

**ESTIMATES COMMITTEE
(1964-65)**

**SEVENTY-THIRD REPORT
(THIRD LOK SABHA)**

**MINISTRY OF FOOD AND AGRICULTURE
(Department of Agriculture)**

**CENTRAL ARID ZONE RESEARCH INSTITUTE,
JODHPUR.**



**LOK SABHA SECRETARIAT
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CORRIGENDA

to

Seventy-third Report of the Estimates
Committee on the Ministry of Food and
Agriculture (Department of Agriculture)
- Central Arid Zone Research Institute,
Jodhpur.

Page 2, para 3, line 5, for 'oridity'
read 'aridity'

Page 5, para 11, line 11, After 'this'
insert 'Committee'

Page 6, para 11, line 7, for 'semi-arid'
and semi-arid' read 'arid and
semi-arid'

Page 37, S.No.8, col.3, line 1, for
'They' read 'The Committee'

Page 38, S.No.12, col. 3, sub-para,
line 7, for 'Institue'
read 'Institute'

Page 42, S.No.1, col.3, line 4,
for 'on' read 'so'

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(1964-65)

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INTRODUCTION

I, the Chairman, Estimates Committee having been authorised by the Committee to submit the report on their behalf, present this Seventy-Third Report on the Ministry of Food and Agriculture (Department of Agriculture)—Central Arid Zone Research Institute, Jodhpur.

2. The Committee took evidence of the representatives of the Ministry of Food and Agriculture (Department of Agriculture) on the 24th December, 1964. The Committee wish to express their thanks to the Special Secretary, Ministry of Food and Agriculture (Department of Agriculture), Director, Central Arid Zone Research Institute, and other officers of the Ministry and the Institute for placing before them the material and information they wanted in connection with the examination of the estimates.

3. The Report was considered and adopted by the Committee on 21st April, 1965.

4. A statement showing the analysis of recommendations contained in the Report is also appended to the Report (Appendix V).

NEW DELHI;

April 23, 1965

Vaisakha 3, 1887 (Saka).

ARUN CHANDRA GUHA,

Chairman.

Estimates Committee.

INTRODUCTORY

The arid tracts in the country cover an area of 4,77,645 sq. KM comprising the following three zones:

- (1) *Northern Arid Zone*: 1,28,750 sq. KM.
Ladakh and Gulgit tract
- (2) *North Western Arid Zone*: 2,95,000 sq. KM.
 - (i) South Eastern Punjab (Ferozepur, Sangrur, Rohtak, Hissar, Mohindargarh and Gurgaon Districts).
 - (ii) Western Rajasthan (Sri Ganganagar, Bikaner, Jaisalmer, Barmer, Jalore, Pali, Jodhpur, Nagaur, Sikar, Jhunjhunu and Churu Districts).
 - (iii) Western Gujarat (Kutch and Jamnagar).
- (3) *Southern Arid Zone*: 53,895 sq. KM.
Rayalseema tract (Bellary, Cuddapah, Anantapur and Chitaldrug Districts).

The arid tract known as the Rajasthan desert lies in the North Western Arid Zone and is the eastern part of the Thar desert of undivided India.

2. The climate in the Rajasthan desert is characterised by extremes of temperature, ranging from even below freezing point in winter to as high as 52°C in summer. Rainfall is precarious and erratic, varying from below 125mm (5") in the western part to over 500 mm (20") in the eastern region. In summer the winds reach a velocity as high as 80 m.p.h. Water is scarce and occurs 500 to 400 ft. below the ground level. It is generally brackish and in some places the water is poisonous due to excess of salts. The soil is mostly sandy and classed as coarse alluvium or desert soil. In many parts, the soil is saline. Vegetation is scarce and there are no forests.

3. Poor conditions of vegetation and over-exploitation on account of pressure of human and/or animal population, combined with the arid nature of the region, which makes natural regeneration of vegetation difficult, have created a serious problem of wind erosion. Fears are often expressed that the Rajasthan desert is spreading. The Committee

understand that the question of extension of desert was discussed in a symposium organised by the National Institute of Sciences, in 1952 and the general consensus of opinion was that the desert was not spreading beyond the existing limits of the arid zone, though the aridity of the atmosphere was increasing.

4. The Committee have been informed that the Rajasthan desert is largely man-made, *i.e.* due to exploitation of the limited natural resources of the soil beyond their capabilities as a result of over-grazing of pastures, cutting of forest growth and frequent cultivation.

5. In 1952, after the formation of the Rajasthan State, the Government of India, realising the seriousness of the problem of wind erosion and the consequent increase in desert conditions in this region, set up a Special Committee, to study the desert problem and to suggest a proper organisation to tackle the same. As a result of the recommendations of that Committee, a Desert Afforestation and Research Station was established in October 1952 under the aegis of the Forest Research Institute, Dehradun. The main object of the Station was to carry out work on extension of forestry including the erection of shelter-belts and afforestation research.

In 1954, the control of the Station was taken over by the Central Soil Conservation Board.

6. During 1955 the services of Dr. A. Y. Goor, an expert on Arid Lands, were obtained under the FAO programme. On the basis of his report, the station was reorganised in December 1956 as Desert Afforestation and Soil Conservation Station. The scope of research was enlarged to cover basic and applied research in major aspects of land use, viz. Forestry, Agrostology and Agronomy.

7. In 1958, the Government of India invited Mr. C. S. Christian, the UNESCO Adviser on Arid Lands problems, to advise the Government on the establishment of a Central Arid Zone Research Station and make recommendations on the use of an equipment grant made available by UNESCO during 1958. On his recommendations, the Desert Afforestation and Soil Conservation Station was reorganised into a full-fledged Central Arid Zone Research Institute at Jodhpur w.e.f. 1st October, 1959. With the reorganisation, the scope of research at the Institute was further enlarged to cover various human and animal aspects associated with the use of arid and semi-arid areas.

II

ORGANISATION AND FUNCTIONS

A. Functions

8. The functions of the Central Arid Zone Research Institute are as under:—

- (i) To obtain an understanding of the amount and fate of water received by the desert areas in terms of rainfall, condensation and surface and sub-surface flow by—
 - (a) studies of the soil-plant-atmosphere water and energy relationships of major plant communities and different parts of the areas;
 - (b) an inventory of run-off, recharge to underground reservoirs and losses therefrom;
- (ii) To obtain an understanding of the regional dynamics of the landscape, its tendency to change as a result of climatic crises, or use by man and its susceptibility to interference and control;
- (iii) To determine the optimum natural plant community for the major environments in the area, in terms of relative densities of adapted and useful trees, shrubs and ground flora species, under conditions of utilisation; and
- (iv) To determine the best use of water and land, in relation to:
 - (a) the optimum balance between forest, pasture, cultivated crops and animal production, and industrial uses, for any particular land system;
 - (b) the specific practices applied to each;
 - (c) the optimum level of soil fertility which can be achieved and maintained in the arid environments;
 - (d) the specific type and quality of produce ultimately most favourable to the human community; and

(e) an assessment of the best group of occupations and sources of income which will give the population the highest and most stable standard of living.

B. Organisation

9. The Central Arid Zone Research Institute is under the administrative control of the Ministry of Food and Agriculture (Department of Agriculture). Two charts showing the organisational set up of the Institute are given in Appendices I & II.

10. The research work of the Institute is carried out in the following four Divisions:—

- (1) Basic Resources Studies Division.
- (2) Resources Utilisation Studies Division.
- (3) Human Factor Studies Division.
- (4) Special Animal Studies Division.

The work assigned to the various Divisions is briefly indicated below:—

Basic Resources Studies Division

To obtain a comprehensive knowledge and understanding of different land systems in arid and semi-arid regions in specific technical aspects concerning Geology, Geomorphology, Plant Ecology, Pedology, Climatology and Hydrology.

Resources Utilisation Studies Division

To undertake research on problems concerning reclamation, utilisation, management and maintenance and improvement of the resources in various fields such as crop Agronomy, Pasture Research and Range Management and Forestry.

Human Factor Studies Division

To study the socio-economic aspects such as domestic economy, source of income and habits of the people with particular reference to the settlement of nomads with a view to raising standards of living of settled farmers by introduction of improved techniques.

Special Animal Studies Division

To study the special problems in the field of Animal Nutrition, Animal physiology and Animal Ecology related to the arid and semi-arid environments.

11. The Institute is advised in relation to its programme of work and activities by National Cooperating Committee for Arid Zone Research. The composition and functions of this are as follows:—

National Co-operating Committee for Arid Zone Research.

Composition:

1. Deputy Minister for Agriculture	Chairman
2. Special Secretary to the Govt. of India, Ministry of Food and Agriculture (Department of Agriculture) or his nominee	Member
3. Agricultural Commissioner	Member
4. Inspector-General of Forests	Member
5. Member (Water Resources), Central Water & Power Commission (Ministry of Irrigation & Power)	Member
6. Shri Raja Ram, Joint Secretary to the Govt. of India, Ministry of Education	Member
7. Director-General of Observatories, or his nominee.	Member
8. Dr. L. A. Ramdas (formerly Assistant Director, National Physical Lab.)	Member
9. Deputy Financial Adviser, Ministry of Food and Agriculture (Dept. of Agriculture)	Member
10. Adviser on Soil Conservation, Ministry of Food & Agriculture (Dept. of Agriculture)	Member
11. A Representative of the Indian National Liaison Commission with UNESCO, Ministry of Education	Member
12. Director, Geological Survey of India or his nominee	Member
13. Chief Conservator of Forests, Govt. of Rajasthan, Jaipur	Member
14. Director, Central Arid Zone Research Institute, Jodhpur	Member-Secretary.

Functions

(i) To organise, coordinate and initiate research in Arid and Semi-arid regions of India;

- (ii) To collect and collate information on Arid Zone Research in India and abroad and make it available to other countries through UNESCO;
- (iii) To approve triennial research programme both fundamental and applied, for the several Divisions of the Central Arid Zone Research Institute prepared by the Director of the Institute.
- (iv) To assess the work carried out during the year by the Institute.

Scientific Advisory Sub-Committee.

12. Besides, there is a Scientific Advisory Sub-Committee which considers the technical programme of the Institute. The composition of the Scientific Advisory Sub-Committee is as follows:—

Composition:

1. Inspector-General of Forests	Chairman
2. Agricultural Commissioner	Member
3. Director (WIN) Central Water and Power Commission	Member
4. Animal Husbandry Commissioner	Member
5. Adviser on Soil Conservation, Ministry of Food and Agriculture (Deptt. of Agriculture)	Member
6. Director, Central Arid Zone Research Institute, Jodhpur	Member-Secretary.

The Sub-Committee meets as often as necessary.

Setting up of Regional Research Stations.

13. The Committee have been informed by the representative of the Ministry during evidence that the question of setting up regional research stations in the arid and semi-arid zones would be considered when the Institute which "is itself in the process of being completely set up" has been fully established and the proposed comprehensive integrated survey of natural resources in the semi-arid and semi-arid regions is partly on the way.

Need for liaison with Defence Laboratory, Jodhpur.

14. The Committee note that one of the duties of the Defence Laboratory, Jodhpur is to conduct basic research as applicable to the arid zone, such as study of the formation and shifting of sand dunes and sand ripples, water treatment and its conservation, under-ground corrosion and trafficability studies on loose soil, etc. The representative of the Ministry has stated during evidence that at present there is no representative of the Defence Laboratory on any

Technical Committee of the Institute. He has, however, stated that there are certain matters like utilisation of solar energy, desalination of water, etc. in which the Defence Laboratory may be able to help. *The Committee suggest that there should be close contact between the Central Arid Zone Research Institute, Jodhpur, and the Defence Laboratory, Jodhpur, in regard to research activities in fields of common interest.*

15. The actual strength of officers and staff of the Central Arid Zone Research Institute as on 1st April, 1964 was ^{Staff Strength}—
Class I—22, Class II (Gazetted)—8 and Class II (Non-Gazetted)—14 Class III—152, and Class IV—123. A statement showing the sanctioned as well as actual strength of officers and staff of the Institute is given at Appendix III.

C. Plan Provision and Performance

16. The total outlay provided for the Central Arid Zone Research Institute during the Third Five Year Plan was Rs. 40 lakhs as detailed below:—

	Rs. in lakhs
(i) Revenue Expenditure	22.00
(ii) Capital Expenditure	18.00
TOTAL	40.00

The Committee have been informed that the expenditure incurred on the Institute upto 1963-64 and the estimated expenditure during 1964-65 and 1965-66 are as follows:—

(A)—Revenue Expenditure:

Year	Rs. in lakhs
1961-62 (Actual)	0.13
1962-63 (Actual)	0.66
1963-64 (Provisional)	4.73
1964-65 (Estimated)	8.63
1965-66 (Estimated)	10.29
TOTAL	24.44

(B)—Capital Expenditure:

1961-62 to 1965-66	34.00
TOTAL	58.44

17. Out of the provision of Rs. 22 lakhs under Revenue, Rs. 5 lakhs were provided for additional posts to be created in the Institute and Rs. 17 lakhs were intended for equipment and experimental works.

The Committee note that out of the Plan provision of Rs. 22 lakhs on Revenue Account, the expenditure incurred upto 1963-64 was only of the order of Rs. 5.5 lakhs. The representative of the Ministry has explained during his evidence before the Committee that the slow pace of expenditure during the first three years of the Third Plan was due to delay in taking up of new programmes. The Committee have been informed that most of the additional posts required for the Institute have since been filled up. Some new research schemes have also recently been started. The equipment has either been purchased or will be purchased during the remaining year of the Third Plan. They have further been informed that the total expenditure under Revenue is expected to exceed the original estimate by Rs. 2.4 lakhs. The Committee understand that provision of Rs. 34 lakhs under capital made for the Institute during the Third Plan is required for construction of laboratories and office buildings, hostel for trainees and residential quarters for staff, etc. The Institute which is to house the laboratories and administrative office has almost been completed. Out of the total estimated expenditure of Rs. 34 lakhs, a sum of Rs. 18.06 lakhs will be given as aid by the Australian Government under Colombo Plan (Rupee contribution).

D. Budget Estimates

18. The actual expenditure on the Institute during each of the years 1961-62, 1962-63 and 1963-64 was as shown below:—

(Rs. in lakhs)

Year	Actual Expenditure
1961-62	9.86
1962-63	10.56
1963-64	15.83

The budget estimates for the year 1964-65 are Rs. 20·35 lakhs, as per details below:—

Sub-head	Non- Plan	Plan	Total of Non- Plan and Plan
			Rs.
Pay of Officers . . .	2,33,500	63,200	2,96,700
Pay of Establishment . . .	2,92,200	2,39,000	5,31,200
ALLOWANCES & HON :			
Dearness allowance . . .	40,600	30,500	71,100
Travelling allowance . . .	32,500	18,000	50,500
Other allowances . . .	26,000	9,000	35,000
Other charges . . .	4,50,000	6,00,000	10,50,000
GRAND TOTAL . . .	10,74,800	9,59,700	20,34,500

III

RESEARCH SCHEMES

A. Planning and formulation of Research Programme

19. As stated earlier, the National Cooperating Committee for Arid Zone Research is responsible for organising, coordinating and initiating research in Arid and Semi-arid regions of India. It is the Chief advisory body in regard to research undertaken by the Central Arid Zone Research Institute. In pursuance of the broad decisions taken by the National Cooperating Committee, the annual research programmes are prepared by the Institute, then considered by the Scientific Advisory Sub-Committee and finally approved by the National Cooperating Committee. The approved programmes are then implemented by the Institute.

Fixing of Priorities.

20. The Committee have been informed by the Ministry that priorities have been fixed for the various items on the programme of work of the Institute as follows:

- (1) Pilot demonstration of research findings.
- (2) Carrying out problem orientated research of applied nature for rehabilitation of natural resources.
- (3) Surveys of natural resources.
- (4) Carrying out fundamental research to supplement applied research.

Priorities are fixed by the Scientific Advisory Sub-Committee and finally by the National Cooperating Committee for Arid Zone Research.

Period of completion of field experiments in forestry.

21. The Committee have been informed by the Ministry that the scheduled period of completion for field experiments in forestry ranges from 3 to 15 years; in agronomy 3 to 5 years; in pasture ecology 3 to 7 years and in range-management 7 to 30 years. The period of completion in other disciplines varies from 1 to 7 years.

Study of measures adopted in foreign countries to tackle Arid Zone Problems.

22. The Committee understand that the Director, Central Arid Zone Research Institute, Jodhpur was deputed by the Government of India in 1960 on U.N.E.S.C.O. training fellowship assignment for six months to study the latest techniques and research problems under investigation in Australia, U.A.R. and Israel. The Director after his visit

submitted a complete report to Government giving details of research work in progress in those countries. The representative of the Ministry has stated during evidence that on the basis of the report of Director, the programmes of work of the Central Arid Zone Research Institute have been re-orientated in the light of the developments that have taken place in the above-mentioned countries. The Committee are informed that the problems of arid zones in Australia and particularly in California in the United States are more or less similar to those of arid zones in India. They are further informed that the Department of Agriculture of Australian Government and their C.S.I.R.O. laboratories have done very good work in tackling arid zone problems.

The Committee are informed that the Institute has been able to get some information about the techniques of tackling arid zone problems in U.S.S.R. from a Russian expert who came to India through U.N.E.S.C.O. and from some cultural delegations who came to India from time to time.

The Committee suggest that the Institute should undertake continuous studies of the techniques and methods being followed in the United States, U.S.S.R., Australia, Israel and Egypt to tackle the problems of arid zone so that promising lines of research can be taken up in the Institute for intensified effort to find solution suited to conditions in India.

23. Ganga Canal has brought prosperity to a section of the Rajasthan desert and turned it into a granary. The new Rajasthan Canal promises to bring water to still larger parts of the parched desert area and make it bloom. *The Committee suggest that the Government may undertake scientific and technological studies of the conditions obtaining before and after the advent of the canals.*

B. Important Research Schemes Undertaken

24. The Committee have been informed by the Ministry that some of the important schemes undertaken by this Institute are as follows:—

(a) *Evolution of technique of stabilising shifting sand dunes*

25. A technique for stabilising shifting sand dunes has been evolved and pilot development has been carried out on an area of 2,000 acres located at Barmer, Girab, Jhunjhunu, Churu, Sardar-sahar, Dungargarh and Bikaner.

The technique consists of (i) protection against biotic influences by erecting a barbed wire and angle iron fence,

(2) setting up micro-windbreaks in a chess board system starting from crest down to the heel of the dune by binding local shrub material of *Zizyphus nummularia* (Ba), *Crotonlaria burhia* (Bui), *Panicum turgidu* (Karad), etc. in parallel rows 2—5 metres apart both ways, depending upon the prevailing wind velocity; and (3) afforestation of such treated sand dunes by direct seeding of grasses and planting with tree species. The seedlings are raised in especially prepared planting bricks which are prepared out of a mixture of farm yard manure, clay and sand mixed in equal proportions and are dried in sun. The tree and shrub seedlings are planted a little away from the micro-wind on its leeward side so that these are not readily uprooted by infiltrating sand.

The plant species of economic and protective value that have been found suitable are:

Tree: *Prosopis juliflora* (Vilayati Babool), *Prosopis spicigera* (khejri) *Acacia senegal* (kummat), *Albizia lebbek* (Siris), *Zizyphus jujuba* (Ber) and *Acacia tortilis* (Israeli Babool), *Tamarix articulata* (Frash), *Dalbergia sissoo* (Shisham).

Shrubs: *Calligonum polygonoides* (phog), *Ricinus communis* (Castor).

Grasses: *Lasirus sindicus* (Sewan), *Panicum antidotale* (Blue panic) *Cenchrus ciliaris* (Anjan), *Saccharum munja* (Munj).

After the sand dune has been stabilised, it serves as fuel and fodder reserve.

The Committee understand that this technique has been standardised. The approximate cost of stabilising shifting sand dune works out to Rs. 125 per acre.

The Rajasthan State Government on the basis of the recommendations from the Institute, have planned to provide funds during the Fourth Five Year Plan for stabilising about 15,000 acres near the towns and villages where shifting sand dunes are a menace to the vegetation.

Since the stabilisation of shifting sand dunes can play an important part in saving the vegetation in villages and towns from the menace of sand and also augment the fuel and fodder supply in the area, the Committee suggest that the technique developed by the Institute may be put to effective use by the State Government on a wider scale. The Committee would further suggest that a phased programme for covering sand dunes in the entire area may be drawn

up for implementation and that the proposed Desert Development Board/Government of India may extend necessary assistance in that behalf.

(b) Selection of Desert Grasses

26. Five desert grasses have been selected for cultivation in desert areas. These are *Cenchrus Ciliarus*, *Cenchrus Setigerus*, *Lasirus Sindicus*, *Dichanthium annulatum* and *Panicum antidotale*. These are perennial grasses and can be cultivated under the arid conditions. They yield from 1 ton to 4 tons of dry forage per acre. These are very palatable to the animals. The habitats suitable for cultivation of these grasses have been determined. Their carrying capacity has been estimated. During the year 1963-64, about 7 tons of seeds of these grasses were collected. The seeds were distributed to the State Departments of Animal Husbandry, Forestry and Agriculture and a number of the Development Blocks in the Arid Zone and other developmental agencies in various States. 30 acres of land have been sown with these pasture grasses for production of pure seed.

The Committee suggest that the seed production of grasses suitable for growing in arid zones may be taken up on an extensive scale, commensurate with the total area to be served, as this would materially increase the forage resources of the State.

(c) Improvement of degraded pasture lands

27. In 52 Blocks covering an area of over 10,000 acres, experimental work on Range Management and Soil Conservation to upgrade the deteriorated grazing land has been conducted for a period of 3 years. These rangelands have been classified into 4 categories: 'Poor', 'Fair', 'Good' and 'Excellent' range lands. Their carrying capacities have been determined and the management practices to improve these degraded pasture lands have been evolved. As a result of these studies, it has been found that heifers (initial weight 92 Kg.) can be maintained on these pastures on carrying capacity basis without supplementary feed and can gain from 40 to 65 Kg. in body weight in one year, depending on the species composition of forage of the grazing land. The maximum production was on "Excellent" grassland. Cows yielding 6 lb. of milk could be maintained, on the estimated carrying capacity basis on "Good" rangelands without supplementary feeds. The supplementary feed was needed during the period January to June in the "Fair" and "Poor" categories of grazing areas when the grass had completely dried up. The sheep lambs gained in body weight.

ranging from 10 to 12 kg. on 'Poor' and 'Fair' type of pastures. Their wool production increased when grazed, on the specified carrying capacity basis, by about 33 per cent.

The Committee suggest that the regeneration of grasses in the range-lands coupled with livestock studies should be taken up on an extended scale, and a phased programme should be drawn up to upgrade the deteriorated grass lands in the arid and semi-arid lands.

(d) *Selection of Exotic tree species*

28. It is stated that the plants which have been found very suitable in the desert areas are being introduced in stages in these areas. 116 species of *Eucalyptus*, 45 exotic *Acacia*, 8 species of *triplex*, 33 species of miscellaneous genera have been introduced from Israel and Australia. During the past 4 years it has shown an extremely good performance and it is expected that it will be possible to harvest this for fuel in a period of 10 to 12 years compared to 40 to 50 years for the local *Acacia* species. In areas where soil moisture accumulates, *Eucalyptus camaldulensis* can be planted with success even in as low rainfall area as 8 inch. Its water requirements are comparatively low and it grows very fast. This can serve for poles. The Institute is in constant touch with the Plan Introduction Division of F.A.O. Similar relationship has been developed with the Plant Introduction Division of the C.S.I.R.O., Australia. It is proposed to appoint a Plant Introduction Officer during the Fourth Five Year Plan for which the proposals are under consideration of the Scientific Advisory Committee of the Institute.

The Committee suggest that wild species of plants may be studied from the aspect of water deficiency and their adoption to arid environment.

They also suggest that the techniques for the uptake of the nutrients under low soil moisture condition, which is an essential necessity in arid areas, may be developed for cultivated plants. The Committee would also like the Institute to intensify its efforts to locate quick growing suitable trees so that the meagre forest resources in the arid zone may be augmented. The Committee further like to stress the need for protecting existing forests against indiscriminate felling.

(e) *Roadside shelter belt planting*

29. Road-side shelter belt planting has been carried out at the Central Mechanised Farm Suratgarh which covers an area of about 30,000 acres. The length of the shelter belt planting is about 100 Km. Such plantings have also been

carried out along side the different roads by standardising techniques for very low rainfall area. The length covered is approximately 315 Km. Afforestation Blocks on rocky site, semi-rocky site, consolidated loam and sand loam sites covering an area of 1,450 acres has been carried out. In these areas, techniques of afforestation have been standardised and now studies are in progress to evaluate the production of fuel, gum arabica and carrying capacity of livestock. Preliminary results during the past two years have indicated that these afforestation areas can become self-supporting in about 5 to 7 years.

The Committee suggest that after the results of evaluation are finalised, these may be communicated to the State Governments concerned so that plantation of road-side shelter belts can be taken up on an extensive scale.

(f) Studies on Soil Conservation against Wind Erosion

30. Experiments are in progress to conserve soil against wind erosion. Stubble mulching with *Bajra* and *Til*, prevents loss of soil during the summer season. The two important oilseed crops which have shown very good promise, for introduction in the arid areas, are groundnut and castor. Varieties of these have been selected and field scale demonstrations have been carried out with these together with that of improved varieties of *Bajra*. The system of wind strip cropping has been taken up for experimentation at 6 sites in the arid zone. The preliminary results show that this system is likely to meet the fodder requirements of the farmer and reduce wind erosion losses, which are caused by sand blowing in the fields.

The Committee suggest that research efforts may be intensified so that a practical solution to the problem of conserving soil against wind erosion may be found early.

(g) Survey of Natural Resources

31. An area of approximately 11,600 sq. Km. has been surveyed for natural resources of land, water, soils, vegetation, economic and social factors impeding development, minerals available for small scale industries and so on. Land Transformation plans have been drawn up for the Siwana Development Block in Barmer district. Similar plans for 3 more Blocks, Ahor, Jalore and Siala are under compilation. The testing of this programme of Land Transformation has been taken up in consultation with the Border Commissioner and the Development staff of Agriculture, Animal Husbandry and Forestry Department of the State Government of Rajasthan and Block Development agencies in the

Siwana Blocks. This Plan embodies recommendations for improvement of agriculture, grasslands, animal husbandry, forestry, etc. During the geological surveys availability of large quantities of lime-stone in the Bhadrajan area was reported to the Mineral Bureau and these are being now prospected by the Mineral Bureau of the State. During the surveys, a large number of wells have been tested for water quality for their use for irrigation and it has been found that about 40 per cent of them supply sweet to slightly saline water and the rest have medium saline to very saline waters.

32. The Committee note that the general consensus of opinion at the Symposium on "Problems of Indian Arid Zone" jointly organised by the Ministry of Education and the United Nations' Education, Scientific and Cultural Organisation from 23rd to 30th November, 1964 at Jodhpur was that the stage had been reached when the Central Arid Zone Research Institute could conduct an over-all appraisal of arid and semi-arid regions throughout India in order to provide a comprehensive reconnaissance picture of land, water, vegetation, human, animal and land use resources. It was felt that with such an over-all picture, the Institute would be in a better position to determine future investigations with an appropriate order of priorities.

The Committee have been informed by the Ministry that the Central Arid Zone Research Institute will now re-orientate its work to carry out a comprehensive reconnaissance survey of land, water, vegetation, human, animal and land use resources as recommended at the Symposium. The requisite number of photographs and Survey of India Sheets for survey work are being indented from the Survey of India Dehradun to start the work.

The Committee attach considerable importance to the completion of this survey as early as possible and suggest that a perspective plan may be drawn up for carrying out an integrated survey of natural resources of all the arid and semi-arid lands in India in a detailed and thorough manner so that the future development of the arid and semi-arid regions could be based on complete and reliable data with appropriate order of priorities. The time limit for the completion of the various stages of the survey may be fixed and it should be ensured that it is adhered to.

As the information, gathered from resources surveys, will be of direct significance to the State authorities in their development activities, the Committee suggest that the desirability and feasibility of associating them with the conduct of

resources surveys may be considered. The Committee recommend that the Institute should evolve a standard method for an integrated natural resources survey so that it can be followed both by the Central and State agencies to gather information on uniform basis.

(h) Survey of Under-ground water

33. The Committee are informed that the survey of underground water has been carried out on a very small scale as a part of the integrated surveys of natural resources, whereas large scale investigations in this behalf are being conducted by the Exploratory Tubewells Organisation and the Under-Ground Water Board of State Government.

The Committee suggest that there should be close co-ordination between the Central Arid Zone Research Institute, the Exploratory Tubewells Organisation and the Under-Ground Water Board of the State Government to avoid any overlapping and duplication of work and to ensure that the survey of under-ground water covers comprehensively all the desired aspects of the problems.

(i) Studies on use of local Ground water

34. The Committee find that the Symposium on problems of Indian arid zone had *inter alia* recommended that "studies be undertaken of methods of efficiently utilising distributed water and local ground water for irrigation purposes and of the most efficient use of rainfall for crop production, pastures, forestry and stock water in the different land types of the regions".

The Committee suggest that the question of such studies being undertaken by the Institute may be examined.

(j) Desalination of brackish water

35. Water with excessive salinity for human or stock consumption is a problem in arid and semi-arid areas. The Committee understand that no study has yet been made of the problem of desalination of brackish water and that work on desalination of water, by the use of solar energy and other techniques evolved in other countries will be started after the Division of Liaison in Physical and Chemical Engineering Studies, has been set up. The proposals regarding the setting up of this Division have been approved by the Scientific Advisory Sub-Committee of the Institute but have yet to be approved by Government.

The Committee suggest that an early decision may be taken on the proposal to set up the Division of Liaison in

Physical and Chemical Engineering Studies. The Committee also suggest that studies in desalination of brackish water may be undertaken on priority basis.

(k) Selection of varieties of Bajra, Jowar and Guar, for introduction in arid areas

36. Varieties of *Bajra* and *Jowar* crops have been tested for their tolerance to saline waters of various salt concentrations from the wells. The highly salt tolerant varieties are now being further tested for tolerance to various salt concentrations at the seeding and late stages of growth.

Sixty-two varieties of *Guar* have been collected from various parts of the arid zone. These are now under test for their yield and quality. Forty three of these varieties have been tested for their gum content. At present all varieties are being exported for gum extraction which fetches low price to the growers.

The Committee suggest that research may be intensified to develop Bajra and Jowar seeds which are tolerant to saline water conditions.

The Committee also suggest that experiments to find out the yields and content of the remaining varieties of Guar may be completed early so that varieties of high yield and quality may be introduced in the arid areas. The Committee understand that there is great scope for improving the export of Guar yielding high quality gum to the foreign countries. The Committee hope that the export of Guar preferably in manufactured form viz. gum will be stepped up to earn more of valuable foreign exchange, giving at the same time due consideration to the requirements of the country for Guar.

(1) Standardisation of method of preparation of gypsum blocks

37. The method for preparation of gypsum blocks, which are used for estimation of soil moisture, has been standardised. The cost of imported gypsum block is around \$1 each, whereas the cost of the locally manufactured block is only 0.75 P. The work on the nylon block, which costs about \$10 each is in progress. The approximate cost of this when standardised will be about Rs. 2. In consultation with Atomic Energy Commission, the Neutron Moisture Meter has been tested at the Station and now the Commission is trying to assemble this equipment for use at other research Centres in the country. This equipment is extremely costly when imported from foreign countries, but

is required for irrigation and soil moisture studies. Soil Tensiometers which cost at present about Rs. 250—300 each, will cost only about Rs. 50—100 each if fabricated with local materials.

The Committee hope that the standard indigenous gypsum blocks evolved by the Institute would be put to extensive use for the purpose of estimating irrigation and soil moisture.

(m) *Socio-economic survey and Rehabilitation of Banjara Nomads*

38. A socio-economic survey in respect of Banjara group of Nomads carried out by the Institute has indicated that 97 per cent of Banjaras prefer settled life and that the remaining 3 per cent only like nomadic life.

A scheme for the sedentarisation of Banjaras group of nomads has been drawn up on the basis of this socio-economic survey and has been passed on to the State Government of Rajasthan for implementation. A similar study on rehabilitation of nomadic cattle breeders has been taken up in the border areas of Bikaner, Jaisalmer and Gangaghat districts where canal water is likely to come very soon. The report is likely to be ready in the next 4 months. Socio-economic survey of settled population has been carried out in 13 Blocks in the lower and central Luni River Basin. Some of this information has been incorporated in the land transformation plans drawn up for development of land resources in the different blocks. A Study on factionalism in the villages has been completed and causes for factionalism have been recorded.

The Committee hope that the scheme drawn up by the Institute for the rehabilitation of Banjara group of nomads if found feasible would be implemented by the State Government.

(n) *Control of Desert Rats*

39. One of the chief problems in the desert areas in India is the control of Indian desert Gerbils (desert rats). Studies on the Indian desert Gerbil, are stated to have been carried out from the aspect of physiology and ecology. This Gerbil can withstand water deprivation for a period of 16 months and can take a very heavy salt load which has been attributed to its peculiar excretory mechanism in the kidney. Twelve poisons have been screened and only zinc phosphide has given 80 to 90 per cent kill in the field. The studies on

the population dynamics of these rats in relation to soil type and vegetation are in progress. It has been established that soil type influences the density of its population. Control measures under field conditions are under test.

Some studies have also been made of the ecology of palm squirrel and hare.

The Committee understand that it is proposed to take up study of ecology of birds in the Fourth Five Year Plan.

The Committee suggest that ecological investigations on animal and insect pests in arid areas may be intensified with a view to evolve suitable methods for their biological control.

(o) *Studies on Sheep*

40. It is stated that work on the variability in Sodium potassium balance in the blood of Marwari sheep has been taken up recently. It has been found that sheep can be classified into high and low potassium types. Some relationship of these types with more production in arid areas seems to exist. It has been stated that this index may be fruitful in building up high wool production flocks.

The Committee are informed that a scheme on the micro-nutrient deficiency in the blood of sheep has been approved and will be implemented as soon as the requisite staff becomes available. It is also proposed to take up the study of re-circulation of nitrogen in the blood of sheep in the Fourth Five Year Plan. It has also been stated that preliminary investigations on Physiological Genetics of sheep from the aspect of resistance to heat and water stress have been started at the Institute. The Committee have however been informed that the breeding work on sheep will be undertaken at the Sheep and Wool Research Institute, Malpura.

As research work on sheep is being done at both the Central Arid Zone Research Institute and the Sheep and Wool Research Institute, Malpura, the Committee would like it to be ensured that there is close co-ordination of activities in this field between the two Institutes so that there is no overlapping or unnecessary duplication of effort.

C. Expansion Plan

41. The Committee understand that an expansion plan for intensification of research activities of the Institute has been drawn up and is at present under examination of the

Scientific Advisory Sub-Committee of the Institute. Thereafter, it will be examined by the Ministry of Food and Agriculture (Department of Agriculture), the Planning Commission and the Ministry of Finance. The main items of the intensification programme are studies on soil erosion, inter-relationship of deficiencies of plant nutrients in the soil, uptake by the plant and the livestock production, salt tolerance by crop species, selection of species of legume plants for cultivation and introduction in the grazing lands, use of radio tracer techniques in the study of soil-water-plant relations and nutrition of crops and animals, study of biology of insect pests of arid zone and their control and study of the methods of birds which damage crops.

42. *The Committee would like to draw attention in this connection to the following recommendations made by the Symposium on Problems of Indian Arid Lands, with which the Committee agrees:*

- (1) The ecological investigations in arid lands of plant communities should be intensified as the information on these subjects is fragmentary.
- (2) The basic research work of the Institute should give research attention to (i) the possibility and desirability of building up soil organic matter in arid and semi-arid environments, (ii) study of the micro-flora of these regions and (iii) the role of rhizobium and the importance of adapted efficient strains for arid, semi-arid, saline and alkali tracts and regions.
- (3) Research should be conducted to set up small scale industries which can be developed as by-product industries based upon industrial raw materials of the Arid Zone consisting of gypsum, limestone, base metals, lignite, salt, sand and medicinal plants.

The Committee hope that the above mentioned research schemes would be considered for inclusion in the Fourth Plan for the Institute.

D Dissemination of Research Results

43. The Committee have been informed that as soon as the results of research projects become available, they are published in the form of original research papers and recommendations are either demonstrated on pilot scale or passed on to the State Governments for adoption through the agency of the Departments of Forestry, Agriculture, Animal

Husbandry and Social Welfare. The reports of surveys conducted are passed on to Government agencies for utilisation. The Committee have been further informed that recommendations arising out of the results of researches conducted in the various fields find a place in the Fourth Five Year Development Plan of the Rajasthan State.

The Committee cannot over-emphasise the importance of ensuring that the results of research conducted by the Institute are translated into actual practice by all the State Governments concerned and would stress that there should be close, effective and continuous co-ordination with the State Governments in the field of research on arid zone problems and the utilisation of results of research.

E. Research and Training Facilities

44. The Committee understand that the Institute has been recognised for Post-Graduate work by the Indian Agricultural Research Institute, New Delhi, and Jodhpur, Rajasthan and Bombay Universities. There are at present six Research Fellows sponsored by the University Grants Commission and the Council of Scientific and Industrial Research who are conducting research in the Institute. The Research Fellows are given guidance for particular research projects, facilities of laboratories and field facilities for experiments. Members of staff are also provided facilities for research for Post-graduate degrees of M.Sc. and Ph.D. of different universities.

45. The Committee understand that besides conducting research, the Institute conducts short term courses on "Grassland Ecology", Improvement of Grazing Resources and Fodder Production", "Water balance studies of Plant Communities" and "Photo Interpretation for Soil and Water Conservation". The training is imparted to persons nominated by the State Governments. So far, such courses have been given to 200 officers and staff of the State Governments. The persons for receiving training mostly come from the States of Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Mysore and Andhra Pradesh.

The Committee have been informed that it is proposed to start post-graduate course in integrated survey of natural resources and water balance studies of plant communities at the Institute whom the Divisions are fully manned. Proposals for setting up of Post-graduate School at the Institute are also under consideration of the Scientific Advisory Sub-Committee.

The Committee understand that no review has yet been conducted of the courses of training in consultation with the State Governments to see whether any modification is called for. The representative of the Ministry has informed the Committee during evidence that the Achievement Audit Committee when appointed will go into this matter.

The Committee consider it of vital importance that the training courses are reviewed periodically in consultation with the State Governments so that any improvements or modifications, where called for, could be effected.

The Committee also suggest that an early decision may be taken on the question of setting up of a "Post-Graduate School" at the Institute in those subjects in which the Institute has adequate facilities.

F. Evaluation of Research Work

46. The research work carried out by the Institute during the year is assessed by the National Cooperating Committee for Arid Zone Research. The representative of the Ministry has informed the Committee that as soon as the Institute is shifted to the new building and when the work is reorganised, it is proposed to appoint an Achievement Audit Committee consisting of independent eminent scientists from outside the organisation to evaluate the work done by the Institute.

The Committee has felt that the proposed Achievement Audit Committee would be appointed soon to review the work done by the Institute since its inception. As regards subsequent reviews, the Committee would suggest that the review may be conducted in the third or fourth year of the Plan so that the advice of the experts is available in time for framing schemes for the next Plan period.

G. Desert Development Board

47. The Committee have been informed by the Ministry of Food and Agriculture that a suggestion to set up a Desert Development Authority for the development of the desert areas in the country was made in September, 1963. This proposal was examined by a Study Group presided over by Joint Secretary, Ministry of Irrigation and Power and having on it representatives of the Central Water and Power Commission and the Ministry of Food and Agriculture. The Group's report was discussed with the representatives of the State Governments of Punjab, Rajasthan and Gujarat, the

Ministries of Irrigation and Power and Health and the Planning Commission at a meeting held in April, 1964. The view of the State Governments' representatives who attended the meeting was that a number of pilot projects of desert development should be taken up in Rajasthan, Punjab and Gujarat and that the entire expenditure on these projects should be met by the Central Government.

The Committee have been further informed that the manner of financing these projects and a proposal to set up a cell in the Ministry of Food and Agriculture for dealing with the problems of desert development has been the subject of negotiations with the Ministry of Finance and a decision is likely to be taken shortly.

48. In reply to questions asked in the Lok Sabha on the 15th September 1964 regarding the delay in finalising "the functions and powers of the proposed Desert Development Board which has been accepted in principle by the Government" and the capital outlay for the various schemes under this proposal, the Minister of Food and Agriculture stated as follows:

"It is in the final stages. The specific proposals with regard to the posts to be created and their grades of salaries and all those things have already been made. Therefore, I hope that it may be possible to finalise it as soon as we get the clearance from the Finance Ministry".

"Rs. 12.5 lakhs would be the amount to be spent during the Third Plan, but the anticipated expenditure during the Fourth Plan is Rs. 10.12 crores. It is a question of taking up specific projects and working them and on the basis of that experience, of evolving a more comprehensive scheme".

On the 23rd March, 1965 in reply to a question eliciting information about the functions, powers and the operational programme of the proposed Desert Development Board, the Minister of Food and Agriculture stated in the Lok Sabha as follows:

"All these points are at present under examination in the Planning Commission, and are likely to be finalised shortly".

49. The Committee are glad that the question of setting up Desert Development Board has been receiving the attention of the Government at the highest level. The desert

area which has vast potentialities extends over 4,77,645 square kilo-metres. The phenomenal increase in food and fodder production in Ganganagar District of Rajasthan, after the advent of Gang Canal, bears eloquent testimony to the vast potentialities of the development of desert area. The Committee have no doubt that Rajasthan Canal, now under construction, will make for similar development of much larger desert areas; but even so, a substantial area of desert will still remain for whose development special measures would have to be devised. The Committee have no doubt that if this area can be properly developed—apart from helping a considerable rise in the standard of living of the local people, it will also help to overcome the food shortage and augment the fodder and fuel resources of the country.

The Committee hope that the Desert Development Board would be set up at an early date with representatives of the Central and State Governments to draw up a coordinated programme for the development of the desert area. The Government should ensure that the results of research carried out in the Central Zone Research Institute and elsewhere are applied with advantage in the field.

The Committee hope that adequate resources for development of the desert area would be made available.

IV CONCLUSION

The Committee consider that the arid zone presents a challenge to India's scientific and technological skill. The Committee feel that with intensified research done in the Institute, coordinated planning by the Desert Development Board, concerted implementation by Government and provision of adequate funds, it should be possible before long to make the desert bloom.

NEW DELHI-1: ARUN CHANDRA GUHA,
April 23, 1965. *Chairman,*
Vaisakha 3, 1887 (Saka). *Estimates Committee.*

APPENDIX III

(Vide para 15)

Statement showing the sanctioned as well as actual strength (Permanent & Temporary) of staff, Classwise and categorywise of the Central Arid Zone Research Institute as on 1-4-1964.

Sl. No.	Designation of the post	Sanctioned Strength		To- tal	Ac- tu- al St- ren- gth	Remarks
		Perma- nent	Tem- porary			
1	2	3	4	5	6	7
GAZETTED CLASS I						
1. Director		1	1	1	1	Since made permanent w.e.f. 28-8-64
2. Head of Resource Studies Division		1	1	1	1	
3. Head of Resources Utilisation studies division	1			1	1	
4. Head of Special Animal Studies Division	1			1	1	
5. Ecologist	1			1	1	Since made permanent w.e.f. 11-11-64. The post of Ecologist since fallen vacant.
6. Geomorphologist	1			1	1	

1	2	3	4	5	6	7
7. Soil Scientist	.	..	1	1	1	
8. Plant Physiologist	.	..	1	1	1	Made permanent w.e.f. 11-11-64.
9. Irrigation-cum-Hydrologist.	.	..	1	1	1	
10. Climatologist	.	..	1	1	1	
11. Silviculturist	.	..	1	1	1	
12. Arostologist	.	..	1	1	1	
13. Agronomist	.	..	1	1	1	
14. Sociologist-cum-Economist.	.	..	1	1	1	Made permanent w.e.f. 11-11-64.
15. Animal Ecologist	.	..	1	1	1	
16. Systematic Botanist	.	..	1	1	..	Made permanent w.e.f. 11-11-64.
17. Geologist	.	..	1	1	1	
18. Cartographer	.	..	1	1	1	
19. Analytical Chemist	.	..	1	1	1	
20. Assistant Agronomist	.	..	1	1	..	
21. Assistant Silviculturist	.	..	1	1	1	Made permanent w.e.f. 11-11-64.
22. Animal Physiologist	.	..	1	1	1	
23. Statistician	.	..	1	1	1	
24. Livestock Officer	.	..	1	1	1	Made permanent w.e.f. 11-11-64.

1	2	3	4	5	6	7
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GAZETTED CLASS II

25. Administrative Officer		I	..	I	I	
26. Plant Protection Officer		I	I	..
27. Curator		..	..	I	I	I Fallen vacant w.e.f. 4-8-64.
28. Assistant Geomorphologist		..	..	I	I	I
29. Asstt. Hydrologist (Ground Water)		..	..	I	I	I
30. Asstt. Hydrologist (Surface Water)		..	..	I	I	I
31. Asstt. Soil Scientist		..	I	I	I	
32. Asstt. Agrostologist		..	I	I	I	Made permanent w.e.f. 11-11-64
33. Assistant Sociologist-cum-Economist		..	I	I	I	
34. Assistant Agricultural Economist		..	I	I	..	

NON-GAZETTED CLASS II

35. Senior Accountant		..	I	I	I	
36. Foreman		..	I	I	I	
37. Senior Research Assistant (Ecology)		..	I	I	I	
38. Senior Research Assistant (Analytical Chemistry)		..	I	I	I	Post vacant since 27-7-64.
39. Senior Research Assistant (Plant Physiology)		..	I	I	..	
40. Senior Research Assistant (Microbiology)		..	I	I	..	
41. Senior Research Assistant (field)		4	I	5	4	

1	2	3	4	5	6	7
42. Soil Conservation Assistant.		..	4	4	4	Made permanent w.e.f. 11-11-64.

43. Senior Research Assistant (Animal Ecology)	..	1	1	1		
44. Senior Research Assistant (Animal Physiology).	..	1	1	..		

CLASS III

1. Superintendent	..	1	..	1	1	
2. Librarian	..	1	1	1	1	
3. Statistical Assistant	..	1	1	1	1	
4. Research Assistants	5	17	22	10		
5. Technical Assistants (Human Factories Study)	..	5	5	5	5	
6. Supervisor	..	4	4	3		
7. Senior Scientific Assistant	1	15	16	15		
8. Upper Division Clerks	2	6	8	8		
9. Accountant	1	..	1	1		
10. Stenographer	..	1	1	1		
11. Store Keeper	..	2	2	2		
12. Artist-cum-Photographer.	..	1	1	1		
13. Mechanic	..	1	1	..		
14. Computer	..	1	1	1		
15. Draftsman	1	3	4	3		
16. Junior Scientific Assistants	15	5	20	17		
17. Observers	..	2	2	..		
18. Tracer	..	1	1	..		
19. Fieldman	..	52	52	51		

1	2	3	4	5	6	7
20. Drivers	.	5	8	13	13	
21. Lower Division Clerks	.	8	9	17	17	
22. Cashier	.	..	1	1	1	
23. Stenotypist	.	1	3	4	..	
TOTAL	.	40	139	179	152	

CLASS IV

1. Dastry	.	.	1	1	2	2
2. Dark Room Attendant	.	.	1	1	1	1
3. Khalasi	.	.	2	2	2	
4. Laboratory Attendant	.	.	5	5	4	
5. Forest Guard/Chowkidar	.	.	51	10	61	59
6. Ploughman	.	.	1	1	1	
7. Peons	.	.	9	14	23	18
8. Sweeper	.	.	1	1	2	2
9. Stockman	.	.	..	29	29	28
10. Mali	.	.	..	1	1	1
11. Tractor Cleaner	.	.	1	1	2	2
12. Store Attendant	.	.	1	1	2	2
13. Head Mali	.	.	1	..	1	1
TOTAL	.		65	67	132	123

APPENDIX IV

Statement showing summary of recommendations/conclusions contained in the Report.

Sl. No.	Reference to Para No. of the Report	Summary of recommendations/conclusions
1	2	3
1	14	The Committee suggest that there should be close contact between the Central Arid Zone Research Institute, Jodhpur, and the Defence Laboratory, Jodhpur, in regard to research activities in fields of common interest.
2	22	The Committee suggest that the Institute should undertake continuous studies of the technique and methods being followed in the United States, U.S.S.R., Australia, Israel and Egypt to tackle the problems of arid zone so that promising lines of research can be taken up in the Institute for intensified effort to find solution suited to conditions in India.
3	23	The Committee suggest that the Government may undertake scientific and technological studies of the conditions obtaining before and after the advent of the canals.
4	25	Since the stabilisation of shifting sand dunes can play an important part in saving the vegetation in villages and towns from the menace of sand and also augment the fuel and fodder supply in the area, the Committee suggest that the technique developed by the Institute may be put to effective use by the State Government on a wider scale. The Committee would further suggest that a phased programme for covering sand dunes in the entire area may be drawn up for implementation and that the proposed Desert Development Board/Government of India may extend necessary assistance in that behalf.

1

2

3

5 26 The Committee suggest that the seed production of grasses suitable for growing in arid zones may be taken up on an extensive scale, commensurate with the total area to be served, as this would materially increase the forage resources of the State.

6 27 The Committee suggest that the regeneration of grasses in the range-lands coupled with livestock studies should be taken up on an extended scale and a phased programme should be drawn up to upgrade the deteriorated grass lands in the arid and semi-arid lands.

7 28 The Committee suggest that wild species of plants may be studied from the aspect of water deficiency and their adoption to arid environment.

8 28 They suggest that the techniques for the uptake of the nutrients under low soil moisture condition, which is an essential necessity in arid areas, may be developed for cultivated plants.

9 28 The Committee would like the Institute to intensify its efforts to locate quick growing suitable trees so that the meagre forest resources in the arid zone may be augmented.

 The Committee further like to stress the need for protecting existing forests against indiscriminate felling.

10 29 The Committee suggest that after the results of evaluation being made of the production of fuel, gum arabica and carrying capacity of livestock as a result of standardised techniques of roadside shelter belt planting, are finalised these may be communicated to the State Governments concerned so that plantation of roadside shelter belts can be taken up on an extensive scale.

11 30 The Committee suggest that research efforts may be intensified so that a practical solution to the problem of conserving soil against wind erosion may be found early.

1	2	3
12	32	<p>The Committee suggest that a perspective plan may be drawn up for carrying out an integrated survey of natural resources of all the arid and semi-arid lands in India in a detailed and thorough manner so that the future development of the arid and semi-arid regions could be based on complete and reliable data with appropriate order of priorities. The time limit for the completion of the various stages of the survey may be fixed and it should be ensured that it is adhered to.</p>
		<p>As the information, gathered from resources surveys, will be of direct significance to the State authorities in their development activities, the Committee suggest that the desirability and feasibility of associating them with the conduct of resource surveys may be considered. The Committee recommend that the Institute should evolve a standard method for an integrated natural resources survey so that it can be followed both by the Central and State agencies to gather information on uniform basis.</p>
13	33	<p>The Committee suggest that there should be close coordination between the Central Arid Zone Research Institute, the Exploratory Tubewells Organisation and the Under-Ground Water Board of the State Government to avoid any overlapping and duplication of work and to ensure that the survey of under-ground water covers comprehensively all the desired aspects of the problem.</p>
14	34	<p>The Committee suggest that the Institute may examine the question of undertaking studies of methods of efficiently utilising distributed water and local ground water for irrigation purposes and of the most efficient use of rainfall for crop production, pastures, forestry and stock water in the different land types of the regions.</p>
15	35	<p>The Committee suggest that an early decision may be taken on the proposal to set up the Division of Liaison in Physical and Chemical Engineering Studies. The Committee also suggest that studies in desalination of brackish water may be undertaken on priority basis.</p>

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16	36	The Committee suggest that research may be intensified to develop <i>Bajra</i> and <i>Jowar</i> seeds which are tolerant to saline water conditions.
17	36	The Committee suggest that experiments to find out the yield and content of all the varieties of <i>Guar</i> may be completed early so that varieties of high yield and quality may be introduced in the arid areas. The Committee understand that there is great scope for improving the export of <i>Guar</i> yielding high quality gum to the foreign countries. The Committee hope that the export of <i>Guar</i> preferably in the manufactured form, viz. gum, will be stepped up to earn more of valuable foreign exchange, giving at the same time due consideration to the requirements of the country for <i>Guar</i> .
18	37	The Committee hope that the standard indigenous gypsum blocks evolved by the Institute would be put to extensive use for the purpose of estimating irrigation and soil moisture.
19	38	The Committee hope that the scheme drawn up by the Institute for the rehabilitation of Banjara group of nomads, if found feasible, would be implemented by the State Governments.
20	39	The Committee suggest that ecological investigations on animal and insect pests in arid areas may be intensified with a view to evolve suitable methods for their biological control.
21	40	As research work on sheep is being done at both the Central Arid Zone Research Institute, Jodhpur and the Sheep and Wool Research Institute, Malpura, the Committee would like it to be ensured that there is close coordination of activities in this field between the two Institutes so that there is no overlapping or unnecessary duplication of effort.
22	42	The Committee would like to draw attention to the following recommendations made by the Symposium on Problems of Indian Arid Lands, with which the Committee agree:
		(1) The ecological investigations in arid lands of plant communities should be

intensified as the information on these subjects is fragmentary.

(2) The basic research work of the Institute should give research attention to (i) the possibility and desirability of building up soil organic matter in arid and semi-arid environments, (ii) study of the micro-flora of these regions and (iii) the role of rhizobium and the importance of adapted efficient strains for arid, semi-arid, saline and alkali tracts and regions.

(3) Research should be conducted to set up small scale industries which can be developed as by-product industries based upon industrial raw materials of the Arid Zone consisting of gypsum, limestone, base metals, lignite, salt, sand and medicinal plants.

The Committee hope that the above mentioned research schemes would be considered for inclusion in the Fourth Plan for the Institute.

23 43 The Committee cannot over-emphasise the importance of ensuring that the results of research conducted by the Institute are translated into actual practice by all the State Governments concerned and would stress that there should be close, effective and continuous coordination with the State Governments in the field of research on arid zone problems and the utilisation of results of research.

24 45 The Committee consider it of vital importance that the training courses run by the Central Arid Zone Research Institute are reviewed periodically in consultation with the State Governments so that any improvements or modifications, where called for, could be effected.

The Committee also suggest that an early decision may be taken on the question of setting up of a "Post-Graduate School" at the Institute in those subjects in which the Institute has adequate facilities.

25 46 The Committee hope that the proposed Achievement Audit Committee would be appointed soon

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to review the work done by the Institute since its inception. As regards subsequent reviews, the Committee would suggest that the review may be conducted in the third or fourth year of the Plan so that the advice of the experts is available in time for framing schemes for the next Plan period.

26 49 The Committee hope that the Desert Development Board would be set up at an early date with representatives of the Central and State Governments to draw up a coordinated programme for the development of the desert area. The Government should ensure that the results of research carried out in the Central Arid Zone Research Institute and elsewhere are applied with advantage in the field. The Committee hope that adequate resources for development of the desert area would be made available.

APPENDIX V

Analysis of Recommendations/Conclusions in the Report.

I. CLASSIFICATION OF RECOMMENDATIONS

A. Recommendation for improving organisation and working:

Serial Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25 and 26.

B. Recommendations for effecting economy.

Serial No. 21.

II. ANALYSIS OF MORE RECOMMENDATIONS DIRECTED TOWARDS ECONOMY.

S. No.	S. No. as per summary of recommendations (Appendix IV)	Particulars
1	21	There should be close co-ordination between the Central Arid Zone Research Institute Jodhpur and the Sheep and Wool Research Institute, Malpura in research work on sheep on that there is no overlapping or unnecessary duplication of effort.

