



COMMITTEE
ON
NATURAL RESOURCES

**GOVERNMENT OF INDIA
PLANNING COMMISSION**

FOREWORD

In the Draft Outline of the Third Five Year Plan published in the middle of 1960 the necessity of a comprehensive view of the natural resources of the country, an assessment of the extent and quality of information available on them, and the need of finding the principal gaps in information and the further steps needed in relation to specific long-range objectives concerning the development of irrigation, power, steel, coal, oil, minerals and land and forest resources and conservation of natural resources generally was stressed. The need for the development of an appropriate machinery for planning coordinated studies of natural resources on a continuing basis and reviewing the results obtained from time to time was also indicated.

As a first step in this direction a preliminary note on 'Natural Resources of India—their survey and assessment' was circulated on April 4, 1961 among organisations concerned with the study and development of natural resources. The central idea of the note was to emphasise the necessity of preparing a resource inventory of the country. A number of useful suggestions were received from the Ministries of the Government of India concerned with natural resources as well as from Dr. P. S. Lokanathan, Director General, National Council of Applied Economic Research. Taking note of these suggestions a fresh note was circulated on September 1, 1961. Dr. Marion Clawson, Director, Land Use and Management of the Resources for the Future, Inc., Washington, was invited in the first week of September, 1961 to help in the constitution of the Committee on Natural Resources. He gave a number of suggestions, and another note was prepared on September 27, 1961 which was discussed at a meeting of the Planning Commission held on October 7, 1961. In this note emphasis was shifted from the resources inventory idea to that of studies on specific problems relating to natural resources. A Government of India notification dated December 23, 1961, establishing the Committee on Natural Resources, was published in the Gazette of India dated January 6, 1962. Subsequent to the notification of the Resolution, the Standing Committee of the Committee on Natural Resources agreed that the Committee on Natural Resources should also include a representative each of the Mines, Coal and Oil Divisions of the Ministry of Mines and Fuel. The first meeting of the Committee on Natural Resources was held on December 26, 1961 and a number of studies were approved.

In this publication the constitution, functions and membership of the Committee on Natural Resources and its Standing and subordinate Committees are given. A brief account is given of the problems on which studies were proposed. This is followed by an enumeration of the studies approved by the Standing Committee of the Committee on Natural Resources at their meeting held on March 14,

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1962. The membership of the Working Groups entrusted with these studies is also detailed. The object of this publication is to bring to wider notice the problems relating to natural resources with which this Committee is concerned. It is particularly desired to stimulate interest in the Universities and other Organisations in the resource problems of the country so that they also participate in this work.

NEW DELHI,
May 31, 1962.

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Planning Commission.*

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I. ORGANISATION

Survey and assessment of natural resources *viz.*, land, water, minerals and energy are necessary preliminary steps to economic development. Valuable work in this direction has already been done by the various agencies of the Government of India and the State Governments. However, a coordinated study of natural resources has not been made. The problem of natural resources is complicated and inter-related. Various sectors of the economy are concerned in utilisation of natural resources and sometimes contradictory interests and claims are to be reconciled. A composite picture of natural resources is not available, and each segment of the government looks at the resources from its own angle. Resources are also inter-dependent and a number of them cannot be managed independently of others. The problem of conservation of resources also requires urgent attention. Apart from agriculture and minerals for which the Indian Council of Agricultural Research and the Geological Survey of India respectively started a programme of monographing of existing information, there is no proper documentation of available information in respect of resources such as water and energy. Keeping all these considerations in view, the Planning Commission proposed the setting up of an appropriate machinery for planning coordinated studies of natural resources on a continuing basis, reviewing the results obtained from time to time and to identify the gaps in information. It was on these considerations that it was decided to set up an organisation within the Planning Commission called the Committee on Natural Resources, to establish certain technical committees, and to appoint a modest specialist staff. The main functions of the Committee are as below :—

- (i) to assess from time to time the available information regarding the natural resources of the country and to identify gaps in it in relation to programmes of planned development ;
- (ii) to arrange for the formulation, in collaboration with the various organisations concerned, of coordinated programmes of surveys of natural resources in different parts of the country in relation to plans for long-term economic development ;
- (iii) to initiate studies on problems relating to natural resources ;
- (iv) to make recommendations bearing on the conservation, utilisation and development of natural resources ; and
- (v) to disseminate information concerning the country's natural resources through publications.

Membership

The Committee on Natural Resources (Main Committee) will consist of the following :—

Deputy Chairman, Planning Commission.	..	..	<i>Chairman</i>
Member (Education), Planning Commission.	..	..	<i>Vice-Chairman</i>
Members of the Planning Commission.			
Director-General, Council of Scientific and Industrial Research.			

Chairman,
University Grants Commission.

Chairman,
Central Water and Power Commission.

Chairman,
Atomic Energy Commission.

Member (Production),
Oil and Natural Gas Commission.

Vice-President,
Indian Council of Agricultural Research.

Inspector General of Forests.

Scientific Adviser,
Ministry of Defence.

Director General,
Geological Survey of India.

Director,
Indian Bureau of Mines.

Surveyor-General,
Survey of India.

Director-General,
Meteorological Department.

Director,
Indian Standards Institution.

Director,
Central Statistical Organisation.

Director,
Indian Statistical Institute.

Mineral Adviser to the Government of India.

A representative each from Mines, Coal and Oil Divisions of the
Ministry of Mines and Fuel.

Director-General,
National Council of Applied Economic Research.

Adviser (Natural Resources), *Member-Secretary*
Planning Commission.

Standing Committee

The Main Committee will be assisted by a Standing Committee and
expert Technical Committees for various fields of study.

The Standing Committee would consider proposals for studies received
from Technical Committees, Ministries of the Government of India, State
Governments, Universities and other Organisations, indicate their *inter se*
priority, and also look after day-to-day problems.

The Standing Committee will consist of the following :—

Member (Education), *Chairman*
Planning Commission.

Member (Natural Resources),
Planning Commission.

Member (Agriculture),
Planning Commission.

Member (Industry),
Planning Commission.

Member (Perspective Planning),
Planning Commission.

Director-General,
Council of Scientific and Industrial Research.

Vice-President,
Indian Council of Agricultural Research.

Dr. S. Husain Zaheer,
Director, Regional Research Laboratory,
Hyderabad.

Dr. B. R. Nijhawan,
Director, National Metallurgical Laboratory,
Jamshedpur.

A representative of the Ministry of Irrigation and Power.

A representative of the Ministry of Mines and Fuel.

Dr. P. S. Lokanathan,
Director-General,
National Council of Applied Economic Research.

Adviser (Natural Resources), *Member-Secretary..*
Planning Commission.

Any addition to the Standing Committee and filling up of any casual vacancy shall be done by the Chairman. Members of the main Committee may attend the meetings of the Standing Committee. Members of Technical Committees may be invited when any matter concerning their subject comes up for consideration.

Technical Committees

The main Committee will be assisted by the following four Technical Committees consisting of experts :—

- (1) Committee on Land.
- (2) Committee on Water.
- (3) Committee on Minerals.
- (4) Committee on Energy.
 - (i) The Committees would be split up into sub-committees and working groups subject-wise.
 - (ii) The Committees would have power to coopt persons whose advice would be useful.
 - (iii) The subject-matter specialists of the Resources and Scientific Research Division of the Planning Commission would be Member-Secretaries of the Committees concerning their respective subjects.

The functions of the Technical Committees shall be as follows :—

- (i) To indicate problems on which studies should be undertaken and to suggest steps that may be taken for tackling them.

- (ii) To prepare a coordinated programme of studies in their respective fields and make suggestions for its implementation.
- (iii) To arrange priority according to which individual studies should be taken up.
- (iv) To make recommendations regarding the closure of studies that may not be considered to be working satisfactorily.
- (v) To make recommendations for starting surveys through appropriate Ministries, State Governments or research organisations in respect of natural resources where gaps in information are discovered.
- (vi) To examine in detail from scientific and technical points of view all schemes submitted to the Main Committee.
- (vii) To recommend institution or institutions at which individual schemes should be taken up for study and research.
- (viii) To scrutinise the technical programmes of research schemes and studies.
- (ix) To scrutinise the annual progress reports and final reports in respect of the studies financed by the Main Committee with a view to assess the progress of work carried out under each of them in the year under report or in the entire period of the scheme, as the case may be.
- (x) To advise on such matters as may be referred to them by the Main Committee.

Membership of Technical Committees and Working Groups set up, as approved by the Committee on Natural Resources, is given in Appendix II.

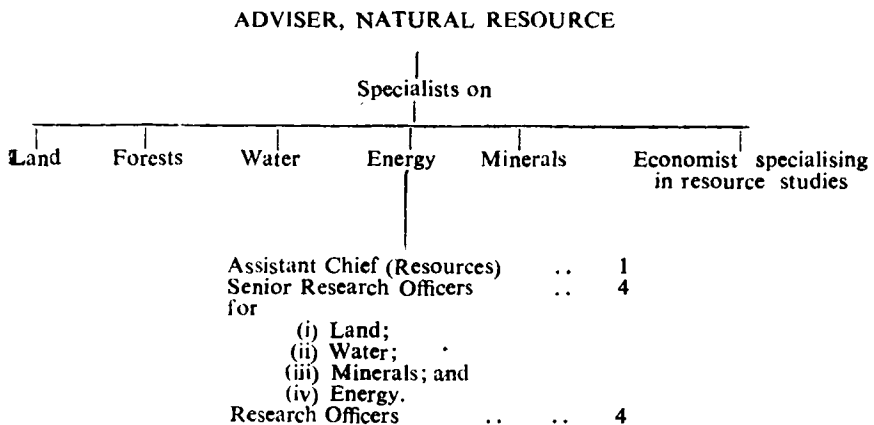
II. Staff

II. STAFF

The Resources and Scientific Research Division will play a leading role in research and planning studies relating to natural resources. It would initiate proposals for studies, surveys and research and will also directly lead such studies. To carry out these functions the Division requires a staff of the highest competence. They will work in full collaboration with the concerned Ministries of the Government of India who must be made to feel that the Resources and Scientific Research Division is promoting their special interests as well as the national interest. They will also have to keep a close touch with the Universities, the National Council of Applied Economic Research and other similar organisations.

Adviser (Natural Resources) will be the head of the organisation and he will be assisted by six specialists, two on land resources including agricultural crops, soil and forests and one each on water, energy and minerals and an economist specialising in resource studies. For fisheries it would be desirable to locate a specialist in the Fisheries Division of the Ministry of Agriculture. These specialists would also be given positions in the Agriculture, Irrigation and Power, Industry and Minerals, and Economic Divisions of the Planning Commission. This will enable them to use material flowing into these Divisions for resource studies and make available material flowing into the Resources and Scientific Research Division to the Divisions concerned with different fields of development. They would, however, not be burdened with day to day problems of the Divisions in which they are placed. For preparing maps, artists in the Charts and Maps Section of the Planning Commission would be utilised and they would also serve as liaison officers with the Survey of India and the National Atlas Organisation who will be largely responsible for making of special maps and their printing.

The proposed organisation is shown in the chart below :



The present position regarding staff is that a Specialist on Land has joined. Director, Irrigation, and Director, Power, of the Irrigation and Power Division of the Planning Commission are working as part-time Specialists on Water and Energy respectively. Chief (Economic Growth and Policy) of the Economic Division also functions as the economist for the resource studies. An Assistant Chief, one Senior Research Officer and two Research Officers have been provided.

III. Problems Proposed for Study

III. PROBLEMS PROPOSED FOR STUDY

The main function of the Committee on Natural Resources is to conduct studies and research on problems relating to the development, utilisation and conservation of natural resources of India. Research implies new knowledge, or new understanding arising out of new arrangements of bits of existing knowledge. The preliminary step in this direction is to take a comprehensive view of the extent and quality of information available in respect of the country's main natural resources. Excepting in the field of agriculture and minerals there is no proper documentation of knowledge regarding other natural resources particularly in the fields of water and energy. Presentation of existing information regarding these resources in a coordinated manner in itself will be a great contribution which the new organisation can make in the planning effort. Though miracles or startling new discoveries need not be expected, the studies will lead to improvement in the degree of understanding of difficult problems and give quantitative dimensions to such understanding. It will also lead to a clear, and sharper understanding and a deeper insight into the resource problems.

The studies undertaken will be practical in the sense that efforts would be made to give specific answers to defined problems. In some cases specific programmes would be suggested which could ultimately go in the form of schemes in the planning effort. This organisation which will consist of leading men who have experience of resources in various fields will be more favourably situated to take an objective view of problems as compared with operating men who are involved in current programmes. In this effort close coordination will be maintained with the Ministries concerned.

When the facts are collected and presented in a systematic manner the next step would be to undertake their scientific analysis so that concrete recommendations are made in respect of conservation and development of natural resources.

The Resource Specialists of the Resources and Scientific Research Division will also be project leaders in respect of their subject. They would guide research on two or three research projects concerning their respective resource subjects at a time.

The studies which would be carried out under the aegis of the Committee are of two types :—

1. Long-term studies ; and
2. short-term studies.

The proposed classification implies that in respect of some problems, studies must be completed within a short period. There is no rigidity in this classification, as some long-term perspective studies of resource problems can be broken up and studied on a short-term basis.

The subjects for the studies would be suggested by the members of the Committee on Natural Resources and by the staff of the Resources and Scientific Research Division. In some cases suggestions for studies can also be made by the Ministries of the Government of India and the State Governments on specific problems. The research and studies would be conducted by the Staff of the Planning Commission or through various organisations of the Central and State Governments or non-official

organisations like the National Council of Applied Economic Research, Universities, etc.

In the following pages are outlined some of the problems on which studies and research can be undertaken. They are classified under two main headings, viz., long-term problems and short-term problems. They are further classified resource-wise.

The outlines of various studies approved so far are given in Section IV on Studies and Surveys approved by the Committee on Natural Resources.

I. LONG-TERM STUDIES

1. LAND

A comprehensive study of the land problem in India, both agricultural and non-agricultural, is required. The existing pattern of land utilisation indicating area under crops, extent of prevalence of soil erosion, salinity, water-logging and other problems, waste-lands fit for agriculture, survey and classification of soils, etc. should be studied. There is no publication in which all this information is dealt with in a coordinated manner, and a comprehensive study would be paying particularly in discovering vital gaps in information. Data about land utilisation is incomplete and there is no sound information about the extent of salinity or encroachment of sea water on agricultural land.

The study of land resources will involve study and location of wastelands including saline, alkaline and water-logged lands. Geobotanical and geo-chemical studies and studies on the improvement of fertility of lands of low yields by the use of fertilisers, conservation of moisture, crop rotation and irrigation wherever possible are necessary. The problem of soil conservation and shifting cultivation will be studied.

The study will also include delimitation of agricultural regions which is essential for agricultural planning and needs close collaboration of the agricultural scientists. Resource maps at State level e.g., climatic maps, maps showing areas liable to regular flooding, land use potential of waste lands, areas which have been water-logged or subject to salinity, and permanent fallows, etc. will be prepared. The methods and scale of mapping will be standardised.

(i) *Agricultural Crops*

Some facts about production of food and commercial crops are available in the book entitled 'Agriculture and Animal Husbandry in India' and in the monographs and atlases published by the Indian Council of Agricultural Research and the Central Commodity Committees. Apart from knowing the area and production of crops in the States information on comparative economic advantage of each crop in each producing region would be helpful. How far present crop patterns reflect geographical or other factors? How far do they reflect economic forces such as transport and markets? If transport improves and becomes faster, better and cheaper, this would tend to shift production into regions where natural conditions for production are best. Growth of industries and cities might lead to formation of urban markets; that would also lead to shifts in producing areas. Changes in marketing and processing of agricultural commodities might also have major impact upon agricultural production.

Figures are often given about per acre yields of various crops in India and then comparisons are instituted with other countries irrespective of their size or climate e.g. the per acre yields in India of rice are compared with

tropical countries like Java and countries like Japan, etc. These comparisons are misleading in the sense that sometimes countries which are small in size are compared with a large country like India with such an astounding diversity in climate, soil, and vegetation. In India itself the yield varies from State to State and it is the Central Indian plateau with its thin layer of soil over a rocky sub-stratum which pulls down Indian yields when average figures are taken. Yields of crops in fertile areas of India which have also progressive farming communities like Andhra Pradesh, Madras and Punjab are fairly high. If the yields of best areas of India are compared with corresponding areas in other countries, then the comparisons can give us suitable conclusions. An analysis of the problem from this angle ought to be made and meaningless comparisons of India with other countries should cease in our reports and publications. This would also give us information about low yield areas where there is scope for improving production.

It is often stressed that India should be self-sufficient in foodgrains. No doubt this a desirable object but when the same acreage is required for more precious crops, is it desirable to grow foodgrains on that land? Wheat area is restricted to northern India though rice can be grown almost all over. There are other competing crops like sugarcane, cotton, tobacco, jute, etc. which give much higher income per acre to the farmer. Sugarcane cannot be grown anywhere in the world as only tropical countries are suitable for its cultivation. Similarly, spices can only be grown in tropical parts of India like Kerala, Madras and Mysore. If India can produce crops which are more valuable as compared with foodgrains that may perhaps be a more desirable situation. This indicates that a study should be made of the income of the farmer from various crops like sugarcane, cotton, tobacco, coconuts, arecanuts, spices, jute, wheat and rice per acre.

One of the criticisms which is made of the Community Development Scheme is that there is a frittering away of resources on too many schemes. It is felt that if the number of projects is less, better results could be produced with the same outlay. The same criticism applies to the techniques of planning in agriculture. Resources are dispersed in far too many projects. The major need of India is the production of food crops and commercial crops. If a concentrated attack is made on this problem and resources are conserved, better results could be expected. A good deal of money which is now being spent on animal husbandry and dairying in States where there is no prospect of their development could be better utilised by its use on more productive schemes. Dairying schemes only succeed when they are worked in large towns which provide a good market. No such conditions exist in States such as Orissa and Assam where other schemes can be more profitably undertaken.

A State like Kerala is most suitable for the production of tropical crops like spices, coconut, arecanut, rubber, coffee, etc. which the rest of India cannot produce. In such areas emphasis should be on these crops. The Himalayan area at altitude above 5,000 ft. is particularly suitable for apple cultivation which can give a much higher income to the farmers. These facts emphasise the need of regional development of agriculture so that crops which are most suitable for a region are grown there. In fact there is need of agricultural development on a regional basis.

The increased supplies required for the growing urban markets are likely to come from regions particularly adapted to each crop. Where are these regions? What agricultural supplies, marketing facilities, transport and

other services will these specialised regions require if they develop in this specialised fashion? How soon must they be provided?

Facts on consumption and analysis of production in respect of the First and Second Five Year Plans are not given anywhere. Agricultural production is based on certain assumptions regarding the availability of water for irrigation, manures and fertilisers, pesticides and fungicides, improved seeds and improved agricultural practices as well as increased area. Increased area may be available where single cropping is followed or where wastelands are being brought under cultivation. Competing crops are making claims for the same area, but there is nobody to decide to which crop the available area should be earmarked. There have been failures in the availability of some of these facilities, particularly availability of fertilisers in required quantities. In some cases unrealistic targets were fixed and adequate provision was not made for some of the measures which could have given greater production.

An immediate task is to find out the potential for increased production in respect of each crop given all facilities for development. Particular attention may also be given to consideration of obstacles to increased production of each crop. Why are crop yields low in some areas and how might they be improved? The impact of major irrigation schemes on crop production also requires to be assessed. The role of prices and their stability from year to year requires consideration. A perspective plan of this nature for a period of fifteen years will be very valuable indeed.

The study can also indicate what are the prospects of building up agricultural exports in respect of certain commodities and to what extent.

Only a close analysis of the information available can throw light on the soundness or otherwise of agricultural planning. Working groups were set up by the Ministry of Food and Agriculture in respect of various crops. Publications of the Indian Council of Agricultural Research and Commodity Committees, reports of the working groups of the Ministry of Food and Agriculture, marketing reports on crops, and information which may be available with the Department of Food on consumption and trade can furnish raw material for the proposed studies.

Study groups have been proposed for each crop consisting of experts on the subject. Reports of the working group would be placed before the Commodity Committees and Committees of the Indian Council of Agricultural Research for their consideration, and after taking due note of their comments the matter would be further analysed and coordinated.

(ii) *Forests*

A total survey of forest resources is urgently required. Data regarding production of forest products, especially with regard to timber, are unsatisfactory and are largely based on guesses. New forms for reporting on the availability of forest resources and production should be adopted, and measures suggested for systematic survey of all the forests including the reserved, protected and unclassified forests.

There is also need of survey of forest lands indicating areas which are badly eroded, those fit for natural regeneration and those fit for planting. Though India has plenty of jungles, there are few forests. This is particularly true of Central and South India. There is need of a more dynamic forest policy and we must make effective use of existing knowledge regard-

ing fast growing trees of economic value. The Mediterranean countries now rely mainly on poplars and eucalyptus raised on a rotation of the order of 10 years. We should grow maximum wood in minimum time and space and also save the wood which we grow from being eaten by white ants by treatment of timber. To meet the needs of pulp, paper, rayon and match industries we will have to rely more and more on fast growing soft woods. Natural forests with trees which have only fuel value require to be replaced over a long-term programme by trees of economic value. A long-range programme extending over four plan periods is indicated for this work. There is very little experimental data on quick-growing species. Planting experiments over adequate areas on a regional basis should be undertaken to provide data on which a sound policy of afforestation and farm forestry can be based. A project for pre-investment survey of forest products and industries has been proposed in the Third Plan. Similar projects for the subsequent Plans should also be taken up on a long-term basis.

Forest resources of inaccessible areas in the Himalayas and other parts of India are not still properly assessed. Survey of these areas "including photogrammetry can be rewarding. A study should also be made as to what steps including development of communications should be taken to tap these unused resources. The study and survey of these areas can be taken up in stages.

(iii) Fisheries

Survey of inland waters capable of commercial fisheries : Rivers and their tributaries, canals, lakes, reservoirs, tanks and ponds with perennial water supply constitute a rich potential source of inland fisheries. An urgent need is a complete survey of waters which do not dry up during summer and which can be stocked with fish. An inventory of the existing waters as to type, namely, ponds, reservoirs, lakes, rivers, etc., and the areas under each type should be prepared. This should be followed by a detailed inventory of the physical, chemical and biological features. When this work is completed, it will provide a sound basis for development of the inland fisheries resources on which specific programmes for fish culture can be formulated.

Survey of marine fisheries : Out of the total fish production of 1.4 million tons annually about 1.1 million tons are marine. The sea fisheries generally exploited are confined to 6—10 miles from the coast. India's marine fisheries resources have not been properly assessed and there is need of a comprehensive survey. The importance of this survey is underlined by the fact that we will have to look more and more to the sea for supplementing food supply for the growing population.

Survey of marine algae (sea-weed) : Marine algae are commonly used as human food in Japan and China. It is a promising source of food iodine, and other products which still remain unexploited in India. The need of a comprehensive survey of the availability of economic sea-weeds on India's coastline and their utilisation is urgently indicated.

2. WATER

Water resources are divided into two categories, viz., surface water and underground water.

(i) Surface water

Up to 1960-61 surface water utilisation for irrigation was estimated at 120 million acre feet, i.e., 27% of usable flow and 9% of total flow. By

1965-66 it is estimated to be 160 million acre feet, *i.e.*, 36% of usable flow and 12% of the total flow.

The irrigation schemes taken up between 1956 and 1966 will add 13.8 and 20 million acres during the Second and Third Plan periods respectively bringing the total to 90 million acres. As against this, the ultimate potential of all the irrigation schemes (major, medium and minor) that can be taken up in India is estimated to be 175 million acres.

The Central Water and Power Commission initiated in 1954 a study of different basins in the country for assessing the ultimate potential of major and medium irrigation projects. For purposes of this study the country was divided into five principal zones covering groups of river basins, and for each river basin the topography, rainfall, intensity of cultivation, possible storage sites, irrigable areas, reservoir capacity and other relevant factors were examined. Studies in respect of four zones are almost complete, while the fifth has been taken up. A preliminary assessment places the irrigation potential of major and medium projects at 100 million acres (gross) distributed as follows :

<i>Zone</i>	<i>River basins</i>	<i>Irrigation potential (million acres)</i>
Zone 1 :	West-flowing rivers (covering river basins in Kerala, Mysore and Maharashtra States and basins of Tapti, Narmda and others)	10
Zone 2 :	East-flowing rivers (covering the basins of Tambaraparani, Vaigai, Cauvery, Mahanadi Godavari, Krishna, Pennar and others)	33
Zone 3 :	Indus basin	13
Zone 4 :	Ganga basin (covering Chambal, Jamuna, Ramganga, Tons, Gomti, Sone, Ganga and its tributaries)	41
Zone 5 :	Brahmputra Basin	3
Total		100

In this context, it will be necessary to clearly demarcate the assured rainfall areas in the country. The Central Water and Power Commission have conducted 21 irrigation potential surveys as given below, out of which reports of those which are in italics, have been finalised.

Zone I: West flowing rivers

River basins of Kerala

River basins of Mysore and Bombay

Tapti Basin

Narmda Basin

River basins above Narmada

Zone II: East flowing rivers

Tambaraparani and Vaigai Basins

Cauvery Basin

Mahanadi and other river basins between

Ganga and Godavari

Godavari Basin

Krishna Basin

Pennar Basin

Zone IV: Ganga Basin

Chambal River

Jamuna River

Ramganga River

Tons River

Gomti River

Sone and other rivers between Tons and Sone

Gagra River

Right bank tributaries of Ganga below Sone

Left bank tributaries of Ganga below Gagra

Main Ganga River

These reports require to be analysed so that surveys are initiated in areas where potential has not been determined. The available data should be carefully evaluated, and suitable programmes undertaken to remedy any deficiencies of either quantity or quality in the data. Long-range economic studies on the most efficient and valuable use of water resources should also be undertaken.

(ii) *Underground water*

Data regarding underground water is available with the Geological Survey of India, Exploratory Tubewells Organisation of the Ministry of Food and Agriculture and some of the State Governments. This data requires to be coordinated and studied so that gaps in information are located. The study should also include (i) a systematic investigation of underground water resources relating to quantity and depth at which water is available, (ii) the legal status of ground water in the country in respect of its exploitation by individuals.

The first comprehensive attempt towards assessment of the minor irrigation potential was made in 1955 by the Minor Irrigation Committee set up by the Ministry of Food and Agriculture. Similar studies were later initiated by the Minor Irrigation Team of the Committee on Plan Projects. Some State Governments have also initiated minor irrigation surveys. A tentative appraisal of the data from these surveys indicates that the total ultimate irrigation potential for minor irrigation projects may be about 75 million acres (gross). A close analysis of the minor irrigation surveys is required so that the States which have not undertaken such surveys may be asked to do so.

3. MINERALS

At the commencement of the First Five Year Plan, though detailed mineral investigations had not been undertaken to any sizeable extent, the

principal mineral regions had been ascertained, and a broad indication obtained of the potential mineral wealth of the country. The Geological Survey of India had shown that while the country had fairly abundant reserves in quantitative terms of coal and iron ore, adequate supplies of mica, refractory raw materials, limestone and ores of aluminium, titanium and thorium, it was deficient in non-ferrous metals like copper, lead and zinc, and had no workable deposits of sulphur, tin, nickel, molybdenum, etc.—mineral raw materials which are important for an economy based on industries. Except for the Digboi oilfield petroleum had not been known to occur in other parts.

The most pressing needs in the context of programmes of planned industrial development were : (i) systematic and detailed surveys and investigations by the Geological Survey of India, and the Indian Bureau of Mines, and the National Laboratories with a view to quantitative and qualitative assessment of the reserves of the more important minerals and their proper utilisation and (ii) a broad National Policy with particular attention to systematic exploitation of minerals with due regard to conservation.

The first two plans provided for the expansion of the Geological Survey of India, and the Indian Bureau of Mines and provision of additional facilities in the National Laboratories to enable them to undertake investigations of mineral raw materials with particular reference to upgrading them, finding uses for low grade materials produced in the course of mining, and for finding solution to the problems posed by deficiencies in mineral supplies.

During the last two Plans intensive geological studies and detailed structural mapping of the mineralised belts undertaken by the Geological Survey of India gave useful indications of sporadic occurrence of minerals in Jammu and Kashmir, of the availability of about 28 million tons of copper ore averaging about 0.8% copper in copper belt at Khetri in Rajasthan and a substantial reserve of lead and zinc in lead-zinc deposits at Zawar in Rajasthan. Detailed structural mapping of the manganese ore deposits in Madhya Pradesh and Andhra Pradesh has revealed that the reserves of ore are much larger than estimated hitherto. Oil reserves in Gujarat and some areas of Assam were also established.

One of the deficiencies in regard to mineral resources is the relatively small size of the known resources of the non-ferrous metals particularly copper, lead and zinc. The increasing demand for these metals, and the existing large gap between indigenous production and the current demands stresses the need for more detailed investigations of all known and reported occurrences of these metals. A separate wing has been organised under the Geological Survey of India for this purpose. Likewise, there is an urgent need to investigate and prove fresh reserves of quality limestone required for the steel industry. In the context of the rapidly increasing demand for petroleum products, it would be necessary to intensify search for petroleum and prove indigenous resources to conserve foreign exchange.

The position is critical in respect of minerals like coking coal, chromite, asbestos, phosphates, zinc and lead ores. Economically workable deposits of tin and nickel have not yet been located.

The Geological Survey of India has published a number of memoirs, records, bulletins and miscellaneous publications which deal with various minerals. Information is given regarding the genesis and occurrence of number of minerals and in some cases information on reserves and quality

of minerals is also given. Besides the published literature the Geological Survey of India has a vast amount of unpublished material. Some useful demand studies for steel, heavy chemicals, coal and aluminium for the period 1960—1970 have been made by the Perspective Planning Division of Planning Commission. The Director, Indian Bureau of Mines, publishes a Year-book on Indian minerals which gives information mineral-wise on the occurrence, distribution, estimated reserves, uses, consumption, imports and exports of minerals in India. This publication as well as the publications of the Geological Survey of India provide valuable raw-material for studies.

In these publications no attempt however has been made to provide an economic analysis of problems. A series of monographs, mineral-wise or in some cases, where the minerals concerned are not important, group-wise, dealing with their reserves, production, consumption and problems relating to marketing, transport and exports would be useful indeed. These monographs would provide a comprehensive study of each mineral, giving historical information, facts regarding reserves, production, consumption, marketing problems as well as conservation measures.

Measures of conservation of metals and minerals, *e.g.* elimination of wastage in mining and metallurgical operations, extending the useful life of the metallic objects, substitution of scarce metals by more abundant ones and also substitution of metals by non-metals like plastics and timber and re-use of metals deserve to be studied. Conservation must be practised in respect of mineral resources considering our immediate and future needs. Minerals which are of strategic importance for defence should be imported in adequate quantities and kept in reserve. Scarce and imported metals and minerals must be strictly restricted to essential use. There are some minerals which are of strategic importance. A study should be made whether their export should be allowed and if so to what extent. Definite policy recommendations would be made in respect of each mineral. A study of this nature would be valuable not only for national planning but also to people who like to start industries as well as for students of economic geography and related subjects.

4. ENERGY

A comprehensive study of energy problems of India including a review of its past sources and uses with projects for the future is one of the long-term studies which the Committee on Natural Resources can undertake. A model is provided by the study entitled "Energy in the American Economy 1950—1975, its History and Prospects" carried on by Resources for the Future Inc. of the U.S.A. Material for the proposed study is available in the various publications of the different agencies such as the Central Water & Power Commission, the Geological Survey of India, the Indian Bureau of Mines, the Atomic Energy Commission, the Fuel Research Institute, the Oil and Natural Gas Commission, and other organisations such as the National Council of Applied Economic Research. There is no single unit which can take a comprehensive view of the energy spectrum. Coal and oil and natural gas are under the Ministry of Mines and Fuel; electricity is under the Ministry of Irrigation and Power, State Electricity Boards and State Governments, Nuclear Research under a separate Department of Atomic Energy; wood fuel from forests under the Ministry of Agriculture. The Committee on Natural Resources can play a useful role in coordinating the activities of these Ministries insofar as energy is concerned and in study of inter-related problems. Some studies in this regard have already

been undertaken in the Irrigation and Power Division of the Planning Commission, and the Third Five Year Plan also contains some analysis of the energy problem. A study will also be made on a geographical or regional basis.

Some of the important aspects which could be studied are :—

- (i) resource potential,
- (ii) conversion of one form of energy to the other and its scope, possibilities and economics,
- (iii) conservation of energy resources,
- (iv) efficiency in production, transmission and utilisation,
- (v) pattern of consumption in the different sectors such as industries, agriculture, traction, domestic use, lighting, etc., and estimates of future consumption, and
- (vi) pricing policies.

Fuel resources can be conserved by improving efficiencies. An outstanding example of the economies that can be effected in this regard is the savings on coal used in power generation due to improvement in thermal efficiencies. While more than two lbs. of coal were required for generation of one kilowatt hour some years ago, the present consumption in India is about $1\frac{1}{2}$ lbs. per unit and prospects of further reduction are in sight. Electrification and dieselisation of railways, use of back pressure turbines in industries, elimination of open fires and use of improved types of stoves in domestic cooking are other possible avenues of achieving fuel economy. The Committee on Natural Resources can direct and pursue these studies.

The implications of animal power, the extent to which mechanisation may benefit agricultural production also should be studied.

In India the rainy season is limited to the months of July to September and December to January in most parts of the country. Immediately after the rains the main problem is of the conservation of moisture as quickly as possible. One major cause of increased agricultural production in agriculturally advanced countries is the ability to perform critical crop operations at exactly the right time. In India large areas become unfavourable for crop production due to lack of adequate farm power as bullocks alone are unable to meet the situation. Tractors have greatly reduced the hazards of unfavourable weather conditions and helped farmers in conserving moisture which is required for proper germination of seed in more advanced countries. On the other hand bullocks and buffaloes also consume agricultural products which can feed human beings thus competing with the rising population. This is one of the studies which might yield major results.

II. SHORT-TERM STUDIES

Here some specific problems on which research and study projects of a short-term nature can be initiated are mentioned.

(i) *Coordinated study of surveys*

At present surveys of natural resources are being carried on by the Survey of India, Geological Survey of India, Central Water and Power Commission and other agencies. If an effective coordination is achieved surveys which are sometimes repeated could be eliminated. Surveys of forests in which close coordination is required between the Survey of India and the authorities concerned with forests in the Government of India and the States could be more effectively organised. It will also enable the Planning

Commission to develop coordinated programmes for surveys of natural resources in relation to plans for long-term economic development.

(ii) *Improvement of revenue records to provide data for economic planning*

Revenue records system in India which dates back to Akbar's reign (1556-1605 A.D.) was primarily designed for assessment of land revenue. With the lapse of time it has been slowly improved to provide statistics on agriculture. As the Patwari agency which prepares these records operates at village level and is in touch with agricultural and local conditions it provides a sound organisation for collection of agricultural and other statistics. It is, however, felt that effective use of this agency is not being made and there is a tendency to start survey schemes with special staff who, apart from the fact that they have no knowledge of local conditions, are far fewer in numbers.

No coordinated study has so far been made of the system of land records in different States of India so that it provides a sound basis for the planning of agriculture.

For preparing a sound inventory of our agricultural resources it is very necessary that full use should be made of the Patwari agency and revenue records system of the different States are studied on a coordinated basis and improved keeping in view the requirements of national planning. Now the aim should be to make these records a tool for fostering agricultural production. Another advantage of this study would be that it would be possible to build up realistic targets from the village level upwards. From the individual villages to blocks, sound village and block plans can be prepared. The statistics which are required include land utilisation, crop acreages, crop yields, extent of water-logging, salinity, improved agricultural implements, livestock, poultry, perennial tanks and ponds in which fish can be bred, agricultural population, agricultural labour force and number of fruit and timber trees. Information on amounts of fertiliser and the acreage of crops for which they are used should also be recorded. At present it is not known for which crops fertilisers are being used and in what quantities. In due course when the soil survey and soil testing scheme progresses sufficiently chemical and physical constitution of soils based on soil analysis should also be given in the revenue records.

The Ministry of Food and Agriculture have recently set up a study group for the improvement of agricultural statistics. This study group is also studying the forms of land records. The work of the study group is of a restricted nature and it can provide material for the study which has been proposed and which is of a wider nature.

(iii) *Gap between research and its application*

There is a considerable gap between the findings of research and their application in practice. In certain fields this gap is very wide while in some fields it is not so prominent. As the country is spending large sums on promoting research it would be pertinent to find out what are the causes of this gap and in what manner it can be bridged. This gap is particularly wide in the field of agriculture. A similar gap exists in the field of industry also and a study of this nature in the field of industry would also be paying.

(iv) *Study of fibres*

Fibres are of three types : those of plant and animal origin and synthetic. Plant fibres are cotton, jute, mesta, sisal, sunnhemp and ramie.

These are dealt with by the Commodity Committees on Cotton and Jute. Animal fibres are wool and silk. Wool is the concern of the Indian Council of Agricultural Research and silk is dealt with by the Silk Board under the Ministry of Commerce and Industry. Synthetic fibres such as rayon, nylon, etc., have developed a good deal recently. In 1954 the Resources Council of Japan made a recommendation for the promotion of acetate fibre industry. Since then manufacture of acetate fibre has developed to the extent that it can compete with wool in price and quality. Though inferior to real wool it can be manufactured at a very much cheaper cost. Its strong fibre can be mixed with wool, silk, rayon and other synthetic fibres to give it a softer touch. The use of synthetic fibre for mixed spinning has also developed and the cloth produced is more durable and lasts much longer. The raw material of some of the synthetic fibres are abundant resources such as air, water, coal, limestone, herbaceous material and electric power. A coordinated study of the fibre resources as well as of connected problems as a whole can be very paying.

(v) *Conservation of timber*

Use of improved logging implements is an important conservation measure for timber. There is a large demand for timber on account of ambitious building programmes which have been undertaken. The Railways continue to be the main consumers of timber on account of their requirements for sleepers. It should be examined whether the use of cement sleepers would not be in national interest as compared with wooden sleepers.

(vi) *Study of fertiliser production, allocations and use*

Present fertiliser use and allocations need to be reviewed critically and future fertiliser use and allocation planned in light of best experimental evidence and best expert knowledge. How far do fertilisers contribute to needed crop output? How can their use be made more effective? Are they actually used on the crops planned, or do farmers divert them to other crops? Are they being used effectively in the areas for which they are being manufactured? If not, remedies should be suggested.

(vii) *Effective water use*

A modest number (perhaps 20 to 40) districts or areas where available irrigation water is not being used effectively should be identified. A programme for most efficient, immediate productive use of available water in these districts should be formulated and the requirements and programmes necessary to achieve the programme of water use requires to be set forth specifically in quantitative terms. Similar projects could be carried out in successive years, as irrigation water is made available to additional areas. It would be advisable and necessary to associate State Governments with the study of efficient use of irrigation water for agricultural purposes and studies would have to be undertaken individually for different schemes.

The crop pattern visualised at the time of preparation of an irrigation project might differ considerably from the actual crop pattern developed on the completion of that project. It is, therefore, important to study the minimum quantity of water necessary for raising the maximum amount of crop in each case.

(viii) *Ground water table*

A systematic study of the ground water table should be made.

(ix) *Flood damage*

Exact methods of assessing flood damages should be evolved and the subject requires further studies. It will be necessary to develop and standardise the techniques of assessing flood damages.

(x) *Paper pulp requirements and raw material supply*

The paper and pulp requirements of the nation not only for the Third Five Year Plan but also for the Fourth and Fifth Plans need to be estimated as accurately as possible; one or more sites for immediate mill development should be indicated; available raw material supply, present and continuing should be analysed; a specific plan for development, construction, operation of paper mills should then be prepared. Forestry plans to ensure an adequate supply of raw materials also require to be formulated.

(xi) *Review and analysis of forest legislation*

Present forest legislation in the various States should be analysed and the extent to which the forest legislation is actually effective should be ascertained by means of field studies; gravity of forest denudation and the degree to which inadequate legislation or inadequate enforcement is responsible should be determined and in specific terms, a programme of forest protection and afforestation should be formulated.

(xii) *Industrial uses of water and problem of pollution of water supplies.*

The major uses of water in industry are for cooling, processing and boiler feed. Industrial needs of water are increasing rapidly. Hence the need to pay attention to methods of conservation and re-use of water in industries has become urgent. Most of the water used for industrial purposes is renewable in the sense that it becomes available for re-use if properly reconditioned.

No data is available on the quantity of water being used by Indian industries. A comprehensive survey is therefore called for.

One of the important problems associated with industrialisation and urbanisation is the pollution of available water supplies, specially rivers, by industrial effluents and trade wastes. This leads, amongst others to mortality of fish and contamination of drinking water. Proper disposal of these waters is difficult and costly. The problems which arise in this connection are being studied by the All-India Institute of Hygiene and Public Health, the Indian Council of Medical Research and the Public Health Engineering Research Institute. There is need for coordinated surveys and experimental work. These should cover analysis of effluents, data on extent of pollution caused by them, development of methods for their treatment and preparation of standards to which they should conform, before they can be discharged into rivers. In view of the large programmes for industrial development, a study of this nature should be taken up early, so that remedial measures are suggested well in advance before the evil assumes alarming proportions.

(xiii) *Sea-water as a source of magnesium, potassium chloride and bromine*

Sea water contains besides sodium chloride, various other minor ingredients in substantial quantities. In India, at present only a negligible quantity of salt bitterns is processed for recovery of the minor constituents many of which are important in the overall mineral economy of the country. Magnesium salts are recovered to the extent of 8,000 tons per year only against a possible quantity of about a million tons.

At present, only a few hundred tons of potassium chloride are recovered from biterms against a possible total of about 80-90,000 tons, though our **requirement** of potash (K_2O) for agriculture are considerable. Similarly, bromine is recovered to the extent of 25-30 tons per year against a possible total of several thousand tons.

A study should be made to the extent these minerals should be extracted, and the economics of extraction as well as use in ancillary industries.

(xiv) Utilisation of blast furnace slag

Blast furnace slag is being utilised for making cement and other building materials in U.S.A. and Europe. In India present annual production of blast furnace slag at the steel plants of Durgapur, Rourkela, Bhilai, TISCO and IISCO is about 2.9 million tons. This will rise to about 7 million tons by the end of the Third Plan. Large quantities of blast furnace slag are accumulating at the sites of steel plants. Except for 18,000 tons of slag cement produced annually at Mysore, there is no other utilisation of the slag although licenses for producing about 2 million tons slag cement were issued during the Second Plan.

The utilisation of blast furnace slag in India for cement making and for various other purposes, e.g. road making, slag wool manufacture, stowing of mines, etc. requires to be studied.

IV. Studies and Surveys approved by Committee on Natural Resources

IV STUDIES AND SURVEYS APPROVED BY COMMITTEE ON NATURAL RESOURCES

The Committee on Natural Resources and its Standing Committee considered the various studies proposed in Section III and approved the studies and surveys which, along with their outlines, are given in the following pages. The membership of the Working Groups set up for conducting these studies is given in Appendix II (ii). While approving the studies it was pointed out by the Committee that their object was initially to assemble and coordinate in a meaningful way all the data available, identify gaps in information, point out problems which needed immediate attention and indicate field of studies to fill up these gaps so that the data could be made use of for economic planning. To begin with, a bibliography of all existing literature on various natural resources in general and the subject taken up for study in particular should be prepared. The studies should be assigned to organisations dealing with various natural resources, and, if necessary, these organisations could be strengthened to undertake the necessary surveys and studies so that no important resource was left un-attended.

1. LAND

STUDY NO. (1)—STUDY ON WASTELANDS INCLUDING SALINE AND ALKALI LANDS AND WATERLOGGED AREAS

Wastelands including saline and alkaline lands

The study will involve the distribution and location of such areas in India; types of soils; annual rainfall and its distribution over the months in such areas; treatment and reclamation of such lands; why such lands are extending; economics of reclamation; quality of saline and alkaline well waters and their improvement; problems of rehabilitation of such lands regionwise; distribution of areas already opened up; difficulties experienced and soil conservation measures needed.

A good deal of important data regarding these land: including ravine areas and saline and alkaline lands is available with the State Agricultural Departments. The methods of reclamation are also known. The Wastelands Survey and Reclamation Committee of the Ministry of Food and Agriculture has brought out reports on the availability of such lands in blocks of 250 acres and above in different States. The schemes for the survey and categorisation of wastelands measuring less than 250 acres have been approved under the Third Plan. What needs to be done is a purposeful coordination of the data, identification of gaps in the data and economic analysis of the alternate measures of reclamation. It is necessary to study the reasons why some lands were lying waste and to identify the various factors responsible for this. It is also necessary to determine capabilities of these lands in terms of crops and forestry. After the wastelands have been surveyed and classified, it might be necessary to strike a balance between their being utilised for agriculture, forests, grazing, etc.

A special reference may be made of the problems of riverine areas which are suffering from chronic poverty due to lack of communications, periodical flooding, lack of drainage, and perennial growth of tall grasses.

Suitability of such areas for mechanised farming needs careful study. An attempt will be made in this study to evaluate the working and success of such attempts at rehabilitation in wastelands from technical and economic aspects including identification of difficulties experienced in rehabilitation which would serve as guide for further rehabilitation programme.

Water-logged areas

The Central Water and Power Commission have taken action to collect useful data on water table for all the States in India. The areas were being classified according to depth of water table. These categories included the areas where sub-soil water was higher than 5 ft., between 5 ft. and 10 ft. and below 10 ft. Areas where water table was between 0-5 ft. was considered as water-logged.

Every year extensive areas were being water-logged due to faulty drainage and incorrect use of irrigation facilities. Areas with water table between 5 and 10 ft. which were in immediate danger of being water-logged should be attended to first, rather than evolving measures for reclaiming the areas already water-logged.

The irrigation policy in certain cases was also responsible for increase of water-logged areas. Such an objective study of water-logged areas when coordinated with water table data may lead to reconsideration or reformulation of irrigation policies. The study would include collection of accurate primary data about the water-table, soil and topography of the area. Assessment of the data so collected would lead to formulation of an objective irrigation policy to be consistent with the long-term needs of an expanding economy.

STUDY NO. (2)—DELIMITATION OF AGRICULTURAL REGIONS

Agricultural development in India is not only a national problem but also a regional problem. Several agencies have been attempting delimitation of agricultural regions for different purposes but a coordinated approach for demarcating such regions has been lacking. Delimitation of agricultural regions would have to be based on factors like soil, climate, cropping pattern and irrigation practices. The major agricultural regions would then be further split up into smaller regions, taking into account socio-economic and agricultural back-ground of the community as well. Such a delimitation would lead to identification of "core" regions. I.C.A.R. has initiated this study on an all India basis.

STUDY NO. (3)—AREAS OF LOW UNIT YIELD

The scope of this study includes (i) collection of existing information on low yield, (ii) assess the reliability of the data, and (iii) specify causes for low yields.

STUDY NO. (4)—SURVEY OF UTILISATION OF WASTE OR BY-PRODUCTS OF AGRICULTURE (FORESTRY, ANIMAL HUSBANDRY AND FISHERIES) AND INDUSTRIES

There are large quantities of waste or by-products of agriculture, forestry, animal husbandry and fisheries which are at present used either in a most uneconomic manner or left completely unutilised, e.g., husk, straw, corn cobs, non-edible vegetable seeds, molasses, inferior fibres, nut shells, jute sticks, saw dust, wood chips, jungle wood, hooves, horns, bristles, feathers and bones, fish scales, fish-meal, sea weeds, sea shells, etc. In some of the advanced countries it has been found possible to make very profitable use

of such products with the help of modern science and technology. It is desirable that similar efforts should be made in India also in an organised manner and on a large scale.

During the World War II, when the country was faced with a severe shortage of fuel, lubricants, starch, bone charcoal etc., some of these waste products were actually put to use on a fairly large scale even in this country. But after the War, most of these efforts have been abandoned. It would be desirable to survey the availability of such waste products, make a list of the various uses to which these products may be put in the light of the experience of other countries and known technological possibilities, work out the economics of such uses in present conditions and under conditions of acute shortage, and encourage research and pilot experiments in such specific directions as may appear to be promising.

STUDY NO. (5)—COORDINATED STUDY OF SURVEYS

The types of surveys required for development projects in different sectors of economy varied over a wide range of scales and contours and covered variety of fields. Some times the same areas had to be surveyed more than once with minor variations to suit the requirements of different departments handling various projects. With proper coordination one survey could serve the purpose. Coordination of these surveys was necessary to eliminate unnecessary duplication of survey work. The basic idea of the study was to coordinate the survey requirements of various agencies for development projects, determine the priorities of various surveys and decide upon the common scales and common surveys which would meet the requirements of the Plans.

STUDY NO. (6)—IMPROVEMENT OF REVENUE RECORDS TO PROVIDE DATA FOR ECONOMIC PLANNING

Under the present Patwari system which is operating in most of the States in India, land statistics data at village level are being collected by the Revenue Department. This system could be profitably utilised for the collection of agricultural and other rural statistics required for planning purposes, e.g., data on (i) fertiliser use, (ii) water-logged areas, (iii) saline/alkaline areas, (iv) trees/fruit trees and (v) perennial water tanks. The question of modifying revenue records was being studied by the Directorate of Economics and Statistics, Ministry of Food and Agriculture. The suggestion regarding the improvement of proforma for collecting revenue records so as to enable the collection of statistics required for planning should be examined by the Directorate of Economics and Statistics.

STUDY NO. (7)—GAP BETWEEN RESEARCH AND APPLICATION

There is a considerable gap between the findings of research and their application in practice. In certain fields this gap is very wide while in some fields it is not so prominent. As the country is spending large sums on promoting research it would be pertinent to find out what are the causes of this gap and in what manner it can be bridged. This gap is particularly wide in the field of agriculture.

Studies are required in respect of the schemes sanctioned and executed, examination of the results achieved and scrutiny as to why some of these results have not been applied.

STUDY NO. (8)—STUDIES ON CROPS—OUTLINE OF STUDY ON INDIVIDUAL CROPS.

1. *Introduction*

Introduction of the crop in the country; development of cultivation in different parts of the country; reasons for localisation of the crop in different regions.

2. *Production*

Area under the crop; production and yield per acre since 1949-50 (annual, Statewise and by regions). Comparison of production and yield rates in India with total production in the world and other countries. Causes for high and low yields. Areas and regions of optimum production potential for future development. Problem areas with low yields and measures necessary for increasing yields.

Review of measures taken in the First and Second Plans for increasing production and the achievement. Review of research for crop breeding and their application. Improved varieties introduced and analysis of weak points in crop breeding programme.

3. *Demand*

Growth of demand. Present Production. Imports and exports of the commodity. Assessment of demand at the end of the Third, Fourth and Fifth Plans made by various agencies.

4. *Targets of production*

Targets of additional production at the end of Third, Fourth and Fifth Plan periods. Analysis of potentials and handicaps of increased production.

Extension of area under the crop. Possibilities of reclamation of land in areas suitable for production. Increase in area at the cost of area under other crops. An analysis of the importance of various competing crops and economic implications of substitution. Cost of production of crops and margins of profits. Price levels and price policies and their impact on production.

Intensive cultivation. Application of results of research. Improved seeds, their breeding and distribution; improved implements; manures and fertilisers; crop protection; introduction of improved techniques of crop planning; improved practices and their adoption and reasons for non-adoption.

Extension of irrigation facilities. Statewise addition to irrigated area through major, medium and minor projects. Crop patterns before and after the introduction of irrigation facilities. Time lag in getting optimum results from irrigation.

Yardsticks of additional production through different methods of improvement and realistic estimates of production potential at the end of different plan periods. Study of exports and imports.

Technological advance and growth of artificial substitute. Increase in the production of substitutes and their effect on demand for and production of the commodity.

2. WATER

STUDY NO. (9)—SURFACE WATER

1. (i) The assessment of the total surface water resources, separately for each river basin and sub-basin, on the basis of observations and data currently available.

(ii) The additional measures that are considered necessary to ensure a comprehensive and dependable assessment of the total surface water resources in each river basin and sub-basin.

2. An assessment of the existing quantum of annual surface water consumptive utilisations, separately for each river basin and sub-basin, for

- (i) Major and medium irrigation projects;
- (ii) Minor irrigation schemes;
- (iii) Industrial uses;
- (iv) Hydel and Steam Power Plants;
- (v) Domestic water supplies, urban and rural;
- (vi) Additional water uses for navigation, (Inland Water Transport) and for upland supplies for ports;
- (vii) Other uses such as leaching, anti-salinity measures, flushing river channels, etc.; and
- (viii) Aggregate consumptive utilisations at present *i.e.* total of (i) to (vii).

3. An assessment of the additional surface water requirements for the consumptive uses, (i) to (vii) mentioned above, for full development of (a) existing projects, (b) projects, currently under construction, and (c) committed projects, *i.e.*, projects accepted in the Third Plan on which construction has yet to commence, in each river basin and sub-basin.

4. (i) An assessment of the losses and gains currently occurring in the river basins in each season of the water year, due to absorption and transit losses; including valley storage and gains by return flow from regeneration and valley storage;

(ii) An assessment of increase in losses and gains due to additional water appropriations for existing and committed projects in each basin and in each season of the water year; and

(iii) An assessment of evaporation losses from reservoirs, canals and river basins.

5. The determination of the unutilised surface water resources in each river basin and sub-basin, after meeting the aggregate current utilisations and the additional requirements for existing and committed projects, allowing for losses and gains in each season of the water year. The surplus unutilised water resources will eventually be determined for different regions of each river basin.

6. The assessment of the optimum future utilisations of the surplus surface water supplies, in each season, in each river basin and sub-basin, having regard to hydrological conditions, regional requirements, and available water resources, etc.

7. An assessment, on the basis of the above studies, of the ultimate utilisations and surpluses in each river basin and for the country as a whole, in the different seasons of the year.

STUDY NO. (10)—GROUND WATER

1. (i) The assessment of the ground water resources separately for each river basin and sub-basin, on the basis of data currently available.

(ii) The additional measures that are considered necessary for a comprehensive and dependable assessment of the ground water resources in each river basin and sub-basin.

2. An assessment of the existing quantum of annual ground water utilisation separately for each river basin and sub-basin, for

- (i) Irrigation;
- (ii) Industrial uses; and
- (iii) Domestic supplies.

3. An assessment of additional ground water requirements for items (i) to (iii) mentioned above, for full development of (a) existing projects, (b) projects currently under construction, and (c) committed projects *i.e.*, projects accepted in the Third Plan on which construction has yet to commence, in each river basin and sub-basin.

4. The determination of the unutilised ground water resources, in each basin and sub-basin, after meeting the aggregate current utilisations, and the additional requirements for existing and committed projects.

5. The assessment of the optimum future utilisations of the surplus ground water resources in each basin and sub-basin having regard to the recharge and depletion of ground water table.

6. Compilation of data currently available regarding behaviour of ground water table in different basins and sub-basins. Further steps considered necessary for having these data recorded and collected in a systematic and standardised manner, to enable a study to be carried out on the year to year fluctuations, and general behaviour of ground water table in the different river basins.

7. An assessment on the basis of the above studies of the ultimate utilisation and surpluses of ground water in each river basin, and for the country as a whole.

8. Preparation of ground water maps giving information regarding depth to water table, yield and quality of water in aquifers, etc.

STUDY NO. (11)—OPTIMUM WATER USE

1. *Minimum Water depth requirements of crops in different regions in relation to climate, soil types, varieties of crops and cropping pattern.*—This would require field and laboratory studies in different regions of the country, would include minimum water depth requirements of crops, and would have to be related to soil surveys, crop pattern and varieties of crops suitable for each region, to enable a study to be made of the minimum quantity of water considered adequate for raising the most suitable crops for a particular area.

2. *Optimum utilisation of water in selected projects in different regions.*—(a) Major and medium irrigation projects; (b) Minor irrigation projects, comprising

- (i) tube-wells
- (ii) tanks
- (iii) open wells
- (iv) pumping schemes,
- (v) diversion schemes

having regard to rainfall, climate, types of soils, cropping pattern, etc.

3. Measures for surface drainage, and for avoidance of wastes in irrigation channels, water courses and field channels and in the fields.

STUDY No. (12)—“USE OF WATER FOR DOMESTIC AND INDUSTRIAL PURPOSES AND CONTROL OF WATER POLLUTION”

1. To make an assessment of the (i) present net quantum of utilisation of water for industrial and domestic purposes, urban and rural, including the quantum drawn and discharge; (ii) additional requirements for the same for full development of existing projects and for projects committed in the Plan; and (iii) probable future requirements over a period of 20 years or more on the basis of the pattern and trends of growth. This assessment would have to be made for ground water and surface water separately for each river basin and sub-basin.

2. To assess the quantum of effluents from industry and sewage disposal plants in different basins and sub-basins and to study the possibilities of utilising such effluents for industrial and agricultural purposes.

3. (i) To make a preliminary appraisal of the extent, nature and magnitude of the water pollution problem in the country; and

(ii) To study administrative, technical and legal measures that exist and to initiate and develop a comprehensive programme for control of water pollution in the country.

4. To study the problem of domestic water supplies to isolated communities particularly in areas where brackish water predominates and/or water is scarce.

5. To make a study of water resources available for domestic and industrial uses in respect of growing urban areas for which availability of water is likely to be a problem.

3. MINERALS

STUDY No. (13)—STUDY OF RAW MATERIALS FOR STEEL

The capacity for manufacture of iron and steel under the Third Five Year Plan is 10·2 million tons of steel ingots and 1·5 million tons of pig iron as against 6 million tons of steel and 900,000 tons of pig iron for sale at the end of the Second Plan. This will be achieved by expanding the public sector steel plants at Rourkela, Bhilai and Durgapur to a target capacity of 5·9 million tons of steel and also by setting up a fourth steel plant with a capacity of 2 million tons at Bokaro. The scope for expansion of capacity in the private sector is limited and expansion of steel capacity will mainly be through the installation of scrap-based electric furnaces.

2. Based on preliminary studies, in the Third Five Year Plan, a tentative target of capacity for steel ingots has been fixed at 18-19 million tons for 1970-71 and for pig iron at 3-4 million tons. The level of development for iron and steel industries under the Third and Fourth Plans and the development which may be projected for the subsequent plans call for a study of raw materials for steel, particularly in the light of the fact that certain basic raw materials like coking coal, refractory raw materials and other flux materials are known to be in short supply. It may be desirable to make a study to determine in what quantity various raw materials are available, where they are available and for how long they would be available. A study of this nature can be of great practical use.

Outline of study

3. For minerals required for the production of steel, e.g., iron ore, coking coal, manganese ore, limestone, dolomite, bauxite, fluorspar, scrap metal, etc., and materials for maintenance, information may be collected as follows:

Regional distribution of principal mineral reserves; of this how much has been proved and indicated. Physical characteristics and analysis of principal ore bodies. Source of supply of existing steel plants and problems being faced by them regarding quality and quantity required by them. Details regarding production of ores in the past 15 years and likely demand during the next 15 years. Scope for expansion of production.

The study is to confine itself to specific problems of shortages of minerals required for steel production. All existing information regarding the availability of quantity and grade-wise raw materials should be taken advantage of and a bibliography of existing literature on minerals should be prepared. The study should start from where the existing knowledge ended. The effects of continuation of conventional methods of processing on the life of existing resources should be discussed and the study should be directed towards latest technical and scientific innovations in the field of processing of raw materials.

4. The existing information regarding reserves of metallurgical coking coal, anticipated increase in the percentage of ash content in future production of coal by mechanised mining methods, accepted need for establishing washeries to meet the demand and the present pattern of consumption and transport problems also call for a detailed study.

5. A study on the pattern proposed above would call for the co-operation of various organisations like the Geological Survey of India, Bureau of Mines, Fuel Research Institute, National Metallurgical Laboratory, and the Hindustan Steel Ltd. Different aspects of the study relating to iron ore, coal, limestone, dolomite, bauxite, manganese, refractory materials would be allotted to the organisations/expert individuals concerned.

4. ENERGY

STUDY No. (14)—CO-ORDINATED STUDY OF DIFFERENT ENERGY RESOURCES WITH SPECIAL REFERENCE TO ECONOMIC ASPECTS

This subject has a number of ramifications. The first question that arises is the type of energy resource that should be covered in this survey. Should it confine itself to the commercial energy resources such as coal, oil, electricity, natural gas, coal gas and atomic power or should non-commercial sources such as cattle dung, vegetal wastes and fuel wood also be covered? Should the studies be restricted to inanimate sources of energy and ignore animate effort? What about the several other forms of energy such as solar energy, wind power, geo-thermal power, tidal power, etc., which at present are not contributing materially to the commercial energy requirements of the nation, but may become important in future on account of technological developments. If these studies are to yield any meaningful results, it is obvious that the entire gamut of energy resources should be surveyed and their impact on the economy evaluated.

2. A study of this kind should start with the assessment of historical growth of energy consumption in India, with particular reference to the First and Second Five Year Plan periods and the possible perspective growth in the next fifteen years. Having arrived at an approximate estimate of energy demand, the next step would be to examine, how the same could be met, with due regard to suitability and costs. Economics of energy supply would depend upon the resource potential in the country, efficiency in production transmission and utilisation, pricing and taxation policy of the Government in regard to the primary sources.

3. The domestic requirements of energy form a sizeable part of the total energy demand. It has been estimated that it constituted over 60 per cent of the inanimate energy consumption in India in 1960. Cattle dung seemed to be the main source of energy for domestic use in rural areas, incidentally depriving the soil of a valuable nutrient. The needs of domestic energy for a rising population with increasing per capita income should be assessed and measures for better utilisation of available fuels examined.

4. Economic growth, industrial production and productivity set the pace of growth in energy consumption. The requirements of electro-chemical and electro-metallurgical industries, steel, fertilisers, etc. in the next fifteen years have to be specially estimated in view of the energy intensive character of these industries. The trends in better utilisation of fuels and productivity will also have to be taken into account.

5. One of the chief consumers of coal is the steam locomotive, which uses the fuel rather wastefully. Dieselisation and electrification of railways will result in more efficient use of the energy resources and conserve coal. How far these programmes could be proceeded with in the next few plan periods will have to be examined on technical and economic basis. Road, sea and air transport are other important consumers of energy and a perspective growth of these, for both civilian and defence purposes, need to be estimated.

6. In agriculture, in addition to meeting the demands for irrigation pumping, the question of mechanisation of farm operations needs to be examined. In India the rainy season is limited to the months of July to September and December to January in most parts of the country. Immediately after the rains the main problem is of the quick conservation of moisture. One major factor for increased agricultural production in agriculturally advanced countries is the ability to perform critical crop operations at the right time. In India, large areas become unfavourable for crop production due to lack of adequate farm power as bullocks alone are unable to meet the situation. The flat nature of the terrain in large parts of India is particularly favourable for mechanised farming. Besides, the waste lands in the river areas with the problem of heavy growth of grass, can be effectively cultivated only by tractors. In more advanced countries, tractors have greatly reduced the hazards of unfavourable weather conditions and helped farmers in conserving moisture which is required for proper germination of seed. This is one of the studies which might yield some useful results.

7. The group of experts who drafted the O.E.E.C. Report on "Europe's Growing Needs of Energy" have commented on the efficiency of utilisation of energy as below :

"Increase of efficiency should be the first line of attack in reducing the demand for energy and thereby the gap between energy consumption and indigenous supply. Not only will it save fuel but it produces an overall economy and it contributes to a cleaner atmosphere. Experience has shown that the capital *investment needed to save a ton of fuel is often less than that required to produce the same additional amount of fuel.*"

"The whole trend of modern industry—larger units, mechanisation, continuous processes and automatic control—is favourable to higher efficiency and larger savings have already been made."

Between 1920 and 1937, it is stated that U.K. made savings by fuel economy to the extent of 50 million tons of coal per annum. Switzerland had

increased its efficiency of utilisation by 25 per cent and France is producing a saving of 1 to 2 per cent per year in its energy input. This aspect has to be kept in view in studying each sector.

Such a wide and comprehensive study of the problems in the energy field cannot be undertaken by any single organisation. Each of the expert organisation or body should assemble the necessary data and prepare papers so that these could be studied further and outlook on energy resources documented in a co-ordinated manner.

On the above outlines the following sources of energy would be studied:—

- (a) Coal, lignite and coal gas;
- (b) Oil and Natural gas;
- (c) Hydro resources; and
- (d) Atomic energy.

The studies are to be confined to growth of energy demand statewide and regionwise, resource potential and supply of energy to meet the demand and comparative costs of manufacture of power from alternative sources.

STUDY NO. (15)—FUEL PROBLEMS OF VILLAGES

Apart from cotton stalks, jute, castor and arhar sticks where these crops are grown, wood and dried cattle dung are the main sources of energy for cooking and heating in the rural areas. It has been estimated that the amount of cattle dung annually available is 1,200 million tons of which 400 million tons are used as fuel, 215 million tons as manure and the rest are wasted. The National Council of Applied Economic Research in their study entitled 'Domestic Fuels in India' have estimated that the amount of cattle dung burnt in India is equivalent to the output of 12 fertiliser factories like Sindri every year—i.e. about Rs. 130 crores per annum. This study was primarily concerned with urban use of domestic fuel and it did not touch the problem of rural areas. Use of cattle dung as fuel is an enormous national waste. It is to be studied in what manner the fuel problem of villages can be solved. The following facts need to be considered.

Outline of study on Rural Fuel Problem

1. Assessment of requirements of domestic energy for rural areas, State and Region-wise.

2. Sources of fuel supply :—

- (a) fuels of vegetable origin : These include crop residues e.g. baggasse, jute sticks, maize cobs etc. The quantities of such residues as are available and regions where available. The fuel value of these sources in terms of coal. In case of certain commodities their alternative industrial uses need also to be studied. The other sources of vegetable origin are trees. The study would include the determination of normal growth of fire-wood, trees in reserved forests and the supply therefrom. Besides this there are other un-recorded sources of supply of fuel-wood. An attempt would be made to determine the quantities of such supplies and rate at which they should be utilised to have continuous supply; and plantation rates to meet the rising demand. Determination of quick growing species suitable for different agro-climatic regions of the country.

- (b) Animal Waste : The data on cow-dung to be assessed worked out region-wise and State-wise. Possibilities of installing cow-dung gas plants in villages. Relative economies of cow-dung as fuel and/or as fertiliser and problem of replacement by commercial fuels.
- (c) Other commercial sources : Assessment of the availability of other commercial sources like charcoal, soft coke, kerosene and electricity *vis-a-vis* demand for them in the subsequent periods.

3. Problems of substitution of various non-commercial sources of energy by commercial sources of energy with the increase in the pace of economic development.

4. A review of improved *chulhas* and cooking ranges evolved by Research Institutes and laboratories as well as by commercial concerns.

GOVERNMENT OF INDIA
PLANNING COMMISSION

YOJANA BHAVAN, PARLIAMENT STREET,
New Delhi-1, the 23rd December, 1961.
the 2nd Pausa, 1883.

RESOLUTION

No. F.6/40/61-S.R. : The First and the Second Five Year Plans were formulated on the basis of available information concerning the land, water, mineral and the energy resources of the country. In recent years various organisations concerned with the survey and utilisation of natural resources have been expanded and have undertaken a series of new investigations. These investigations have led to greater knowledge of the nation's natural resources and have also brought to light gaps in information and deficiencies in relation to future requirements. As envisaged in the Third Five Year Plan and with a view to drawing up long-term plans of development, it is necessary to take a comprehensive view of the information available in respect of the country's main natural resources. The principal gaps which exist, the surveys required and the further measures needed in relation to specific long-range objectives in the development of irrigation, power, steel, coal, oil and minerals, and land and forest resources have to be identified. For achieving long-term goals, it is also necessary to assess the resources and requirements in relation to different regions. The Third Five Year Plan has stressed the need for a coordinated and continuing effort on the part of the Planning Commission, the various organisations of the Central and the State Governments, leading institutions engaged in scientific and economic research, and the Universities to ascertain the nature and extent of the country's natural resources and the requirements of development and to suggest appropriate measures. In pursuance of these recommendations, it has been decided to constitute a Committee on Natural Resources, the main functions of the Committee being :—

- (i) to assess from time to time the available information regarding the natural resources of the country and to identify gaps in it in relation to programmes of planned development ;
- (ii) to arrange for the formulation, in collaboration with the various organisations concerned, of coordinated programmes for surveys of natural resources in different parts of the country in relation to plans for long-term economic development ;
- (iii) to initiate studies on problems relating to natural resources ;
- (iv) to make recommendations bearing on the conservation, utilisation and development of natural resources ; and
- (v) to disseminate information concerning the country's natural resources through publications.

2. The Committee will consist of the following :

Deputy Chairman, Planning Commission	.. ..	Chairman
Member (Education), Planning Commission	.. ..	Vice-Chairman

Members of the Planning Commission.

Director-General,
Council of Scientific and Industrial Research.

Chairman,
University Grants Commission.

Chairman,
Central Water & Power Commission.

Chairman,
Atomic Energy Commission.

Member (Production),
Oil & Natural Gas Commission.

Vice-President,
Indian Council of Agricultural Research.

Inspector General of Forests.

Scientific Adviser,
Ministry of Defence.

Director-General,
Geological Survey of India.

Director,
Indian Bureau of Mines.

Surveyor-General,
Survey of India.

Director-General,
Meteorological Department.

Director,
Indian Standards Institution.

Director,
Central Statistical Organisation.

Director,
Indian Statistical Institute.

Mineral Adviser to the Government of India.

Director-General,
National Council of Applied Economic Research.

Adviser, Natural Resources,
Planning Commission

..

..

Member-Secretary

3. The Committee will be assisted by a Standing Committee and expert Technical Committees for various fields of study.

TARLOK SINGH
Additional Secretary to the Government of India.

TECHNICAL COMMITTEES

TECHNICAL COMMITTEE ON LAND

Adviser (Resources), Planning Commission. *Chairman*
 Agricultural Commissioner, Indian Council of Agricultural Research.
 Additional Agricultural Commissioner, Indian Council of Agricultural Research.
 Inspector General of Forests, Ministry of Food & Agriculture.
 Soil Conservation Adviser, Ministry of Food & Agriculture.
 Economic & Statistical Adviser, Ministry of Food & Agriculture.
 Statistical Adviser, Indian Council of Agricultural Research.
 Director, Indian Agricultural Research Institute.
 President, Forest Research Institute & Colleges.
 Surveyor General, Survey of India.
 Chief Engineer, Floods (Designs & Planning), Central Water & Power Commission.
 Chief Engineer, Floods (Field Investigations), Central Water & Power Commission.
 Head, Regional Planning Unit, Indian Statistical Institute.
 Joint Secretary (PC), Planning Commission.
 Chief, Perspective Planning Division, Planning Commission.
 Chief (EG&P), Economic Division, Planning Commission.
 Specialist, Land Resources, Planning Commission.
 Director, Agriculture Division, Planning Commission.
 Dr. P. S. Lokanathan, Director-General, National Council of Applied Economic Research.
 Shri Lal Singh, Retired Director of Agriculture, Punjab.
 Dr. B. N. Uppal, Agricultural Adviser, Punjab Government, Chandigarh.
 Dr. S. Krishnamurti, Dean, Government Agricultural College, Coimbatore.
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 Dr. Arjan Singh, Member, Minor Irrigation Team, Committee on Plan Projects, Planning Commission.

TECHNICAL COMMITTEE ON WATER

Adviser (Irrigation & Power), Planning Commission. *Chairman*
 Chairman, Central Water & Power Commission.
 Member (Design & Research), Central Water & Power Commission.
 Member (Planning & Investigation), Central Water & Power Commission.

Member (Hydro-Electricity), Central Water & Power Commission.
 Chief Engineer and Joint Secretary, Ministry of Irrigation & Power.
 Shri H. C. Kalra, Joint Secretary, Ministry of Irrigation and Power.
 Chief Engineer, Floods (Field Investigations), Central Water & Power Commission.
 Irrigation Adviser, Ministry of Food & Agriculture.
 Chief Engineer, Exploratory Tubewells Organisation, Ministry of Food & Agriculture.
 Engineer-in-Chief, Ganga-Brahmaputra Water Transport Board.
 Secretary, Central Board of Irrigation and Power.
 Senior Industrial Adviser, Development Wing, Ministry of Commerce and Industry.
 Development Adviser, Transport Wing, Ministry of Transport and Communications.
 Agricultural Commissioner, Indian Council of Agricultural Research.
 Soil Conservation Adviser, Ministry of Food & Agriculture.
 Director-General of Observatories.
 Director, Indian Agricultural Research Institute.
 Shri Baleshwar Nath, Member, Minor Irrigation Team, Committee on Plan Projects, Planning Commission.
 Shri M. P. Mathrani, Member, Irrigation and Power Team, Committee on Plan Projects, Planning Commission.
 General Manager, Beas Project, Nangal Township (Punjab).
 Chief Engineer (Irrigation), Madras.
 Chief Engineer (Irrigation), Uttar Pradesh.
 Chief Engineer (Irrigation), Maharashtra.
 Officer-in-charge, Ground Water Division, Geological Survey of India.
 Chief, Perspective Planning Division, Planning Commission.
 Chief, Health Division, Planning Commission.
 Chief (EG&P), Economic Division, Planning Commission.
 Director (Irrigation), Irrigation and Power Division, Planning Commission.

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Director-General, Geological Survey of India.		
Coal Mining Adviser, Ministry of Mines & Fuel.		
Mineral Adviser, Department of Atomic Energy.		
Chairman, Hindustan Steel Ltd.		
Chairman, National Mineral Development Corporation.		
Member (Production), Oil & Natural Gas Commission.		
General Manager, National Coal Development Corporation.		
Director, Indian Bureau of Mines.		
Director, Central Board of Geophysics.		
Director, National Metallurgical Laboratory.		
Director, Central Fuel Research Institute.		
Director, Regional Research Laboratory, Hyderabad.		

Director, Petroleum Research Institute.
 Director, Central Mining Research Station.
 Head, Metallurgy Division, Atomic Energy Establishment.
 Officer-in-Charge, Naval Chemical & Metallurgical Laboratory.
 Chief Metallurgist, Hindustan Steel Ltd.
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 Chief (EG&P), Economic Division, Planning Commission.
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 Member, (Hydro Electricity), Central Water & Power Commission.
 Member (Thermal), Central Water & Power Commission.
 Member (Production), Oil & Natural Gas Commission.
 Coal Mining Adviser, Ministry of Mines & Fuel.
 Director-General of Observatories, Meteorological Department.
 Head, Metallurgy Division, Department of Atomic Energy.
 Director, National Aeronautical Research Laboratory.
 Director, Central Fuel Research Institute.
 Director, Petroleum Research Institute.
 Director, Power Research Institute.
 Chief, Perspective Planning Division, Planning Commission.
 Chief (EG&P), Economic Division, Planning Commission.
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SUB-COMMITTEES

SUB-COMMITTEE ON LAND

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WORKING GROUPS

WORKING GROUP ON MAPS

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WORKING GROUP ON WASTELANDS, INCLUDING SALINE, ALKALI AND WATER-LOGGED LANDS

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Controller, Gama Garden,
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Deputy Agricultural Commissioner,
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Rice Committee,
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Oilseeds

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Secretary,
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Joint Director of Agriculture,
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Cotton

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Jute, Mesta, Sisal and Ramia

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Chief Jute Development Officer,
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Ministry of Food and Agriculture.

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Specialist on Land,
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Director, Agriculture Division,
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Assistant Chief (Resources),
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Spices

Director,
Indian Agricultural Research Institute.

Head, Botany Division,
Indian Agricultural Research Institute.

Spices Specialist,
Indian Council of Agricultural Research.

Specialist on Land,
Planning Commission.

Director, Agriculture Division,
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Assistant Chief (Resources),
Planning Commission.

Coconut, Arecanut and Cashewnut

Secretary,
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Ministry of Food and Agriculture.

Secretary,
Indian Central Arecanut Committee,
Ministry of Food and Agriculture.

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Shri P. D. Nair,
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C/o Agriculture Adviser, Government of Kerala.

Plantation Crops : Tea, Coffee, Rubber and Cinchona

Chairman,
Tea Board.

Chairman,
Rubber Board.

Chairman,
Coffee Board.

Director,
Tocklai Experimental Station.

Director, Cinchona,
West Bengal.

Director, Rubber Plantation,
Kerala.

Director of Research,
Coffee Research Station.

Deputy Secretary (Plantations),
Ministry of Commerce and Industry.

Specialist on Land,
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Director, Agriculture Division,
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Shri P. S. Subramaniam,
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United Planters' Association of Southern India,
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**WORKING GROUP ON SURVEY AND UTILISATION OF WASTES, AND BY-
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President,
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A representative of the Ministry of Mines and Fuel.

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WORKING GROUP ON COORDINATED STUDY OF SURVEYS

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President,
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Chief Engineer, Floods (Designs and Planning),
Central Water & Power Commission.

Chief Engineer, Floods (Field Investigations),
Central Water & Power Commission.

Deputy Surveyor General,
Survey of India.

Economic and Statistical Adviser,
Ministry of Food and Agriculture.

Director,
National Atlas Organisation.

Soil Conservation Adviser,
Ministry of Food and Agriculture.

Director, Defence Surveys,
Ministry of Defence.

Chief Soil Survey Officer,
Indian Agricultural Research Institute.

Agricultural Chemist,
Government Agricultural College, Ludhiana, Punjab.

Specialist on Land,
Planning Commission.

WORKING GROUP ON GAP IN RESEARCH (AGRICULTURAL CROPS)

Adviser (Resources),
Planning Commission.

Agricultural Commissioner to the Government of India.
Indian Council of Agricultural Research.

Director,
Indian Agricultural Research Institute.

Additional Agricultural Commissioner,
Indian Council of Agricultural Research.

Statistical Adviser,
Indian Council of Agricultural Research.

Dr. Arjan Singh,
Member, Minor Irrigation Team,
Committee on Plan Projects,
Planning Commission.

Dr. T. J. Mirchandani,
Retired Director of Agronomic Survey and Experimentation.

WORKING GROUP ON GAP IN RESEARCH (ANIMAL HUSBANDRY AND FISHERIES)

Animal Husbandry Commissioner,
Ministry of Food & Agriculture.

Fisheries Development Adviser,
Ministry of Food & Agriculture.

Director (Oceanography),
Council of Scientific & Industrial Research.

Dairy Development Adviser,
Indian Council of Agricultural Research.

Director,
National Dairy Research Institute.

Director,
Indian Veterinary Research Institute.

Sheep & Goat Specialist,
Indian Council of Agricultural Research.

Nutrition Specialist,
National Dairy Research Institute.

Specialist on Land,
Planning Commission.

Senior Research Officer (Animal Husbandry),
Agriculture Division,
Planning Commission.

Shri S. G. Iyer,
Retired Poultry Specialist, Indian Veterinary Research Institute.

WORKING GROUP ON COAL, LIGNITE AND COAL GAS

Coal Mining Adviser,
Ministry of Mines and Fuel.

Director,
Petroleum Research Institute.

Director,
Central Fuel Research Institute.
Thermal Specialist Engineer,
Central Water and Power Commission.
Director (Power),
Irrigation and Power Division,
Planning Commission.

WORKING GROUP ON OIL AND NATURAL GAS

Director,
Petroleum Research Institute.
Director of Geology,
Oil and Natural Gas Commission.
Director (Power),
Irrigation and Power Division,
Planning Commission.
Shri P. R. Nayak,
Indian Refineries Ltd.
Shri W. B. Metre,
Senior Technical Adviser,
Burmah Oil Co. (I.T.) Ltd.

WORKING GROUP ON HYDRO RESOURCES

Chairman,
Central Water and Power Commission.
Member (Hydro),
Central Water and Power Commission.
Director (Power),
Irrigation and Power Division,
Planning Commission.

WORKING GROUP ON ATOMIC ENERGY

Administrator,
Tarapur Atomic Power Station.
Director,
Power Research Institute.
Chief (EG&P), Economic Division,
Planning Commission.
Director (Power),
Irrigation and Power Division,
Planning Commission.
Dr. P. S. Lokanathan,
Director-General,
National Council of Applied Economic Research.

WORKING GROUP ON FUEL PROBLEMS IN VILLAGES

Member (Hydro),
Central Water and Power Commission.

President,
Forest Research Institute and Colleges.
Ministry of Food and Agriculture.

Director,
Central Fuel Research Institute.

Officer on Special Duty (Scientific Research),
Planning Commission.

Specialist on Land,
Planning Commission.

Director (Power),
Irrigation and Power Division,
Planning Commission.

Dr. P. S. Lokanathan,
Director-General,
National Council of Applied Economic Research.

WORKING GROUP ON SURFACE WATER, GROUND WATER (including minor irrigation) AND OPTIMUM WATER USE

Adviser (Irrigation and Power),
Planning Commission.

Member (Planning and Investigation),
Central Water and Power Commission.

Chief Engineer and *ex-officio* Joint Secretary,
Ministry of Irrigation and Power.

Chief Engineer,
Exploratory Tubewells Organisation,
Ministry of Food and Agriculture.

Chief Engineer, Floods (Designs and Planning),
Central Water and Power Commission.

Agricultural Commissioner
Indian Council of Agricultural Research.

Irrigation Adviser,
Ministry of Food and Agriculture.

Irrigation Adviser,
Ministry of Community Development and Cooperation.

Shri Baleshwar Nath,
Member, Minor Irrigation Team,
Committee on Plan Projects,
Planning Commission.

Director-General,
Meteorological Department.

Secretary,
Central Board of Irrigation and Power.

Director,
Indian Agricultural Research Institute.

Director,
Programme Evaluation Organisation,
Planning Commission.

Director (Irrigation),
Irrigation and Power Division,
Planning Commission.

WORKING GROUP ON USE OF WATER FOR INDUSTRIAL AND DOMESTIC PURPOSES AND CONTROL OF WATER POLLUTION

Adviser (Irrigation and Power),
Planning Commission.

Senior Industrial Adviser (Engineering Industries),
Development Wing,
Ministry of Commerce and Industry.

Senior Industrial Adviser (Chemical Industries),
Development Wing,
Ministry of Commerce and Industry.

Chief Engineer (Floods and Field Investigations),
Central Water and Power Commission.

Deputy Director-General of Health Services,
Ministry of Health.

Chief (Industry),
Industry and Minerals Division,
Planning Commission.

Chief, Health Division,
Planning Commission.

WORKING GROUP ON RAW MATERIAL FOR STEEL

Adviser (Resources),
Planning Commission.

Director (Finance),
Hindustan Steel Ltd.

Coal Mining Adviser,
Ministry of Mines and Fuel.

Director-General,
Geological Survey of India.

Director,
Indian Bureau of Mines.

Director,
Central Fuel Research Institute.

Director,
Central Board of Geophysics.

Director,
National Metallurgical Laboratory.

Shri Maheshwar Prashad, Deputy Secretary,
Ministry of Steel and Heavy Industries.

Director, Planning, Railway Board.

Shri K. Srinivasan, Deputy Secretary,
Ministry of Transport and Communications.

Shri J. M. Trehan,
Ministry of Transport and Communications.
Specialist on Land,
Planning Commission.