the respondents felt that there was no benefit, while one-third felt that the settled population could purchase salt and other commodities from them. About the other trading nomads, a significantly greater percentage felt that articles could be purchased, sold, exchanged or repaired.

17.8 The Commitee has been greatly handi capped about the availability of data about nomads. Whatever little data is available is in respect of Rajasthan, based" on a few surveys conducted by the Central Arid Zone Research Institute and some information from the Central Sheep and Wool Research Institute, Avikanagar. The Committee has, therefore, no option but to deal with the problem of nomadism so far as it relates to nomads in Rajasthan. All that it would like to say here is that it is a well- known fact that 'Malda' nomads in Gujarat are also a serious sociological problem.

Pastoral Nomads

17.9 Pastoral nomads are generally of two types — the truly nomadic who have no fixed centre but follow seasonal migratory routes to grazing areas, largely governed by the availability of foraging and drinking water resources, and those who follow migratory routes to the seasonal pastures but return to their own abodes during certain seasons. There are sheep and goat nomads as well as cattle nomads. It has not been possible for the Committee to get any information about the number of cattle which migrate, whether permanently or seasonally. As regards sheep, it is estimated that a little more than 0.5 million sheep are in permanent migration and the flock are not brought to their home tract at any time of the year. About 1 million sheep migrate for 6 to 9 months but they start returning to their home tract by July, imme diately before the onset of monsoon season. About 0.2 million sheep migrate for nearly 3 to 4 monhts.

Artisan Nomads

17.10 The second important category of nomads is of those who specialise in certain trades, like gadoliya, lobars, sansis and sattias. The sattiias and the sansis carry on a limited trade in cattle and render veterinary services to the livestock cf the villages on their routes. It is these nomads, who are known for their immoral activities, illegal transactions and skill in thieving and who have created a resentment in the minds of the settled population against the helpless nomads. They are placed even by the nomads themselves in the lowest category of their social hierarchy.

17.11 The nomadic blacksmiths are locally called Gadoliya lohars. They are one of the artisan nomads in the States of Rajasthan, Punjab and Madhya Pradesh. The traditional occupation of the gadoliya lohars is blacksmithy and trade in cattle. Their movements to different places are dependent upon the availability of blacksmithy work and prospects of trade in cattle. They have developed a symbiotic relationship with the sedentary farmers for supplying them with agricultural tools and implements. They also sell utencils for the farmers' households. These materials are supplied to the rural population on cash or exchange basis. The technology of manufacturing the tools, implements and utencils of iron is indigenous and it involves hard work and a large amount of labour. Almost all the members of a family remain engaged in this occupation. Uncertainty of the availability of work and risk in earnings has created feelings of fraternity and mutual give-and-take in society. Unlike other nomadic groups, generally they do not take loans from the moneylenders. They are economically and culturally very backward. Their children are normally not sent to school, and as such, illiteracy is very common.

17.12 These nomads move about in small kinship bands in their bullock-carts with their families. The nature of movement of different bands of these artisans nomads follow a regular cycle on monthly intervals. They owe their allegiance to a definite demarcated area. In one band the number varies from one to twelve families. During movements, they split themselves into smaller constituents which group and regroup at different places, depending upon their social and economic needs. Their movements are limited only to those places which are connected by roads or trucks on which their bullock-carts can go. Owing to the recent socio-economic changes and the increasing means of communications, the gadoliya lohars are not as welcome in the villages as about 15 years ago. About one-fourth of the gadoliya lohars stated that there has been a definite decrease in their getting work of blacksmithy and in cattle trade in recent years. Ninety-five per cent of the household surveyed therefore, desire to abandon nomadic life and lead a sedentary or semi-sedentary life, leading finally to sedentarisation.

Trading Nomads

17.13 From the remote past to the eighteenth century trades were dependent on the nomad caravans. There were very few lines of com munication which could connect big cities. The villages were in isolation and very poorly con nected by cart tracks and footpaths. Even in the present time, there are villages in the Great Desert which are approachable only by walking and goods are carried by packed animals.

17.14 Banjaras are one of the most publicised trading group of nomads. They are camp dwellers. Their entire drama of life is enacted under the open sky. Historically these are very old nomads and were associated with the desertic landscape. Their role in carrying grains from one place to another is referred to by Elpbinstone" (1916) and Hague (1928), Hutten (1961) has described them as a caste of "Carriers, traders and cattle herders more or less nomadic. The 1911 Census Report of Marwar lists the Banjaras as carriers by pack animals.

Aggarwal (1956) has mentioned their role in the destribut ion of salt in the desert villages and their high sense of honesty. Todd has also referred to their functioning in pur chasing and distributing salt on caravans of bullocks.

17.15 The Banjaras are organised into distinct clans in different territories (Malhotra and Bose 1967). Each clan is divided into smaller groups called tandas. In each tanda there are six to twenty families. The doctrine of collective responsibility operates among the members of the tanda (Malhotra and Bose 1967). The families within the tanda are bound by kinship ties which give security to the mem bers. The rights, obligations and expectations towards one another are well established. The structure of the family is patriarchal. Early marriage is very common among them. Every tanda has a headman who commands respect from other members.

17.16 The main occupation of the Banjaras is trading in salt. They roam from village to village with bullocks which carry goods and other material possessions that are few and limited to the bare necessities of life. Even though now-a-days, the salt trade is carried by big wholesale traders with modern transport facilities, it remains the main source of susten ance of most of the families of the Banjaras. The trade is carried on with the family labour force. The women render only minor assist ance in economic pursuits.

17.17 With the onset of rains, the Ban jaras move towards saline basins where salt is manufactured. After rain, grass and water are available on route for their animals. In addi tion to salt trade, they sell fuller's earth and onions in the remote villages of the desertic tracts. These Banjaras move towards Gujarat State during post-monsoon period where they get ready employments in the form of haulage of commodities, like building material, grains, etc., on the back of their bullocks.

17.18 The nomadic Banjaras do not avail of any community facility and have no social as well as cultural relationships with the settled population whom they meet only for trade purposes. There is some communication bet ween the money lenders and the Banjaras, as the latter generally take loans from them for their trade etc.

17.19 The Banjaras are economically back ward and their standard of living is very poor. As a result of improved means of communica tion and the opening of in accessible areas to road transport their traditional relationship of mutual dependence with the sedentary popu lation has broken down. The Banjaras find it difficult to sell their commodities with good margin of profit as in the past. Shortage of grazing land is another problem for them. Their earnings have sufficiently declined and several of them are in perpetual debt.

Sedentarisation

17.20 Because of the severe sociological tensions created by nomads, whether pastoral nomads or artisan nomads or non-descript, there is a general cry that nomads should be sedentarised. At the same time, it is often argued that artisan nomads like gadoliya lohars are not amenable to sedentarisation. The Committee would take the view that nomadic communities will accept sedentarisation and modify their economy provided the society can give them a firm base for livelihood which is better tthan what they are earning today. The economic attraction will prevail in all human motivations.

17.21 In the chapter on "Livestock Development" the Committee has already explained how gradually nomadic sheep breeders can be brought to a limited number of centres in the ranges for the breeding and lambing season without any serious difficulties to them. Gradually,

when they come to such centres for nearly 8 months in the year, the sedentarisation will automatically follow. Therefore, their move ment outside will then be limited to a few months in the year to exploit large grass ranges available. When the community is so gathered, all the advantages of a sedentarisation, a society can give, should be given to them by the State. It is a two-way process. In the case of cattle, the Committee has explained in the chapter on "Livestock Development", there is probably a seasonal migration in case of serious drought to a good pasture. If pastures are suitably developed round about the villages and in the case of movement necessitated by bad drought along migration routes, nomadism in this class will be extremely temporary.

17.22 The artisan nomads are following a nomadic existence because thereby they are at present serving a basic need for service t0 the villages scatered over long distances. As long as village communities are isolated in space and cannot afford their own artisan services, such nomadic artisanship has a value in society. But today with communications expanding and established artisan systems developing in reasonably approachable urban centres, many communities who use the artisan nomads may no longer find them necessary. Thus, over time this will be a dying race unless we now take steps to utilise the skills that are available in the artisans for the benefit of themselves and the society. Gadoliya lohars are mainly lohars. There are carpenter nomads, blacksmith nomads and so on. It has been pointed out that in the town of Jaipur itself 100 families of gadoliya lohars stay today who earn their livelihood by applying their skill for the benefit of the town business. We can take them as almost' sedentarised because as long as the customs exists and improve they are not going on their travels. The strategy, therefore, is obvious. Before the artisan nomads die out by sheer force of economics, it is desirable to bring together into groups under a village industry development project in a convenient area close to available markets under the strategy explained in the report of the Committee on "Village and Cottage Industries". Selection of centres and persuading nomadic groups to concentrate there, will be infructuous unless 'the necessary raw material supply, credit and marketing facilities are simultaneously imposed on the centre. Training them for greater skills is also a part of village industry development.

17.23 One of the important nomadic groups under the miscellaneous criterion is the ban jaras. These are traders. Even today in large parts of India in the rural areas the produce to primary market is actually brought by middle men from the growers. Many primary markets are on the "Hat." system gathering for one day in a week. This system also supplies the consumer necessities of the rural population round about. The intermediary is the nomadic trader. The "Hat" system is gradually chang ing over to a daily market system and automatic sedentarisation of the nomadic traders in many parts of the country. As long as the need for such intermediaries persists in Rajasthan, the banjaras have got an important position in the economic structure. Like other nomads, their livelihood is also liable to be eroded by the sheer force of economics. It is reported that they are now joining the poorer sections of the community. Methods of rehabilitating them by sedentarisation and giving them trading oppor tunities in urban centres is probably the answer.

17.24 There are other nomads like thieving community, beragis and others who anyhow are a social nuisance. There is no known methods of sedentarisation of these people whose liveli hood depends upon their wits.

18. ORGANISATION AND FINANCIAL ARRANGEMENTS

In the preceding chapters, we have delineated some details about the main elements of the programmes for the development of drought prone areas. We have pointed out in Chapter 4 "Strategy of Development" that the objective has to be to initiate economic growth utilising the full potential of the area with the help and participation of the people of the area based on watershed approach "Economic growth with social justice" has to be kept in view. In other words, the approach has to be comprehensive development within the frame of an integrated area development programme, with special emphasis on the least advantaged. Both the beneficiary oriented approach and the integrated area development programme activities have to go hand in hand.

. 18.2 The Ministry of Rural Reconstruction had issued guidelines for the creation of an organisation to plan, coordinate and monitor the implementation of the DPAP and we have to see to what extent the existing set up is equipped to discharge the approach advocated by us for the development of these areas.

18.3 The Task Force on Integrated Rural Development (1973) appointed by the Plan ning Commission had recommended a corpo rate body on the pattern of a joint stock company of a non-profit type for designing, co-ordinating and implementing the programme in each DPAP District. The Central Govt, in consultation with the State Governments, opted for a District Development Agency registered under the Societies Registration Act, 1860 instead of a company, as recommended by the Task Force.

18.4 An analysis of the present set up in the various State indicates that all States did not opt for this set up. In Tamil Nadu, a Rural Development Corporation was set up in Dharam-puri District while Madhya Pradesh continues to implement the programmes through the office of the District Collector. Maharashtra also set up an agency in two Districts, namely, Ahmednagar and Sholapur, which were part of the project assisted by the International Development Association. In some States contiguous drought prone block areas in some of the districts, where coverage of the programme was restricted to a few blocks, the administration of the programme in such Districts was taken over by the District Develop-ment Agency in the neighbouring district which had sizeable area under the programme.

18.5 The main functions of the Agency, as laid down, are broadly, as follows:

(i) to examine the departmental proposals for development of these areas and fix-ing interse priority between sectors and areas;

(ii) to watch and report on the progress of implementation of works;

(iii) to provide liaison with fmancal institutions and State and Central Government Departments;

(iv) to control and regulate the release of funds to the executing departments;

(v) to maintain audit and accounts of the agencies/district development bodies;

(vi) to arrange proportion of shelf of projects and

(vii) to initiate concurrent evaluation and impact studies on various aspects of the programme.

18.6 Some staff was also provided. A Pro ject Director, a Project Economist, a Credit Planning Officer and an Accounts Officer with suitable supporting staff was sanctioned. Later, some Agencies also had few assistant Project Officers to assist in schemes relating to agri culture, dairying, etc. The execution of the programme was per se left to the technical departments concerned, only funds provided for the DPAP being routed to the executing depart ments through the District Development Agency.

18.7 At the State level, initially states had different departments responsible for this pro gramme. In some States, Agriculture Depart ment while in others the Planning or the revenue or the Rural Development Departments were the coordinating agencies. Some rationalisation was brought about during the Fifth Plan and, by and large, except for Maharashtra where the Planning Department has administrative responsibility for this programme, in most other States, it is either the Agriculture or the Rural Development Department which is the nodal department for this programme. A Special Cell was also established in most of the States com prising of specialists in important disciplines to provide technical guidance for the programme, coordinating the functions of various depart ments at the State level, overseeing the field execution of the programme, ensuring monitor ing and evaluation of the programme. State level Coordination Bodies headed by the Chief Secretary, were set up in most States to ensure active involvement of various departments and technical heads.

18.8 At the apex level in the Government of India, a special technical cell was created in cluding specialists in the disciplines of livestock development, dryland farming and soil conser vation, irrigation and economics. This Division headed by a Joint Secretary is responsible for formulating specific guidelines on various parameters of the programme, scrutinise the deve lopment projects critically, supervise the execution of the programme to the extent possible, organise training courses for various functiona ries to acquaint them with the peculiar develop ment problems of these areas and to update their skills in regard to the latest development in their disciplines.

18.9 With the extension of the IRD pro gramme to all the development blocks in the country, with effect from 2nd October, 1980, the Ministry of Rural Reconstruction issued guidelines stating that wherever SFDA/District level agency did not exist, such agencies should be set up for implementing IRD and other pro grammes. It was also stressed that at the district level, there should be only one agency for implementing such programmes. This agency was named as Distrct Rural Develop ment Agency. In Districts where SFDA/DPAP agencies were in existence, the Ministry had advised that these two agencies should be merged into a single agency renamed as Rural Deve lopment Agency. In 1981, some additional staff was provided in each of the agencies like a Rural Industries Officer, APCT (Monitoring), etc. Instructions further stipulated that in the district where CAD programme headquarters is located, IRD programme may be implemented by the Command Area Development Authority itself. Similarly, where the Command Area Development covered only one revenue district, the IRD programme in that district may also be implemented by the CAD Authority. In other Districts covered by CAD, the State Gov ernments may set up separate agencies for implementation of the IRD programmes.

18.10 It would be seen from the above that as things stand today, the erstwhile district deve lopment agencies for coordinating and im plementing the drought prone area/desert deve lopment programmes have been taken over by the newly designated Distt. Rural Develop

ment Agency. The old DPAP agency is now designated as Distt. Rural Agency and as men tioned earlier, for implementing all the special programmes including DPAP, IRD, SFDA, etc. Each Rural Development Agency has a govern ing body headed by the Collector/Dy. Com missioner and consists of the representatives of the State Government, cooperative institutions, Lead Bank, Zilla Parishad, General Manager, DIC, two representatives of weaker sections, one of which has to be a Scheduled Caste/ Scheduled Tribe, one representative of rural women and MPs and MLAs of the District. There is also the provision of the nomination of an Executive Committee consisting of five or six members to look into the various programmes intensively and take necessary decisions. How ever, matters of long term importance such as approval of the Plan have to be brought up before the full meeting of the Agency.

18.11 It must be noted here that the existing agencies are only concerned with the special programmes assisted by the Government of India like DPAP, DDP, SFDA and IRD. Apart from these special programmes, each State has its normal programmes covering all activities in the district over which this Agency has no control, except to the extent that the depart ments concerned at the State level while draw ing up their schemes/programmes may also take into account the programmes undertaken with the special assistance of the Government of India. Actual execution of the programme is in the hands of the normal departmental hierar chies and the Distt. Rural Development Agency has no control either on the staff executing these programmes or on its detailed execution. In other words, the role of the existing agency gets restricted to planning, coordination and moni toring, with such information as may be supplied by the Departments, only in respect of special programmes. It is, therefore, implicit in the present set up that the normal State Plan acti vities and the special programme activities are being carried out simultaneously in the district without any single agency being responsible for the planning, coordination and implementation of these programmes.

18.12 The Committee has recommended in its report on "Organisation of Administrative and Financial Structure for Backward Area Development" what it considers to be appro priate organisational and financial arrangements for realising the full potential of the area and executing a comprehensive development pro gramme embracing all activities—developmental, social services, infrastructure, etc. In Chapter 3 of the said Report, it has laid considerable emphasis on the pla nning processes and decen tralisation of planning. Integrated area deve lopment refers to a method of action, implying "coordination .of policy and of action at all levels". While the ultimate aim is to improve the social and economic conditions of the indivi duals, family being the basic unit for development, there are large number of programmes which can be taken up only on an area basis. With this end in view, the Committee has re commended that "Block" should be the unit for planning and development and "family" to be the basic unit for planning and development. As District has too large an area for a comprehen sive development programme, it has further recommneded that the programme should be planned and implemented on the basis of an Integrated Development Project (IDP) consist ing of two or three blocks, the actual size being decided by the States, depending on the local conditions. The Committee's approach attempts to view the problem of development of backward area in its totality, in contrast with the sectoral approach which is now the case. In order to ensure that necessary resources are provided to achieve the objective of integrated rural deve lopment, it has recommended a Sub-Plan approach for earmarking of Central and State Plan funds for the development of all backward areas, suffering from fundamental types of backwardness, on the basis of certain formula indicated in para 4.6 of the report, referred to earlier. Once a Sub-Plan is prepared for the backward areas, it has further been suggested that funds should be dissegregated on District/Project basis. A nucleus fund has also to be provided for taking up such schemes as cannot be

provided, for various reasons, in the Sub-Plan schemes, to fit in with local aspirations and requirements in the interest of maximising development and helping the poor sections,

18.13 The Committee would, therefore, reiterate that the recommendations made by it in its report on "Organisation of Administrative and Financial Structure for Backward Area Development" covering planning processes and decentralisation, methodology of Central and State Plan allocations, organisational set up for plan implementation, personnel policies, financial and budgetary control etc. are eminently suited for the development of the drought prone areas and should be implemented as early as possible. Any other tinkering with structure creation may be counter-productive.

18.14 As regards the organisational set up, broadly the Committee has recommended:

District: There should be a District Planning and Coordination Cell under the Chairmanship of the Collector to work out a proper programme anjd secure the best deployment of resources particularly in respect of such schemes and programmes which cut across the boundaries of more than one IDP. The collector should be assisted by an advisory committee for planning, implementation, coordination and monitoring consisting of not more than 15 members with a view to plan, coordinate, implement and monitor all programmes in the district, irrespective of the source from which they are funded.

Project Level: An Integrated Project Level Authority consisting of two or three blocks should be set up by an executive order. The Committee has explained at length in the report, referred to earlier, why it is not in favour of setting up of this Authority either under the Societies Registration Act or as a Company. Each IDP will be headed by a Chief Executive Officer and would have a Board of Management. The Collector of the District would be the Chairman of the Board. The authority has been entrusted with the responsibility for planning, direction and monitoring of all programmes in the project and the blocks within its jurisdiction. While actual implementation of programmes would continue to remain, as hitherto, with the concerned Departments, the Authority would exercise such powers as are considered necessary to ensure not only the coordination of the work of all the departmental officers in the project but also be in a position to exercise such control as would enable it to issue directions and take work from them.

Block Level: The Block Development Officer, or his equivalent, would function as an Executive Officer under the IDP A and all beneficiary oriented programmes would be implemented by the Block administration under the overall superintendence and direction of the IDP authority.

State Level: Apart from the high-level Steering Committee which will guide implementation of all the programmes, a Coordination Cell has been suggested at the State headquarters not only to monitor the progress but also to ensure that the funds earmarked for the development of these areas are not diverted by the departmental heads to other areas. A rationalisation of the existing administrative structures in the block and the district has also been recommended.

18.15 The Committee has emphasised in its Report that the development programmes in the drought prone areas have to be based on a watershed approach. It is essential to create an organisation to tackle the essential problems relating to rational use of land in the drought prone areas as recommended in Chapter 5 of this report at project/State level. The idea of creation of an inter-disciplinary State level land authority/board has already been advocated several times in the past and the Committee understands that most States have such authori ties/boards. The Committee would strongly recommend that each State should have an inter disciplinary land authority/board for planning in major watersheds and giving guidance to the lower level organisation in the planning, exe cution and implementation of the programmes on micro watershed basis. The existing departments at the State level like agriculture, forestry, horticulture, etc. are concerned with their sectoral activities. What is essential is an organi sation at the State level which can ensure preparation of integrated projects on watershed development, guide their implementation and monitor the progress with reference to the overall objectives.

18.16 In the same Chapter, the Committee has also recommended to the need for such a Board at the Central level. In the management of the land and water resources of the country, the tradition so far has been to confine itself to supporting some research and administrative activities like survey works and soil conservation treatment in the inter-State catchments of a few big reservoirs. With the initiation of special programmes like the command area develop- ment and drought prone area programmes, the role of Centre in land and water management has been growing ancT more positive and innova tive role seems to be indicated for the Central Government. Many suggestions have been made in the past in this direction and at one time there was also an acceptance, in principle, that there should be a focal point of authority at the national level for all matters relating to the assessment of land resources. The Committee would strongly urge that as a counterpart of the State Board, the Central Government in the Ministry of Agriculture must also set up a National Land Use Board/Authority.

18.17 The Committee notes that, the drought prone areas programme is with the Ministry of Rural Reconstruction. Expertise in various disciplines, which constitute the key compo nent of planning and implementation of programmes on watershed approach are located in the Department of Agriculture, and in the Department of Agricultural Education and Research under the Ministry of Agriculture. As it is essential that there is complete coordination and agreement between various disciplines which has to provide input to' the development acti vities in drought prone areas, the Committee would strongly urge the constitution of a Stand ing Multi-Disciplinary Committee with its own secretariat to guide project preparation, super vise implementation and provide necessary technical and research support, etc.

Coordination between the Drought Prone Areas Programme and Dro ught Relief

18.18 The present procedure is that at the request of the State Governments, the CentralGovernment sends the Teams to assess the damage of the drought affected areas. The Teams generally comprise representatives of the Ministry of Finance, Ministry of Works and Housing (Rural Water Supply Wing), Planning Commission and the Department of Agri- culture (Drought Situation in the States—June, 1980—Ministry of Agriculture). On the basis of their reports and the recommendations of the high level Committee on specific programmes, relief funds are approved by the Centre to the affected states. Most of the relief works are taken up on an ad hoc basis and in the absence of any coordination between the agency execut ing the drought prone area programme and the famine relief, there is not proper linkage between these two integral elements. The Committee would strongly recommend that

a representative of the Division dealing with the drought prone area programme should invariably be included in the Central Team to assess the quantum of funds to be made available to the States and once schemes are sanctioned and approved, whether for creation of permanent assets or for providing relief, these should be prepared and executed in consultation and under the supervision of the Integrated Development Project Authority. The Authority in the Project would be in a far better position to decide as to the type of works which should be undertaken immediately to provide relief to the affected people. It would use these funds not only for providing relief to the drought affected but also get a part of their own programmes for the benefit of the area with the help of these funds. The Committee is of the view that if such a system could be streamlined and operationalised, there would be better utility for funds made available for drought relief, in such areas which have been identified 'as chronically drought affected.

19. ACKNOWLEDGEMENTS

The Committee wishes to place on record its deep appreciation of the .work done by the Members of the Working Group on Rural Development. The Committee was greatly benefited from the Seminar on Development of Desert and Drought Prone Areas organised by the H.C.M. State Institute of Public Adminisrtation, Jaipur in collaboration with the Indian Institute of Public Adminisrafion from March 6-8, 1981. The Committee would like to place on record its gratitude to the Director, H.C.M. State Institute of Public Administration and other officers of the Institute who organised the Seminar and to the State Governments and research institutions who sent their representatives for participation in the Seminar. Also," the Committee is "particularly indebted to the State Government of Rajasthan, for its active participation in the Seminar and for their hospitality. The Committee would also like to thank the Planning Commission for making available grant-in-aid to the H.C.M. State Institute of Public Administration to enable it to meet a part of the expenditure on the Seminar.

2. The Committee also takes this opportunity of thanking individuals, State Governments, Ministry of Rural Reconstruction and research institutions especially the International Crop Research Institute for the Semi-Arid Tropics, Hyderabad; Indian Agricultural Research Insti tute, New Delhi; Central Arid Zone Research Institute, Jodhpur for their valuable suggestions and papers contributed by them.

3. We also wish to record our appreciation of the valuable services rendered by Shri Hit Prakash, Consultant, Planning Commission, for drafting the report and to Shri G. P. Bharal, Senior Research Officer and Shri S. S. Sangal, Research Officer, for collecting, collating and analysing the data as well as assisting in draft ing of the report. Our thanks also are due to the excellent service rendered by the Secretariat.

Sd/-
New Delhi, (B. SIVARAMAN)
30th September, 1981. Chairman

APPENDIX I

Composition & Terms of Reference of Working of Working Group of Rural Development of N.C.D.B.A.

1. COMPOSITION

1. Shri G. L. Bailur, Joint Secretary, Department of Rural Development.
2. Shri A.J.S. Sodhi, Joint Secretary, Department of Agriculture.
3. Shri D. R. Bhambla, Agrl. Production Commissioner, Department of Agriculture.
4. Shri R. N. Kaul, Joint Commissioner, Soil Con servation & Land Development, Department of Agriculture.
5. Shri Shravan Kumar, Secretary (Forest and Rural Deve lopment), Government of Andhra Pradesh.
6. Shri H. K. Khan, Secretary (Agriculture, Forests and Cooperation), Government of Gujarat.
7. Shri K. K. Srivastava, Adviser (PC), Planning Commission.

8. Shri P. H. Vaishnav, Joint Secretary, Planning Commission.
9. Shri S. K. Banerjee, Adviser (A&I), Planning Commission.
10. Adviser (Agriculture), Planning Commission.
11. Shri Nitin Desai, Consultant, Planning Commis sion.
12. Shri Hit Prakash, Consultant, Planning Commis ion.

The Chairman of the National Committee on the Development of Backward Areas will normally Chair the meetings.

2. TERMS OF REFERENCE

(a) To estimate the extent of inter-regional dispari ties in agricultural development;.

(b) To evaluate the extent to which the planning process for agriculture, rural industry and allied activities and the operations of lending institu tions have benefited different regions in the country;

(c) To assess the impact of special programmes for rural development like DPAP, CAD, SFDA and IRD on inter-regional disparities;

(d) To identify the potential for rural development in areas which have lagged behind;

(e) To recommend programmes and policy measures for stimulating rural development in areas which have lagged behind.

APPENIDIX II

Questionnaire on Rural Development Drought Prone Area Development

General

1. What are the important components of the Pro gramme? Is the weightage given to different com ponents adequate to restore and ecological balance in the long run and raise the level of income and employ ment in the short run?

2. Who prepared the project report for the district? Was this report prepared by the District Technical Heads and consolidated by the district agency or these are prepared at the State level in consolidation with the district authorities?

3. Has any bench mark survey been done in the district or is the areas covered under the programme?

4. Are the schemes included under the programme based on a detailed survey of the available resources based on a working plan or shelf of schemes, or are these formulated on ad hoc basis?

5. In a multi-disciplinary programme of the type of DPAP coordination among various departments is very important. How far different departments had con sulted each other in the formulation and are involved in implementation of their schemes?

Watershed Development

6. Watershed has been adopted as a basic unit of development for the Drought Prone Area Programme. Has this approach been adopted? If so, please describe how the watershed were identified. If not, what are the problems visualised in introducing watershed as a unit of development?

7. In the demarcated watersheds, have all the relevant components been taken up and implemented in a coordinated manner?

8. Watershed development is a new concept and requires considerable amount of awareness. Has the extension mechinery been suitably geared to enlist people's cooperation in the adoption of this approach? Has this approach also been adopted by other concern ed technical departments? Is there a training programme for watershed management?

9. Have scarcity relief works been organised in the project area since this programme was launched? If so, please give the amount of expenditure incurred and also the periodicity of such relief works? Were the relief works integrated with DPAP or were taken up on ad hoc basis?

10. What normal state plan schemes relating to rural development are being implemented in the project area, and is there any coordination in the planning and execution of DPAP and the State Plan schemes?

Beneficiaries

11. It was envisaged that in the context of new approach of Integrated Rural Development, other special programmes like DPAP will also adopt an integrated approach and the infrastructure component required to support all the programmes will be provided by one single integrated agency. Has this been achieved? If not, does state apprehend any difficulties? If so, please describe the same with any alternative modifications.

12. Has there been a target fixed for coverage of a minimum number of beneficiaries from among the weaker sections comprising of small and marginal farmers and agricultural labourers? If yes, please specify.

13. Are separate targets fixed for the coverage of scheduled castes and scheduled tribes beneficiaries? If so, to what extent have they been achieved?

14. What were the activities which provided substan tial income and employment to the participants under this programme and how? Were there any components either not found suitable or relevant to the needs of the beneficiaries? If so, please describe the same in details?

Minor Irrigation

15. What type of minor irrigation schemes have been taken up and what are the most successful schemes?

16. How many schemes have been completed and how long did it take to complete the different types of schemes?

17. Is development of the command of these irriga tion schemes taken up simultaneously on the CAD pattern or is the work taken up subsequently? Please describe the steps taken for consolidation of holdings and successful implementation of C.A.D. approach.

18. What is the role of community irrigation works? What is the degree of success achieved and the problems experienced?

19. What is the gap between the creation of irriga tion potential and its utilisation in different types of irrigation schemes. What are the reasons for Ihis gap? What remedial steps have been envisaged?

20. How much of the irrigation potential remains untapped? Please give details separately for surface and ground water resources.

Agriculture

21. What are the main components of the programme in the agriculture sector?

22. What special measures have been taken up for development of the un-irrigated areas under the pro gramme?

23. What type of agricultural demonstrations are being laid out? Have these demonstrations served the objective? Has there been any evaluation of the impact of these demonstrations in terms of increase in the consumption of fertilizers and adoption of new agronomic practices?

24. What extension support is being provided under the programme for adoption of improved agricultural practices?

25. The level of adoption of improved agricultural inputs is generally low in the DPAP districts. What steps have been taken to raise the use of these inputs and with what degree of success?

26. What are the main components of soil conserva tion programme? Is this programme taken up on watershed basis?

27. What are the existing provisions for the maintenance of soil conservation works? Are these provi sions adequate?

28. Has there been any evaluation of soil conservation component? If so, what are the findings?

Animal Husbandry

29. What are the main components of the pro gramme?

30. What are the critical constraints for development of animal husbandry in the project area? To what extent these constraints are being removed under the programme?

31. Food and fodder are important constraints. How are different schemes of Livestock development linked with pasture development and fodder development?

32. The programme of animal husbandry develop ment envisages distribution of milch animals, poultry birds, rams and cows. Is availability of animals also considered in formulation the programme?

33. What steps have been taken to increase the availability of animals, birds etc. and to upgrade the breed of the livestock?

Forestry

34. What are the main components of forestry schemes taken up under the programme?

35. What measures have been taken tip to develop farm forestry and social forestry to meet the requirements of fuel and fodder?

36. What are the difficulties in forestry development?

Credit

37. What is the position of availability of credit for meeting the requirements of the weaker sections?

38. Are ihere difficulties in the flow of credit for the poor? If so, specify the difficulties?

Evaluation

39. Has the programme made any impact in the project area in terms of the restoration of ecological balance and/or raising the productivity of the local resources?

40. Evaluation studies have indicated that there is a wide gap between benefits projected and these actu ally realised. What are the sectors in which this gap is very wide?

41. Evaluation studies have indicated that the dura bility of the assets created under the programme has been affected due to poor quality of construction work. Is it true of the programme in your State?

42. Please indicate for each sector the proportion of cost of staff and establishment to the total cost.