

# Requirement Analysis Document

## 1. INTRODUCTION

### a. INARIS- An Introduction

One of the fundamental aspects of resource management is to have information on the extent, nature and properties of natural resources and their utilization for sustainable food security for the growing population of the country. Many organizations are engaged in collection, interpretation and utilization of data in their respective fields of operation, but at the same time this has restricted their application in a holistic mode for development as information are rarely available at one source, and the scattered way of data organization is a bottleneck in data accessibility. Thus, planners and development agencies have always faced a tough time to get data for planning at local and/or regional level, in bringing out the total perspective of the region in changing the social fabric of the people. Based on the interaction among the basic resources like soil, water, climate, animal and vegetation that form the prime components of the production system, this project is viewed to strengthen the information system and will help in determining the carrying capacity of the region. The animal and plant genetic resources of India are of great global importance. These resources need proper evaluation that can be done through interactive interpretation in a relational database system. Also, digitizing socio-economic database along with biophysical factors is essential to objectively monitor and evaluate the current and future agricultural growth and development. The major objectives of the project are to generate digital database on agricultural information management system at regional/ local level for appropriate land use plan based on the integration of various multidisciplinary data sets generated by the participating organization and interpret them into management information. The database will contain information on major soils, crops, cropping system, productivity in each agro-eco-zone/State/District including management practices, irrigation status, fertilizer consumption, input requirement etc. Collection of temporal information on land use, distribution of operational holding, cropping pattern, production, productivity, irrigated area, sources of irrigation, distribution of modern inputs, livestock composition and production will be undertaken to assess the changing scenario. Creation of database on livestock population and their distribution, fodder production, feed requirement and do parameters of integrated live stock development in each zone will be done by the institutes like NBAGR and other collaborating agencies. NCAP will integrate the socio-economic features related with natural resource management. Other institutes like CRIDA, NBFGR, IISR, CPCRI, IIHR, NRC-AF, DWMR will be creating the relevant database on the respective fields of operation. IASRI will create a database on the All India Co-ordinated Research Project. Goal of this Mission Mode Project is to provide a data warehouse on soil, water, climate, animal, fish, crops and cropping system along with socio-economic and geographical features on a single platform, and allow to evolve methodologies to interpret the interlinked data through the Central data Warehouse (CDW) for planning and development purposes as per the requirements of the user agencies. In this project existing databases will be integrated and database on critical data gaps of

various fields will be designed for important parameters in respective fields. The main objective is to design and develop an operational and flexible warehouse for agricultural resources so that it can be expanded further, in future as per requirements.

**i. Goals of the Project**

- To integrate existing databases of crops, plant genetic resources, horticultural and plantations crops, spices, animal genetic resources, fish genetic resources, socio-economic resources, agro-forestry system, water resources, agricultural farm mechanization etc.
- To design and develop comprehensive database on the above agricultural resources.
- To develop resource maps based on various databases through GIS, and
- To develop warehouse of the above databases.

**ii. Utility**

The development of data warehouse for agricultural research, management and education will:

- Improve the quality of research and planning.
- Reduce duplication of research efforts.
- Encourage dissemination of research findings.
- Facilitate qualitative research supported by agricultural databases.
- Help in the development of Decision Support Systems (DSSs).
- Use as effective tool for agricultural research and education planning.
- Develop effective linkages with other national and international organizations.

**b. Organisations Associated with the Project**

**i. Indian Agricultural Statistics Research Institute, New Delhi**

This is the lead Institute of this project Indian Agricultural Statistics Research Institute(IASRI), is a premier organization in the field of research in Agricultural Statistics, Computer Applications in agriculture and allied subjects. Initially a small Statistical section was established in 1930 under the then, Imperial Council of Agricultural Research, to assist the State Departments of Agriculture and Animal Husbandry in planning their experiments, analysis of experimental data, interpretation of results and rendering advice on the formulation of the technical programmes and examining the progress reports of the schemes funded by the Council. Dr. PV Sukhatme was appointed as Statistician to the Council in 1940 and research was initiated for developing objective and reliable methods for collecting yield statistics of principal food crops. Efficiency and practicability of these methods were demonstrated in different states for estimating yield by crop cutting experiments. The recognition, which this method attained, was such that in the course of a few years, the method was extended practically to the entire country to cover all principal food and non-food crops. Research in

sampling theory and training of field and statistical staff were initiated resulting in the organization of the Statistical Section into a Statistical Branch with permanent footing in 1945 accompanied by appropriate expansion in its strength. Statistical Branch soon acquired international recognition as a center for research and training in the field of Agricultural Statistics. In 1949 it was named as Statistical Wing of the Indian Council of Agricultural Research (ICAR). During 1952 on the recommendations of two Food and Agricultural Organization (FAO) experts Dr Frank Yates and Dr DJ Finney who visited the Council on the invitation of the Government of India, activities of the Statistical Wing were further expanded and diversified. In August 1955, it moved to its present campus. The Statistical Wing was re-designated as the Institute of Agricultural Research Statistics (IARS) on 2nd of July 1959. The Institute was declared as a full-fledged Institute in the ICAR system in April 1970 and is since then headed by a Director. Name of the Institute was changed to Indian Agricultural Statistics Research Institute (IASRI) on 1st January 1978, emphasizing the role of 'Agricultural Statistics' as a full fledged discipline by itself. A third generation computer, Burroughs B-4700 system was installed in March 1977 in a new three-storied Computer Center building. The Institute provided selective information services to scientists in the ICAR Institutes and Agricultural Universities on references to documents relating to areas of their specific interest from Information System for Agricultural Sciences and Technology (AGRIS) from 1975 to 1989. From October 1983 to March 1992 the Institute also functioned as a Center of Advanced studies in Agricultural Statistics and Computer Application under the aegis of the United Nations Development Programme (UNDP). This programme was aimed at developing a Centre of Excellence with adequate infrastructure and facilities to undertake advanced training programmes and to carry out research on various aspects of agricultural statistics and computer application.

### **Mandate of the Institute**

- To undertake basic, applied and adaptive research leading to new developments in Agricultural Statistics and related fields for bridging gaps in the application of Statistical Techniques to the problems of Agricultural Research.
- To assist in the development and strengthening of National Agricultural Statistics System.
- To conduct post-graduate and in-service training courses in Agricultural Statistics and Computer Applications in Agriculture.
- To provide advisory/ consultancy services to agricultural scientists, planners, policy makers and others on their statistical and computer requirements.
- To act as a repository of information on Agricultural Statistics for research and dissemination of such information.
- To develop the Institute as an Advance Centre of Excellence for education and training in Agricultural Statistics and Computer Applications.
- To liaise with ICAR Institute, SAUs and State Agricultural

/Animal Husbandry / Veterinary Sciences departments etc. and undertake sponsored research and training for national and international organisations

ii. **Central Plantation Crops Research Institute, Kasaragod**

The CPCRI was established in 1970 at Kasaragod by merging the Central Coconut Research Station, Kasaragod; Central Coconut Research Station, Kayangulam and Central Arecanut Research Station, Vittal along with its five sub-stations at Palode (Kerala), Peechi (Kerala), Hirehalli (Karnataka), Mohitnagar (West Bengal) and Kahikuchi (Assam). All India Co-ordinated Spices and Cashew nut Improvement Project was established during 1971 and in 1972 the All India Co-ordinated Coconut and Arecanut Improvement Project (AICCAIP) started functioning. During 1986 (VII Five-year Plan) research on spices and cashew were delinked from the Institute with the establishment of National Research Centres at Calicut and Puthur respectively. Simultaneously the All India Co-ordinated Cashew nut and Spices Improvement Project was bifurcated and the project on spices was transferred to Calicut and that of cashew to Puthur. Further, arecanut was excluded from the ambit of the AICCAIP and in its place oil palm was included and the project was renamed as All India Co-ordinated Research Project on Palms (AICRPP). Later, palmyrah palm (*Borassus falbellifer*) was also included in the Project. On inception of NRC-Oil Palm during 1999, research on oil palm was shifted from CPCRI. Unlike other crops the plantation crops are perennial cash crops with relatively long gestation period and economic life span. Thus productivity and sustainability of the plantation crops are governed by long-term crop management practices. Hence a wise and judicious allocation of the basic resources is pre requisite for economic crop production. Different agencies in public, private, co-operative and non-governmental sectors are involved in research, development, training, extension, and procurement, marketing and exporting aspects of plantation crops. This necessitates the systematic compilation of this vast, unorganized at various levels, and multidisciplinary data into an efficient integrated resources information system. CPCRI undertakes crop improvement and developing appropriate production, protection and processing technologies for coconut, arecanut and cocoa. CPCRI acts as the national repository for genetic resources of the mandate crops and produce parental line and elite planting materials. It is the head quarters of All India coordinated Research Project on Palms. CPCRI also undertakes transfer of technology programmes and acts as the lead center of plantation crops research.

**Mandate of the Institute**

- To integrate the existing database on plantation crops.
- To design and development database on important plantation crops.
- To develop plantation crops resource map of the country through GIS.

iii. **Indian Institute of Spices Research, Calicut**

Spices research in India gathered momentum with the launch of the All India Coordinated Spices and Cashew Improvement project in 1971 at Central plantation Crops Research Institute (CPCRI), Kasaragod, Kerala. The Cardamom Research Center at Appangala, Karnataka, originally established by the then Mysore government to initiate research on cardamom, was taken over by CPCRI in 1974 from the Indian Institute of Horticultural Research, Bangalore. During the fifth five-year plan, the Indian Council of Agricultural Research (ICAR) recognized the need to initiate concentrated research on major spices in the country and established the Regional Station of CPCRI at Calicut on 10th Nov. 1975. The Quinquennial Review Team (QRT) appointed by ICAR after reviewing the works of CPCRI for 1975 –83, recommended the founding of an Independent National Research Center for Spices (NRCS). In 1986, NRCS was established with its head quarters at Calicut and the Cardamom Research center at Appangala was merged with it to intensify research on spices more effectively with mission mode programmers. The All India Coordinated Spices and cashew Improvement project was also bifurcated into two separate projects and the headquarters of All India Coordinated Research project on spices was shifted to NRCS, Calicut. In recognition of the scientific contributions of NRCS during the short span of decade and the growing importance of spices as a high-value export oriented produce, the center was further elevated to the Indian Institute of Spices Research (IISR) with effect from 1st July 1995. Spice crops come under seasonal / annual spice (e.g. Chilies) and perennial spice crop categories (e.g. Black Pepper). India being the “Land of Spices”, producing major spices like Black pepper, Nutmeg, Cardamom, Turmeric, Ginger, Vanilla, Paprika, Allspice, Cinnamon, Clove and Garcinia, Chilly etc. The information available on these crops is very much limited to annual production, export and import etc. But for efficient planning and implementation of different developmental programs on spice production, detailed database covering district level units on parameters like soil suitability, vertical predominance, production, productivity, marketable surplus markets, marketing channels, post harvest handling, production grades / quality standards, cost of cultivation and input availability for production etc. are essential. In addition, information on latest technologies developed by various research organizations on spice development, production, protection and post harvest techniques are need to be collected and made available to scientific community working on similar tasks. This necessitates the systematic compilation of this wide, unorganized multidisciplinary information / data into an efficient integrated resources information system.

### **Mandate of the Institute**

- To conserve Genetic reformers of spices as well as soil, water and air of spice agro-ecosystems.
- To develop high yielding and high quality spices varieties and sustainable production and protection systems using traditional and non-traditional techniques and normal biotechnological approaches.

- To develop post harvest technologies in spices with impassion on product development and product diversification for domestic and export purposes.
- To act as a center for training in research methodology and technology up gradation of spices and to coordinate with national research projects.
- To monitor the adoption of new and existing technologies to make sure that research is targeted to the needs of the farming community
- To serve as a national center for storage, retrieval and dissemination of technological information on spices

iv. **Indian Institute of Horticultural Research, Bangalore**

Indian Institute of Horticultural Research (IIHR) was established in 1968 under the aegis of Indian Council of Agricultural Research. The headquarters of the Institute is located at Hessaraghatta 26 km away from Bangalore. The Institute is one of the largest in Asia engaged in research on most of the important tropical horticultural crops. There are 2 regional stations located at Chettalli in Coorg District, Karnataka and Bhubaneswar, in Orissa. Besides, there is a Krishi Vigyan Kendra at Gonikoppal, Coorg and a Trainers Training Centre at Hessaraghatta, Bangalore. The main research complex of the Institute is located at Hessaraghatta, which is located 26 km from Bangalore. It houses the Divisions of Fruit crops, Vegetable crops, Ornamental crops, Post Harvest Technology, Soil Science and Agricultural Chemistry, Plant Physiology and Biochemistry, Biotechnology, Plant Pathology, Entomology and Nematology, Plant Genetic Resources, Extension and Training and Sections of Medicinal plants, Economics and Statistics, Seed Science and Technology and Agricultural Engineering. This research infrastructure is supported by the requisite technical and administrative manpower. The farm attached with the Institute has an area of 266 ha. land out of which 169 ha. is under cultivation. It can boast of as one of the ultra-modern laboratory complexes. The Institute has regional stations at Chettalli in Coorg district of Karnataka catering to the Western Ghats ecosystem and at Bhubaneswar in Orissa catering to the needs of tribal farmers of the Eastern states. The Project Coordinator of the Tropical Fruits is also located at the Institute. The Institute has on its roll 204 scientists, 266 technical staff, 456 administrative, auxiliary and supporting staff. More than 10 Universities have recognized the Institute for carrying post-graduate research work. A close collaboration exists with the University of Agricultural Sciences, Bangalore in training of PG students in a wide variety of disciplines related to horticulture. The efficient planning and implementation of different developmental programs on horticultural crops depends on production parameters like soil suitability, varietal dominance, marketable surplus, marketing channels, post-harvest handling practices, cost of cultivation and market availability for sustained production. In addition, information on latest technologies developed by various research organizations on horticultural improvement, production, protection and post-harvest technologies need to be collected and made available to the scientists, planners and managers working in the related fields.

The digitization of comprehensive database on horticultural crops will definitely enhance the pace of development in terms of increasing the area, production and productivity of horticultural crops, which have taken lead in the new millennium with reference to nutritional aspect of food-security and export potential.

### **Mandate of the Institute**

- To undertake basic and applied research for developing strategies to enhance productivity and utilization of tropical horticultural crops viz., fruits, vegetables, ornamentals, medicinal and aromatic crops and mushrooms.
- To act as a repository of scientific information relevant to horticulture.
- To act as the Centre of training for upgradation of scientific manpower in modern technologies for horticultural production.
- To collaborate with relevant national and international agencies in achieving the above objectives.

### v. **Project Directorate for Cropping Systems Research, Modipuram**

The Project Directorate for Cropping Systems Research (PDCSR) has its origin in the Stewart Scheme of Simple Fertilizer Trails on Cultivars Fields, which was initiated in 1952-53. After three years, Model Agronomic Experiments Scheme was also added to the Project. In 1968-69 this project was upgraded to All India Coordinated Agronomic Research Project (AICARP) with two components viz. Model Agronomic Experiment and Simple Fertilizer Trails. Then AICARP was elevated to the level of Project Directorate for Cropping System Research (PDCSR) in 1989. PDCSR has a strong network of coordinating centers; comprising 37 on-station research centers (25 main and 12 sub centres) and 32 on-farm research centers, in addition to a multi-disciplinary team of scientists at Modipuram. These centers are functioning under collaborative agreements with all the SAUs in the country, spread over five major ecosystems, viz.; arid, semi arid, sub-humid, humid and coastal. At present the total plan budget of PDCSR is Rs. 2405 lakh (Rs. 903 lakh for head quarters and Rs. 1501 lakh for coordinating centers) with scientific manpower of 38 head quarters and 132 at different centers. Since its inception, the project has made significant contributions to the development and refinement of crop production technologies for diverse eco-edaphic and resource base situations in the country.

### **Mandate of the Institute**

- To undertake basic and applied research for developing strategies that contributes to enhance efficiency of cropping systems appropriate for different farming situations and agro-ecological zones.
- To act as a repository of information on cropping systems.

- To provide leadership role and co-ordinate the network research with state agricultural universities for generating location specific cropping systems technology.
  - To act as center for training in research methodologies in the field of cropping /farming research.
  - To collaborate with national and international agencies in achieving these goals.
  - To provide consultancy in the related fields.
- vi. **Central Research Institute for Dry Land Agriculture, Hyderabad**

Rainfed Agriculture is crucial to the country's economy and food security because 67% of the net sown area is rainfed and about 44% of the total food production is contributed by rainfed agriculture. Attempts to improve the scenario of rainfed agriculture were initiated in the early 1920s. India's first Dry Farming Research Center was established in 1923 at Manjri near Pune in the then Bombay province. Soon after that, dry farming research centers were also started in Raichur, Hagari, Bijapur, Rohtak and Solapur. Efforts undertaken in these centers were, however, far too inadequate given the vastness of rainfed areas and magnitude of the problems. The few recommendations that came out of these research centers could not bring about any remarkable increase in the productivity of rainfed areas. Green Revolution in mid sixties, though ushered in a new era of Indian Agriculture, had led to alarming productivity disparities between rainfed and irrigated regions. As a large number of farmers are small and marginal and depend on rainfed agriculture for their livelihood, the Government of India and the Indian Council of Agricultural Research (ICAR) recognised the need for the comprehensive and multi-disciplinary research in dryland agriculture to develop appropriate technologies for efficient management and utilization of natural resources to improve the productivity of the dryland regions. As a part of this effort, the ICAR has launched the All India Coordinated Research Project for Dryland Agriculture (AICRPDA) in 1970. The unique feature of this project was its focus on location specific and inter-disciplinary approach in identifying and analyzing the yield limiting constraints encountered in the rainfed areas of the country. AICRPDA encompassed 23 cooperating centers representing contrasting agro-climatic regions of the country. The project established the possibilities to enhance dryland crop productivity by atleast two folds by employing proper soil, water and crop management practices. Realizing the importance of the role of weather in dryland agriculture, the All India Coordinated Research Project on Agrometeorology (AICRPAM) was set up in 1983 with 12 cooperating centers. Currently AICRPAM has 25 centers located in various State Agricultural Universities. The modest successes of AICRPDA and the increasing importance of the need for basic, applied and strategic research in rainfed agriculture resulted into the establishment of a full-fledged Research Institute - Central Research Institute for Dryland Agriculture (CRIDA) at Hyderabad in 1985. The central task assigned to CRIDA was to embark upon lead and strategic research in rainfed agriculture, leaving location specific problems and their solutions to AICRPDA and AICRPAM. With the launching

of the National Agricultural Technology Project (NATP) by the ICAR in 1998, CRIDA was further strengthened by donning the responsibility of planning and coordinating research in rainfed agroecosystem in the country in a production system and matrix mode.

### **Mandate of the Institute**

CRIDA conducts problem oriented multi-disciplinary research. The mandate of the Institute includes:

- To undertake basic and applied research that will contribute to the development of strategies for sustainable farming systems in the rainfed areas.
- To act as a repository of information on rainfed agriculture in the country.
- To provide leadership and coordinate network research with SAUs for generating location-specific technologies for rainfed areas.
- To act as a center for training in research methodologies in the fields basic to management of rainfed-farming systems.
- To collaborate with relevant national and international agencies in achieving the above objectives.
- To provide consultancy.

### vii. **The ICAR Research Complex for Eastern Region, Patna**

The ICAR Research Complex for Eastern Region, Patna formerly DWMR came into existence on April 1, 2001 with the following five research programmes: Land, Water, Environment and Engineering Research Programme (LWEERP), Patna (Formerly Directorate of Water Management Research, Patna) Crop Research Programme (CRP), Pusa (Formerly Regional Station, CTRI, Rajamundhry) and eastern Uttar Pradesh (location to be finalized) Horticulture and Agro-forestry Research Programme (HAFRP), Ranchi (Formerly Central Horticultural Experiment Station of IIHR, Bangalore) Livestock and Fishery Improvement and Management Programme (LFIMP), Patna Socio-Economic and Extension Research Programme (SEERP), Patna It is also the headquarters of three All India Coordinated Research Projects that include AICRP on Water Management (25 centres in different agro-ecological zones), AICRP on Optimisation of Ground Water Utilization through Wells and Pumps (five centres in different agro-ecological zones) and AICRP on Diaraland Improvement (three centres in different agro-ecological zones). Water plays the central role in crop production. It not only enhances crop growth but also ensures the efficiency of other inputs like seeds, fertilizers and pesticides. Concrete efforts are necessary to maximize the existing water-use through appropriate water management practices. Data pertaining to water resources are scattered in different forms, collected and collated by multiple agencies and institutions employing diverse methodologies, do not match with the dynamic data requirement of complex agricultural environment. It is necessary that a comprehensive information system on water resources is developed to provide systematic and periodic information to the researchers, planners,

decision-makers and developmental agencies. For the diverse planning, research and development activities on the present and future use of water resources, a strong database plays a vital role. This will help in the identification of technologically appropriate, economically viable, socially acceptable and environmentally non-degrading approach for agricultural planning.

### **Mandate of the Institute**

- To undertake strategic and adaptive research for efficient management of natural resources to enhance productivity of agricultural production systems comprising of agricultural and horticultural crops, livestock, avian and fisheries in different agro-ecological zones of the eastern region.
- To facilitate and promote coordination and dissemination of appropriate agricultural technologies through network/consortia approach involving ICAR institutes, state agricultural universities, and other agencies for generating location specific agricultural production technologies through sustainable use of natural resources.
- To provide scientific leadership and act as a center for vocational as well as advanced training to promote agricultural production technologies.
- To act as repository of available information and its dissemination on all aspects of agricultural production systems in the eastern region.
- To collaborate with relevant national and international agencies in liaisons with state and central government departments in achieving the above objectives for enhanced technology dissemination.
- To provide need based consultancy and advisory support in promoting agriculture in the eastern region.

### viii. **National Bureau of Soil Survey & Land Use Planning, Nagpur**

The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Nagpur, a premier Institute of the Indian Council of Agricultural Research (ICAR), was set up in the year 1976 with the objective to prepare soil resource maps at state and district level to provide research inputs in soil resource mapping, and its applications towards land evaluation and land use planning, land resource management, and database management using GIS for optimising land use on different kinds of soils in the country. The Bureau has also been engaged in carrying out agro-ecological and soil degradation mapping at the country, state and district level for qualitative assessment and monitoring the soil health towards viable land use planning. The research activities have resulted in identifying the soil potentials and problems, and the various applications of the soil surveys with the ultimate objective of sustainable agricultural development. The Bureau has the mandate to correlate and classify soils of the country and maintain a National Register of all the established soil series. The Institute is also imparting in-service training to staff of the soil survey agencies in the area of soil survey and land evaluation,

soil survey interpretations for land use planning. The Bureau in collaboration with Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is running post-graduate teaching and research programme in land resource management, leading to M.Sc. and Ph.D. degrees. The research of the Bureau has resulted in identifying various applications of soil surveys in education, planning and management.

### **Mandate of the Institute**

- Soil survey and mapping the soils of the country to promote scientific and optimal land use programmes in collaboration with relevant institutions and agencies.
- Imparting training and education and promoting awareness on the soil resources and its state of health.
- To conduct and promote research in the National Agricultural Research System in the areas of Pedology, Soil Survey, Land Evaluation and Land Use Planning.

#### ix. **National Bureau of Plant Genetic Resources, New Delhi**

Established in its present set up in 1976, although the activities were initiated in 1946, National Bureau of Plant Genetic Resources (NBPGR) is the nodal organization in India for exchange, quarantine, collection, conservation, evaluation and the systematic documentation of germplasm resources. It operates under ICAR system (DARE). The whole concept of conservation of PGR in India has undergone a conceptual transformation evolving gradually over the past four decades. It has developed its own network based on the principles of agro-ecological analogues. Its regional stations represent different phyto-geographical regions with distinct ecological conditions. At the Head Quarters, Bureau is organized into five divisions, namely Plant Exploration and Collection, Plant Quarantine, Germplasm Evaluation and Germplasm Conservation. Besides these divisions, Bureau also has three units – Plant Germplasm Exchange Unit, Tissue Culture and Cryo Preservation Unit (TCCP), Policy Planning Unit and Agricultural Research Information System (ARIS) Unit. With its present setup, India has taken a lead among the developing nations in establishing a well organized and functioning plant genetic resources system. Major efforts are now devoted towards developing strong national plant genetic resources system in the country with NBPGR as the leading organization linked effectively with other thirty ICAR institutes, NRC's, AICRP's and SAU's. Each of these centers is designated as national active germplasm site for specific crop(s) and has been assigned responsibility of maintaining, evaluating and supplying germplasm out of its collection to the user scientists. Bureau maintains the national base collections of different crops kept under long-term storage at  $-20^{\circ}\text{C}$  in the national gene banks. Also in vitro collections are maintained in the TCCP unit. Its regional stations maintain Fields collections. It has also developed facilities for cryo-preservation of seeds, pollen and in vitro cultures in liquid nitrogen, ( $-196^{\circ}\text{C}$ ). Besides a chain of clonal repositories have been envisaged under its network. Computerized national database on plant genetic resources and national herbarium of cultivated and wild plants are also

operative under its system. The basic research is related to conservation and utilization of germplasm from an integral part of Bureaus research programmes so as to improve quality and effectiveness of multi-faceted services for the sustainable management of plant genetic resources.

### **Mandate of the Institute**

- To plan, conduct and co-ordinate plant explorations for collection of diversity in germplasm of cultivated plants, their wild relatives and naturally occurring species of economic importance.
- To undertake introduction and exchange of plant germ plasm for research purpose.
- To examine the seed and plant materials under exchange for the presence of associated pests and pathogens and also to salvage the healthy material from the infected / contaminated samples.
- To undertake and promote conservation of plant genetic resources on a long term basis employing in vivo, in vitro, cryo preservation techniques and also to assist in in situ conservation efforts.
- To develop and operate the national database for storage and retrieval of information on plant genetic resources.
- To conduct basic researches for providing a sound scientific backup to its services.
- To develop and operate the national herbarium of crop plants and their wild relatives
- To organise suitable training programmes at the national, regional and international levels.

### x. **National Bureau of Animal Genetic Resources, Karnal**

The animal wealth of India is represented by a broad spectrum of native breeds of cattle (30), buffalo (10), goat (20), sheep (42), equines (6) and camels (8). In addition several other forms like poultry, duck, geese, quails, yak, mithun, pigs are also important components of animal wealth of India and contribute a big share in animal production. India is bestowed with a large population of domestic animals with 204.5 million cattle, 83.5 million buffalo, 50.8 million sheep, 115.2 million goat, 1.99 million equines, 1.03 million camel, 12.8 million pigs, 0.06 million yaks and 0.13 million mithun. This national resource is also significant contributor to national economy. Livestock sector accounts for 21 % of the value of output of agricultural sector, which is 29 % of the gross domestic product of the economy. The livestock census is conducted every five years in India. This provides age and sex wise data at the district level on different categories of animals. State animal husbandry departments, Central Statistical Organization and National Sample Survey Organization are conducting surveys on production, prices and utilization of animal products all over the country. Surveys are also being conducted by different research organizations on animal diseases, animal genetic resources, migration of livestock etc. Still many data gaps persist in the data on animal resources. These gaps are there because the data collected is not being compiled in its entirety. Most of data has not been computerized till now.

Moreover a centralized database on animal resources does not exist in the country. A national database on animal resources can be of immense help for sustainable development of these resources in the country. Such a database combined with databases on other natural resources can help planners, researchers and development agencies in evolving more realistic strategies and development plans for management and conservation of this natural wealth of the country. Planners, researchers, development agencies and farmers require data on animal resources for further studies and evolving realistic strategies for improvement and rearing of livestock and poultry. The data is also required for keeping a watch on prices and movement of animal products, animal feed, and establishment of services such as veterinary hospitals, artificial insemination (AI) centers, meat and dairy industries etc. Further, there is a need to study animal resources in relation to other aspects of agriculture, such as soils, vegetation, and climate, socio-economic, land use, water resources for overall development of agricultural production system. The spatial data combined with attribute data on all these aspects of agricultural sciences and animal resources will lead to development of geographical information system as envisaged under this project.

### **Mandate of the Institute**

- Identification, evaluation, characterization, conservation and utilization of livestock and poultry genetic resources.

#### **xi. National Bureau of Fish Genetic Resources, Lucknow**

Considering the national programmes for improvement and expansion of both inland and marine fisheries of the country, it has been recognized that enhancement of fish production alone is not enough and conservation of the diversity of the natural fish population is necessary pre requisite. Appreciating this, the government of India approved establishment of the National Bureau of Fish Genetic Resources during the sixth five-year plan. The Bureau was then sanctioned in December 1983 under the Indian Council Of Agricultural Research with its main center at Allahabad in UP.

### **Mandate of the Institute**

- Collection, classification and evaluation of fish genetic resources of the countries.
- Maintenance and preservation of fish genetic materials.
- Cataloging of genotypes.
- Introduction of exotic species in Indian waters and Conservation of exploited and endangered species.

The Water Resource of India contain diverse group of flora and fauna. It has got about 2118 species of fin fish; this includes 1360 marine fishes, 82 Brackish Marine, 16 Brackish, 73 Warm Brackish Marine, 67 Warm Brackish, 366 Warm, 34 Cold Warm and 120 Cold fishes. Because of various reasons, the ichthyofauna of India is declining.

Effective conservation and sustainable utilisation has been hampered due to lack of species-specific database. In view of the national programme for improvement and expansion of both inland and marine fisheries of the country, it has been recognized that enhancement of fish production alone is not enough and conservation of the diversity of the natural fish population is a necessary prerequisite. For launching any germplasm conservation programme it is important to have knowledge of what, where and how to conserve. In this sense it has become very essential that we develop perspective map of our germplasm resources that are as detailed as possible and to develop atlas on all the information of the area and have a common protocol for arrangement and collection of data. The information once put in the form of map will help the resource managers to communicate between their colleagues and other stakeholders. It will also help the resource managers to visualise where the object of interest are located such as stream or any other waterbody. Once the stream is located on map it will be easier to determine relation between identified object such as plant type, slope, substrate type etc. to the stream. Once these occurrence will be mapped it will be possible to develop hypothesis of relation between the object and the water bodies and also it will be possible to develop spatial map having information about fish distribution. This type of spatial analysis is possible with the use of maps created by geographical information system (GIS). The geographical information system consists of computer hardware, software and georeferenced data and is capable of inputting, storing, manipulating, analysing and outputting the data. The GIS coverage allows one to assess the influence of physical characteristics on biological computers of habitat. This information will provide managers with the tools to evaluate the importance of this resource to fishes. So there is an urgent need to develop a system having georeferenced database of fish and fish habitat, macro reach and lake classification. It should includes attribute data on:

- Fish distribution.
- Land and water use as well as water quality parameters.
- Fishery potential.
- Economic value.
- Patterns of harvest and use.

The system should be comprehensive, yearly updated and have an accessible database. It should provide georeferenced summary level of fish and fish habitat data for water bodies throughout the region. The georeferenced information has to be digitised and linked to a digital watershed atlas for use in GIS. It should incorporate a number of new design concepts such as thematic segments, water body identifier and combines streams, river, and lake and reservoir information into one system.

Lot of digital data is already available in the country with different organizations. The Space Application Centre, Ahmedabad has prepared wetland maps of whole India and all water bodies are available in digital form with Survey of India. This information can act as the base map over which all other scattered data associated with fishes can be overlaid. The National Remote Sensing Agency, Hyderabad is having satellite imagery all over India of different time scale. These data can provide us the status of water bodies at different time interval. The developed information will serve as a valuable tool in managing natural fishery resources and undertaking developmental activities which affect water resources with minimal damage to fish species diversity.

xii. **National Center for Agricultural Economics and Policy Research, New Delhi**

NCAP was established by ICAR in 1991 to articulate the relevance of agricultural economics input and policy research in the NARS. NCAP is mandated with policy-oriented research, strengthening of agricultural economics in NARS and enhancing ICAR participation in policy decisions. NCAP became functionally active with the development of manpower and institutional infrastructure since 1996 onwards. The Center has an approved cadre strength of 20 scientists; most of them are already in position. Besides, scientists from the collaborating institutions also add to the professional capability of the Center. Presently policy research is conducted under five theme areas and major ongoing and proposed coverage of research issues by theme areas are as follows:

**Technology policy:**

Analysis of agricultural R&D policies; Decision support system for research priority setting and impact assessment; Role of technology in meeting challenges of poverty, sustainability and globalization of agriculture.

**Sustainable agriculture systems:**

Alternate development pathways in crops, cropping systems and agricultural typologies; nutrient management by ecosystems; sustainability status, trends and dimensions in natural resources management.

**Markets and Trade:**

Trade prospects and competitiveness of Indian agriculture in post WTO period; Government intervention in food grain markets; Demand and supply projections for livestock products; Problems and issues in marketing of perishable farm products.

### **Institutional change:**

Tenancy reforms; linkages in seed industry, institutional reforms in irrigation management, public-private partnerships in research and extension, role of NGOs; evaluation of self-help groups in credit delivery.

### **Agricultural growth and adjustment:**

Sector, region and commodity outlook; socioeconomic dynamics and growth pattern; diversification and sustainability aspects; supply response in various sectors through agricultural modeling; sources of growth in Indian Agriculture. Strengthening social science capacity in NARS and policy interfacing mandates are addressed through collaborative research linkages, policy paper/brief/PME notes publications and activity linkages with central and state government departments. NCAP has research linkages with 8 ICAR institutes and 15 SAUs within NARS. Globally, the Centre has established research linkages with ICRISAT, IFPRI, DFID, ACIAR, ICLARM and IRRI. During 1995-2000, the Centre has published 14 policy papers, 14 policy briefs and 8 NATP PME notes for disseminating the policy research findings.

### **Mandate of the Institute**

- a. Policy oriented research on
    - Technology generation, diffusion and Impact assessment
    - Sustainable agricultural production system
    - Interaction between technology and other policy instruments like incentives, institutions, trade etc.
    - Agricultural growth and adjustment with focus on role of technology.
  - b. Strengthening agricultural economics and policy research and teaching capability in the state agricultural universities and ICAR institutes.
  - c. Enhancing ICAR participation in agricultural policy decisions.
- xiii. **Agroforestry Unit , IGFRI , Jhansi**

Agroforestry has become so popular that it hardly needs any further elucidation as it is integrated self sustainable land use management system which involves deliberate introduction and/or retention of woody components such as trees, shrubs, bamboos, canes, palms, climbers, etc. with agricultural crops including pasture/animals simultaneously or sequentially on the same unit of land and/or time to meet the ecological as well as socio-economic needs of the ever increasing population. This new vistas of life science by virtue of its manifold merits have to play a vital role in dryland agriculture where crop failure is frequent because of vagaries of environmental factors viz. rainfall and temperature. Our prime objective is to enhance the productivity of rainfed agriculture areas and wastelands so that we can achieve the production target of 250,285 and 350 metric ton of

food grains, green and dry fodder and fuel wood respectively by 2000 AD besides meeting our national target of one third geographical area (110 million hectare) under tree and green cover and also redressal of highly polluted environment through various agroforestry systems. With the establishment of National Research Centre for Agroforestry at Jhansi, significant strides were taken to develop various models of agroforestry systems both on-station and on-farm research so that one could be in position to establish an agroforestry system as per needs in a specific agroecological region. The demand of the day is to promote biomass productivity per unit time of the arable as well as wasteland for boosting the economic status of farmers so that they could be self-dependent for their daily basic needs of food, fodder, fuel, wood and timber. India is 7th largest country in the world encompassing geographical area of 328.7 million ha with a population of more than 1000 million people. Productive area available is around 300 million ha of which 76.5 million ha is recorded forest area. Actual forest cover is 63.34 million ha of which 26.13 million ha is degraded. About 20 million ha is covered under private tree planting (Agroforestry, farm forestry, social forestry and other plantations). Thus, 57.21 million ha of good forest and tree covers exist in the country. In order to meet the increasing demand of our fast growing population, we would require to boost the production of food grain and fuel wood for human consumption and green and dry fodder for livestock to the tune of 250,350 and 2085 million ton, respectively besides 75 million m<sup>3</sup> of timber. Under these circumstances we have no alternative but to follow the integration of tree with agricultural crop, which is known as agroforestry. The National Forest Policy (1988) sets a goal to have a minimum of one-third of the total area of the country under forest or tree cover. This means that about 100 million ha should be covered with forest/tree covers. For achieving the target about 43 million ha ( $100 - 57.21 = 42.79$ ) area has to be regenerated/afforested with Government and Private efforts. The National Agriculture Policy (2000) recognizes "Agroforestry and Social Forestry as prime requisites for maintenance of ecological balance and augmentation of biomass production in the agricultural systems". For practicing sustainable agriculture the policy envisages implementation of agroforestry in irrigated, rainfed and shifting cultivation area. The policy also stresses greening of wastelands by adopting appropriate afforestation models. To fulfill the National Forest Policy objectives of having 33% of country's area under forest and tree cover, 15 million ha of degraded forests have to be regenerated/afforested under Joint Forest Management and 28 million ha under agroforestry/ social forestry programmes. For completing the task in 10 years period adequate financial, technical, policy and legal supports have to be provided. Thus, annual targets for greening will be 4.3 million ha (1.5 million ha under JFM & 2.8 million ha under agroforestry/social forestry) to be covered with people's participation or through private forestry initiatives. To be in tune with the proposed National Agriculture Policy (2000), that endows teeming trust to agroforestry, emphasis has to be pitched on research for promoting vogue agroforestry models, for nitrogen fixation, organic matter addition and nutrient recycling. Even, according to agriculture policy farmers will be encouraged to take up farm/agroforestry

for sustainability of resources in addition to higher income generation by evolving technology, extension and credit support packages and removing constraints to development of agroforestry. Agroforestry practices are very ancient but the advent story of organised agroforestry research began in 1979 at Imphal, the capital of Manipur when a Seminar on Agroforestry was organised by the ICAR to accumulate and compile the data pertaining to the research and development of agroforestry in India. On the recommendation of Task Force, set up on basis of the discussions and issues emerged in aforesaid seminar, the All India Coordinated Research Project on Agroforestry was launched in 1983. With the augmentation of agroforestry research in India, a need was felt to establish a National Research Centre for Agroforestry (NRCAF) which started functioning from May, 1988 at Jhansi with the following mandate to accelerate the hastening basic, strategic and applied research in agroforestry.

### **Mandate of the Institute**

- To undertake basic and applied research for developing and delivering technologies based on sustainable agroforestry practices on farms, marginal and wastelands for different agroclimatic zone in India.
- To coordinate network research with the SAUs/ICAR institutes /other related research institutes for identifying technologies which can be transferred from one region to another.
- To provide training in:
  - . research methodologies and
  - a. use and application of technologies developed at various levels.
- To develop technologies packages of different agroforestry practices for various agroclimatological Zones for transfer to farm fields and wastelands.
- To act as repository of information on the subject.
- To collaborate with relevant national and international agencies for achieving the above objectives.
- To provide consultancy.

#### xiv. **Central Institute of Agricultural Engineering, Bhopal**

The CIAE is located at 77°27'E and 23°20'N with an elevation of 495 m at Nabi Bagh on Berasia Road, Bhopal. In the last two decade of existence of Central Institute of Agricultural Engineering, Bhopal, the major aim of the institute has remained to conduct research and development to facilitate agricultural mechanization, to conserve soil and water through land development, application of efficient utilization of renewable and non-renewable sources of energy in agriculture. The institute has made its niche in the country as well as in many Asian and African countries through national and bilateral research cooperation, training of engineers and supply of quality prototypes. It has been effectively participating in international research programmes with different countries such as USA, UK, France, and Japan. It has linkage with south Asian countries namely Bangladesh, China, Iran etc. through Regional Network of agricultural machinery- a programme sponsored by ESCAP for

exchange of technology and human resource development for mutual benefit. The climate in Bhopal is very pleasant. During winter, temperature varies between 10-25 and in summer 25-42 degrees Celsius. The average annual rainfall in the region is about 1200 mm, confined mainly during the months of June to August. Bhopal city is also known for its beautiful lakes and magnificent mosques whose beauties are best viewed from the Lakshmi Narayan temple, located on a hilltop. The city is linked by air and rail from Delhi and Mumbai. CIAE is 7 km from Bhopal Railway Station and about 10 km from Bhopal Airport. Agricultural Engineering provides the technology to facilitate agriculture through efficient utilization of inputs besides reducing drudgery. It is generally believed that only large farmers have availed of the benefits of modern farm technology. Small farmers have also been found to utilize selected farm equipment through custom hiring. Equipment for tillage, sowing, irrigation, plant protection and threshing has widely been accepted by them. The mechanical power threshers were introduced in the late sixties and by seventies they became very popular even amongst small farmers. The strategy for the mechanization of agriculture in the country needs careful attention due to the varying levels of social and economic status of farmers, extremely diversified agro-ecology and physiography. Most of the information on farm mechanization is mostly available in print media and free access to them is very difficult. A need has been felt to develop farm mechanization database, which will provide information on: Crop Production and Land Development Equipment, Irrigation & Drainage Equipment, Poultry Equipment, Dairying Machinery & Equipment, Fisheries Equipment (including Trawlers, Crop Processing & Value Addition Equipment), Renewable Energy Gadgets, Power units (Human, Animal, Power Tiller, Tractor, Self propelled, Engines & Motors), Allied Machinery, Environment Safety Equipment, Spare parts & components.

### **Mandate of the Institute**

- To undertake basic, applied and adaptive research leading to development/ improvement of equipment, technology, process for crop production, irrigation and drainage, post-harvest technology and processing, and energy-use in agriculture and rural industries.
- To develop hardware and technology with cooperation with other ICAR institutes in the area of crops, horticulture, aquaculture and animal husbandry for production and processing.
- To provide leadership and coordinate network of research with state agricultural universities for generating location specific technologies.
- To provide input to ICAR on policy intervention with respect to agricultural mechanization, energy management in agriculture, irrigation and drainage and post harvest technology.
- To provide consultancy and undertake sponsored research from industry and other organizations.
- To act as a repository of information on agricultural engineering.

- To act as a centre for training in research methodologies and technology and conduct post graduation education programme leading to Master's and Doctoral degrees in Agricultural Engineering.
- To collaborate with relevant national and international agencies in achieving above objectives.

## 2. Role of Participating Centers:

Name of Co-operating Centers	Responsibility
<b>IASRI, New Delhi</b>	<ul style="list-style-type: none"> <li>• To develop architectural infrastructure for Central Data Warehouse at IASRI, New Delhi.</li> <li>• To develop extraction, cleaning, and loading tools of Warehouse.</li> <li>• To develop warehouse management tools of warehouse.</li> <li>• To develop querying tools of warehouse.</li> </ul>
<b>CPCRI, Kasaragod</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on plantation crops.</li> <li>• To design and development database on important plantation crops.</li> <li>• To develop plantation crops resource map of the country through GIS.</li> </ul>
<b>IISR, Calicut</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on spices.</li> <li>• To design and develop database on important spices.</li> <li>• To develop resource map on important spices base cropping system in the country through GIS.</li> </ul>
<b>IIHR, Bangalore</b>	<ul style="list-style-type: none"> <li>• To integrate existing database on horticultural crops.</li> <li>• To design and development database on horticultural crops.</li> <li>• To develop resource maps of major horticultural crops in the country through GIS.</li> </ul>
<b>PDCSR, Modipuram</b>	<ul style="list-style-type: none"> <li>• To design and develop database on cropping systems in the country.</li> <li>• To develop resource map of different cropping systems in the country through GIS</li> </ul>
<b>CRIDA, Hyderabad</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on physical and climatic parameters.</li> <li>• To design and development database on physical and climatic parameters.</li> </ul>

	<ul style="list-style-type: none"> <li>• Generation of physical and climatic database on agro-ecological sub-region wise.</li> <li>• Digitization of various climatic variables through GIS.</li> </ul>
<b>ICAR RCER , Patna</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on water resources.</li> <li>• To design and develop database on various aspects of water resources.</li> <li>• To develop water resource maps of the country through GIS.</li> </ul>
<b>NBSS&amp;LUP, Nagpur</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on soil resource in the country.</li> <li>• To design and develop database on soil parameters in the country.</li> <li>• To develop resource map on soil parameters through GIS.</li> </ul>
<b>NBPGR, New Delhi</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on plant genetic resources.</li> <li>• To design and develop database on various aspects of plant genetic resources.</li> <li>• To develop plant genetic resource maps of the country through GIS.</li> </ul>
<b>NBAGR, Karnal</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on animal resources in the country.</li> <li>• To design and develop database on animal genetic resources in the country.</li> <li>• To develop resource map on animal resources in the country through GIS.</li> </ul>
<b>NBFGR, Lucknow</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on fish resources in the country.</li> <li>• To design and develop database on fish genetic resources in the country.</li> <li>• To develop resource map on fisheries resources in the country through GIS.</li> </ul>
<b>NCAP, New Delhi</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on socio economic database relevant to agriculture research and education in particular agricultural development in general in the country.</li> <li>• To design and develop database on various socio economic parameters for few identified cropping system in selected regions in the country.</li> <li>• To develop resource map of various</li> </ul>

	important socio-economic parameters through GIS.
<b>NRC-AF, Jhansi</b>	<ul style="list-style-type: none"> <li>• To design and develop database on Agro-Forestry system in the country.</li> <li>• To develop resource map of different Agro-Forestry system in the country through GIS.</li> </ul>
<b>CIAE, Bhopal</b>	<ul style="list-style-type: none"> <li>• To integrate the existing database on agricultural farm mechanization.</li> <li>• To design and develop database on various aspects of agricultural farm mechanization.</li> <li>• To develop agricultural farm mechanization maps of the country through GIS.</li> </ul>

### 3. Rationale:

#### i. Database on Plantation Crops

This project envisages digitization of database on various aspects of plantation crops such as natural resources, technologies evolved, pests and diseases, production and trade, cropping systems, socio economic scenario etc. A comprehensive database has become essential since information is being generated by many agencies and conventional mode of dissemination of the same involves enormous time delay. Moreover, often one may fail to utilize all the available information and thereby reduce the efficiency of various spheres of activities. On completion of this project, the respective agencies can effectively use this information for optimum allocation of natural resources, policy formulations and extension services. It is expected that this database will directly or indirectly influence all the future program/strategies on plantation sector. It is proposed in this project to follow a holistic approach by involving all the concerned bodies engaged in research development and extension on a small holder plantation crops (viz., coconut, areca nut, cocoa, cashew, oil palm and palmyrah). Collaboration with ICAR institutes (NRC Cashew, NRC Oil palm), SAUs and National/ State Departments will be sought for compiling/ generating data. The infrastructure established under this project will also be used for regular updation and thereby making the customers well informed.

#### ii. Database on Spices Resources

The available database at present is macro economic in nature covering a broad unit of country and state level only. Further the available statistics is limited to area, production, export and import details on few major spices like Black pepper, Cardamom, Ginger, Turmeric and Chillies only, out of nearly 52 spices grown in the country. But for efficient planning and implementation of different developmental programs on spice production, detailed database covering district level units on parameters like soil suitability, varietal predominance, production, productivity, marketable surplus, markets, marketing channels, post harvest handling practices, grades/quality standards, cost of cultivation and input availability for production etc. are essential in addition to the presently available details for all the major spice crops under different agro climatic regions. In addition, information on latest technologies developed by various research organizations on spice improvement, production,

protection and post harvest techniques are needed to be collected and made available to the scientific community working on the similar task. In this fast growing era of Information Technology creation of such a detailed database will definitely increase the pace of development of spice industry. Since India holds a major share on production, export and consumption of spices in the world, it becomes imperative to create a national level database on different aspects of spice production, marketing and economics in easily accessible and usable form. However, emphasis should be given in creating district/taluka/block level details, as the basic unit for developing the system becomes important for getting a ground level picture of spice scenario in our country. The outcome of this project would do the creation of Spices Resource Map of India as a whole, which in turn directs the planners/researchers in setting their goals in right direction.

### iii. **Database on Horticultural Crops**

The efficient planning and implementation of different developmental programs on horticultural crops are, production and parameters like soil suitability, varietal dominance, marketable surplus, marketing channels, post harvest handling practices, cost of cultivation and market availability for sustained production are essential in addition to the presently available details for all the major horticultural crops under different agro-climatic regions in the country. In addition, information on latest technologies developed by various research organizations on horticulture improvement, production, protection and post-harvest technologies are needed to be collected and made available to the scientists, planners and managers working on the related field. The digitization of comprehensive database on horticultural crops will definitely enhance the pace of horticultural crops area, production productivity and industry, which has taken the lead in the new millennium with reference to nutritional quality of food and export potential.

### iv. **Database on Cropping System**

This project envisages digitization of database on various aspects of plantation crops such as natural resources, technologies evolved, pests and diseases, production and trade, cropping systems, socio economic scenario etc. A comprehensive database has become essential since information is being generated by many agencies and conventional mode of dissemination of the same involves enormous time delay. Moreover, often one may fail to utilize all the available information and thereby reduce the efficiency of various spheres of activities. On completion of this project, the respective agencies can effectively use this information for optimum allocation of natural resources, policy formulations and extension services. It is expected that this database will directly or indirectly influence all the future program/strategies on plantation sector. It is proposed in this project to follow a holistic approach by involving all the concerned bodies engaged in research development and extension on a small holder plantation crops (viz., coconut, arecanut, cocoa, cashew, oil palm and palmyrah). Collaboration with ICAR institutes (NRC Cashew, NRC Oil palm), SAUs and National/ State Departments will be sought for compiling/ generating data. The infrastructure established under this project will also be used for regular updation and thereby making the customers well informed.

### v. **Database on Climatic Resources**

Systematic database provides a way of finding information quickly and easily based on a chosen reference point. Most of the data available today are obtained from different sources, which are generally incompatible and in-consistent. Another problem is the time lag between collection of data and their publication in the form of maps. Emphasis in utilization of current information technology for establishment of database on climatic resources is desirable for different agro-climatic regions, which could be integrated and utilized by other area for national database development. The prime objective of the project is to establish a digitized

database on climatic resources that would be capable of delivering accurate, useful and timely information to a wide range of scientist, planners and decision makers. On the long-term basis, the database may be utilized to provide data for improved mapping and monitoring dynamics in agro-climatic parameters

vi. **Database on Water Resources**

COWB, CWC, CWPC, CBIP, CADA of different irrigation projects, Dept. of Agriculture, Statistics, Economics of Federal States and the Central Government and several other institutions outside the ICAR system are involved in collecting the data on varied aspects of water resources and relevant agricultural information. Within the ICAR system also, the fragmentation exists due to the necessity to work within the mandate of the research institute/center. Thus DWMR, WTC, NBSS & LUP, CRIDA, CSSRI, etc. have been developing technological information on efficient water resources utilization. A comprehensive database integrated to form a single platform is essential to overcome the shortfalls of conventional planning which often fails to take into account every possible aspect not due to ignorance but simply due to difficulties in accession and analysis thereafter due to gaps in the data. Tailored data to meet specific needs is normally not available. Often agencies are blamed for not addressing the drainage related issues while planning irrigation projects. Secondary salinization and water logging in many irrigation projects owe their origin to lack of foresights. This project envisages digitization of database on various aspects of water resources and technologies evolved. A comprehensive database has become essential on a single platform, since information is being generated by many agencies and conventional mode of dissemination of the same involves incompatibility and in order delay. On completion of the project the user agencies can effectively utilize this information on Internet and other modes of dissemination for optimum utilization of water resources, policy formulations and extension services to enhance the overall agricultural production.

vii. **Database on Soil Resources**

The proposed project on soil resource database management has been viewed to strengthen the information system conceptualized by ICAR. Other user agencies, in particular, the planning portfolio is eagerly waiting for such database. Based on the inventory of basic resources like soil and associated properties forming components of the production system, will help in determining the carrying capacity of the soils in a particular region. For achieving this goal, these resources need proper evaluation through interactive interpretation in a relational database system. This project aims at giving suitable opportunity to link different information system on various kinds of natural resources on multi-disciplinary mode through enhanced interactive ness among research institutes by providing first hand information on the related problems and potential in the production systems. This information system shall be one of the biggest in the world. World database like SOTER, ISRIC, etc. have shown great interest in this project. Once this database is in operation, it will help the world scientific community work on global agricultural scenario.

viii. **Database of Plant Genetic Resources**

The project envisages digitization of database on related aspects of plant genetic resources and technologies involved. Till now the information generated by different agencies and organizations on conventional mode are facing difficulties in information dissemination due to incompatibility. The proposed project is aimed to digitize the comprehensive plant genetic information on single platform and it will edge the dissemination of plant genetic information to the user agencies at a faster rate.

ix. **Database of Animal Genetic Resources**

The proposed project aims to develop a national database and subsequently geographical information system on various aspects of animal resources and related technologies. A detailed and comprehensive database has become essential on a single platform, since many agencies and institutions are generating the data, and this leads to incompatibility and delay in dissemination processes if it is maintained at different sites. By the end of the proposed project, the user agencies can effectively utilize the central data information through the Internet and other modes of information dissemination.

x. **Database of Fish Genetic Resources**

The proposed project envisages digitization of database on all related aspects of fish genetic resources and technologies involved. Till now the information generated by different agencies and organizations on conventional mode are facing difficulties in information dissemination due to incompatibility. The proposed project is aimed to digitize the comprehensive fish genetic information on single platform and it will ease the dissemination of fish genetic information to the user agencies at a faster rate.

xi. **Database on Socio-Economic Resources**

The Centre's mandate of policy research, policy interfacing and agricultural economics research capacity strengthening in NARS underlines the importance of policy interventions in shaping our Indian agriculture. To be futuristic, forward looking and proactive to face emerging issues and anticipate future challenges, NARS has to be responsive to the dynamic situations and needs. Policy research has a key role to influence the management of Indian agriculture. Comprehensive database covering socioeconomic aspects of agriculture is the felt need by multiple stakeholders. Development of socioeconomic database is the assigned responsibility for NCAP under the INARIS Project. The key feature of NATP is to improve the overall efficiency of agricultural technology management process encompassing generation, assessment, refinement and dissemination of technologies. Agro-ecosystem and production system based existing, prospective and potential agricultural technologies are to be targeted and designed in tune with current and future needs, resources and opportunities. PME and Impact Assessment are to be integrated within each project cycle to continuously orient the ongoing agricultural technology management process demand driven, client oriented and need based. Effective implementation and sustaining of this philosophy of NATP right from project designing, prioritization to impact assessment rests on the continuous and readily usable database support at every production system and agro-ecosystem level both during and beyond the implementation of NATP. Central Data Warehouse facility comprehensively covering agriculture related databases, implemented in a mission mode project has potentially vital supporting links cutting across production/agro-ecosystems; TOE/MM/PSR modes; and PME/Impact Assessments. The expected outputs from this Central Data Warehouse support Production System Research in programme mode cross cutting research in Mission Mode and strategic research in Teams of Excellence mode and more importantly PME & Impact Assessment during implementation phase. The proposed database generation and digitization activity is, therefore, a necessary condition for supporting and exploiting the new agricultural technology management initiatives targeted under NATP. Furthermore, by avoiding duplication of similar data generation and management activities by different researchers and institutions, the expected output from this INARIS project will result in efficient use of scarce research resources in the entire process of agricultural technology management during and beyond NATP implementation phase. The underlying assumption of the proposal is three fold; Multiple agency level support in providing existing database for further integration and digitization, Collaborating Institutional level support for the integration and digitization of existing and augmented data base and finally, continuous support to the initial and add-on phases for updating and extending the coverage to represent all the identified production systems across space and time. The overall objectives of the socioeconomic database development proposal are two-fold; (I) to collate, augment and digitize the finalized socioeconomic database by gap filling, extending the spatial and

temporal coverage and expanding the data coverage from multiple institutions and agencies; and (ii) to facilitate the integration of socioeconomic data base with agriculture and bio-physical database in a digitized, usable and exchangeable format.

#### xii. **Database on Agroforestry Resources**

A search of the relevant literature revealed that a number of databases are available abroad pertaining to forestry, to mention a few TREEBASE, FORESTWORLD, SMARATFOREST, PROSPECT etc. and a comparable number of databases are available for individual crops viz. SOYBASE, SINGANE, PEARSCAB etc., but there is virtually no database available in agro forestry barring one or two bibliographic database developed at ICRAF. In India there seems to be practically no database recently available on agroforestry/forestry. This calls for the utmost need to have a database on agroforestry. The proposed project is viewed to strengthen the information system conceptualized by ICAR.

#### xiii. **Database on Agricultural Mechanization**

The proposed project envisages digitization of database on all related aspects of farm mechanization and technologies involved. Till now the information generated by different agencies and organizations on this area are scattered and facing difficulties in information dissemination due to incompatibility. The proposed project is aimed to digitize the comprehensive farm mechanization in different parts of the country on single platform and it will ease the dissemination and planning resources in this aspect.

### **4. Review of Literature**

#### **i. Database Management Systems**

Many developed countries who are already ahead of the developing countries in creation of natural resource database have been successfully employing advance GIS and computerized system. The reason being to keep pace with the increasing and changing demands of the research workers, experiments, developmental agencies and most importantly the actual worker- the farmer community. This also contributes in changing the economic and environmental scenario of their respective countries. Apart from developing databases and information systems using the modern software tools like GIS, RDBMS and MIS they are also linking the databases and information systems to several bodies including the administrative and civil cells providing wide range of applications like planning different environmental and agricultural projects. In India also, the awareness and utilization of technology in the field of Natural Resource Management System involving GIS technology, other software tools like RDBMS and MIS is growing rapidly. Several premier institutes and government bodies are already engaged in doing the work using GIS and other latest technologies. In IASRI, some work has already been done and much more work in this respect is in progress using different information systems like GIS, MIS, etc. Remote sensing satellite data has been used for improvement on crop yield estimation. Some projects are underway for developing land use statistics with the use of GIS. IASRI has also been engaged in developing different kind of databases time to time and also information systems for different target users. Some of the information systems developed includes NISAGE (National Information System for Agriculture Education), ARDIS (Agriculture Research Data Information System), IRIS (Inventory Research Information System). Along with developing the databases and information systems the Institute is now, working on linking these databases and information systems to the modern electronic communication media like creating websites, INTERNET, E-mail, etc. which is going to be very helpful for the research people, experimenters, developers, other organizations and to a certain extent – the actual worker i.e. farmer. Further the institute is working towards interlinking all the existing and newly developed databases and information system with the GIS bases database with the help of data

warehouse i.e. INARIS.

## ii. **Database on Plantation Crops**

Digitization of collections are usually initiated due to one or more of the following reasons:

- a. To make the collection available on the Internet.
- b. To simplify the handling of the data
- c. To preserve the collection

The three main application areas usually have different requirements to the quality of the collection on digital form. To make a collection available via Internet, one should minimize the amount of data to be transferred to the end user, and consequently a low or medium quality will often be accepted to obtain rapid access. When the objective is to simplify the handling of the collection, the digital format must have a quality high enough for normal use. When a collection digitized for preparation, the quality of the digital format must be high enough to represent all the relevant details that may be found in the original objects. Not much information is available on digitization. The search made in the Internet gave few references mainly concerned with digitization of Libraries and other general aspects. In India, not much work has been done especially in the Agriculture sector. The beginning has been done in NBSS & LUP, Nagpur as an Institute Project.

## iii. **Database on Spices**

In spite of India being a major producer in the field of horticultural crops in general and spice crops in particular, the available database is very weak and does not provide any support for developmental strategies. Strengthening the database on area, production, productivity and production of spice crops both for impact assessment and interventions needs a major thrust. At present, there is no project/scheme, which may be able to provide National estimates of area, production and productivity on various spice crops. Directorate of Economics and Statistics is the only source of reliable data on area and production in spices, though also the number of crops covered is limited. Reliable export and import data and its value are being provided by DGCI&S, Calcutta through their periodical publications. Directorate of cocoa, arecanut and spices development under Ministry of Agriculture, Govt. Of India is publishing spice statistics since 1983. The first printed version of the statistical book covering the period of 1970-1983 was published in 1985. Data have been updated and graphical representations added for easy comparisons. Since then every year the book is being published. However, the available data is limited to area, production, productivity, export and prices etc. Annual and periodical publications such as: Spice Statistics, Spice Export Review and Spice Market (weekly) are the regular publications from Spice Board, Ministry of Commerce, Government of India. Data in these publications emphasize more on commerce and trade. Production trend, export direction, exported quantity, domestic and international prices and their movements' etc. were given. Spices Board's offices all over the growing regions in the country enable the organization to collect valuable price information and arrival data etc. However, the information given by Spice Board does not provide the cost aspects involved in both production and marketing. One of the functions of the erstwhile 'Cardamom Board' as stipulated in the cardamom Act. 1965 was to collect, compile and publish statistics relating to cardamom industry. Since its inception in the year 1966, till it became the 'Spices Board' it has been collecting statistical information on various aspects of cardamom industry covering area, production, auction sales, prices, export etc. Large cardamom was also covered. The International Pepper Community (IPC) has played a significant role in collection and dissemination of information by starting a series of 'Pepper Statistics' and 'Pepper Statistical Year Books' since 1980. However, as every one in the IPC and its Secretariat would acknowledge, there is still scope for further improvement. Bade and Smit (1991) has outlined

many shortcomings in available data on pepper.

- Data on area and production does not provide information on density of vines. Age structure, information on cultural practices, cost of production, disease incidence etc.
- Data on area and production does not provide information on density of vines. Age structure, information on cultural practices, cost of production, disease incidence etc.
- Farm gate prices are not available.
- Lack of information on post-harvest practices including storage
- The available trade data does not provide detailed components, only aggregates are provided.

Food and Agriculture Organization (FAO)'s Yearbooks, UNCTAD publications, and communication from Commonwealth Secretariat are other sources of statistical information on spices. However, the type of data available through these sources cannot be used to make micro level analysis, which can help in changing farm level policy measures. Moreover, all the information is available in printed hard copies only. Digitization can help in pooling the entire source at one place and can be accessed by all needy persons. Indian Institute of Spices Research, Calicut is trying to create a database as one of the objectives in all ongoing projects. All available information is digitized in piece i.e. by various sections in the institute. A separate database for the 'gene bank' in the Institute is created and put into use. Published secondary data on socio-economic and trade aspects are collected and are being digitized separately. But, there is no uniformity in individual databases, which can enable inter linking

#### iv. **Database on Horticultural Crops**

Wide-ranging Indian climatic conditions are well suited for boosting production of a variety of horticultural crops (fruits, vegetables, flower/ornamental/medicinal and aromatic crops) presently hold appreciable position in global scenario. But the available information on this aspect is scattered and the database is very weak and does not provide any support for developmental strategies. Strengthening the database on geographical area, production and productivity of the various horticultural crops for the nation's interest. In several advanced countries database on horticulture have been created and play a dominant role in the economy of those countries. Under various projects Indian Institute of Horticultural Research (IIHR) had generated database at different locations and thus it is difficult to get comprehensive information in ordered manner. However, the type of data available through these sources cannot be used to make micro-level analysis, which can help in changing farm level policy measures. The digitization of all horticultural crops data and geographical spread and related technologies can help in pooling the entire source at one place and can be disseminated to all needy agencies at a faster pace.

#### v. **Database on Cropping System**

According to 1992-93 land use statistics, reporting area for the country is 305 million hectares, which is 92.8% of total geographical area. Total cultivable area in the country is 60% of the reporting area. The gross sown area is about 1% more than total cultivable area for the country as a whole. Further, gross irrigated area of the country is 36% of the gross sown area. Food grains cultivation formed 70% of total cropped area, consisting of 57% under cereals and 13% under pulses. Among the cereals, the share of rice and wheat is 23% and 13% respectively. But the exact information on land use statistics of prevalent cropping systems is lacking. Moreover, the cropping system remain dynamic in time and from time to time, major cropping systems zone have been delineated by approximation through available area estimates under different cropping systems. Gill (1994) has raised issues related to rice-wheat production systems. Yadav et. al. (1998) have identified 30 important pre-dominant cropping systems in India but information on exact area under these systems have been

lacking. In coastal co-systems different cropping systems like rice-rice-cassava, coconut-tubercrop-coconut-banana and cassava-pulses etc. have been reported by Sarkar and Gangwar (1998). Under irrigated ecosystem, soybean-wheat has been identified as important cropping system. Pigeonpea-wheat system has already been spread to non-traditional areas in Northern Indian (Sandhu et. al. 1973). However, comprehensive study on areas production and productivity of different cropping systems have not been undertaken in different agro-eco-regions which would be taken in the present project proposal and a database base will be developed.

#### vi. **Database on Climatic Resources**

In India, rainfall is highly seasonal in character and most parts of the country receive 75 to 90 percent of the annual rainfall due to Southwest monsoon during June 10 to September. There is considerable yearly variability in the dates of commencement and withdrawal of southwest monsoon. A number of relationships have been marked out between seasonal rainfall parameters (amount, duration and average rainfall per day) and date of onset of monsoon to develop response-farming strategies at a seasonally arid location in India. Two kinds of predictions are available from national meteorological services on (i) seasonal rainfall on all India basis for the southwest monsoon season, and (ii) the onset of monsoon over Kerala coast. The advancement of southwest monsoon is also closely monitored after the onset. However, the all India forecast of southwest monsoon rainfall is valid for limited areas in the country. Incorporation of the long range forecast of seasonal rainfall can be useful for developing response farming strategies for those areas with considerable variability in the start of the monsoon. Therefore, an attempt was made to identify the set of the criteria to define the areas. For this purpose, the monthly rainfall data recorded during the year 1871 to 1994 in 29 meteorological sub-divisions were analyzed to find the relationships between the mean monthly rainfall, and (i) lowest amount of rainfall received during the months of June to September, (ii) the highest amount of rainfall during the months of June to September, and (iii) the probability for the monthly rainfall to be equal to or greater than the potential evapotranspiration during June to September. Very high correlation was noticed between the mean monthly rainfall and the lowest amounts of rainfall received during June. The relationship between the mean monthly rainfall and the highest amount of rainfall recorded during the months of June to September revealed that the highest amounts of rainfall received during the months of June and July are highly correlated with mean monthly rainfall. Thus, it is obvious that the rainfall was more erratic during the months of August and September in different meteorological sub-divisions. The rainfall exceeded potential evapotranspiration with more than 90, 75 and 50 percent probabilities wherever the mean monthly rainfall was more than 240, 190 mm & 150mm. In the regions with the mean monthly rainfall less than 90mm, the monthly rainfall rarely exceeded potential with mean monthly rainfall ranging from 90 to 19mm during the starting months of rainy season. The Institute has been implementing GIS facilities for creation of digital information on climatic parameters, like rainfall and other parameters such as irrigation and socio-economic variables for about 1104 mandals of Andhra Pradesh with an objective for developing and targeting technologies as for resource capabilities of each mandal. In this perspective it is necessary to develop spatial climatic information system at national level for overall agricultural development. This assumes importance as climatic database is generally not developed and made available at single platform for various user agencies, planner and policy makers.

#### vii. **Database on Water Resources**

National Water Policy (1987) statement has dwelt upon the urgency of strengthening the database on different aspects of water resources. Lack of proper documentation of data and its availability to intended users has been identified as a major lacuna that hinders the analytical process involved in decision making by planners, technocrats and field officials. Utility of such database is indicated in maximizing availability of water, modernization of

irrigation works, evolving water allocation priorities, fund allocation, water pricing, energy management and numerous other domains. Since 1950-51, the country has made high investments in developing water resources; the state expenditure on creation of the irrigation potential is reportedly Rs. 80,000 to Rs.1x105. Ultimate irrigation potential of the country is estimated to be 138.1 m ha. CWC report (1998) indicates that 89.7 m ha potential has been created by 1997 (provisional estimate). According to Ministry of Agriculture, irrigated area is 48.8 m ha. Thus the gap between potential created and utilized is 40.9 m ha. In other words, 46% of the investment is not being utilized. Ground water development in the country is highly skewed. The states of Punjab and Haryana have developed 98% of the ground water resources whereas eastern part of the country comprising of states like Bihar, Assam, West Bengal and North Eastern States have exploited only 10 per cent of the ground water resources. Gupta et al. (1994) prepared the ground water quality map of India. They opined that utilization of brackish and poor quality resources database is essential for planning its use. Non-utilization of these waters is leading to several problems like soil salinization, water logging etc. Tyagi et. al. (1993) studied regional water balance and proposed model to generate scenario for varied policy alternatives in different irrigation commands. Likewise, other researchers have developed decision making models state agencies have utilized these models and extensive database would help in refining, validating and evaluating different propositions and better management of irrigation systems. Effectiveness of improved water management practices in improving crop yields and water use efficiency has been demonstrated in ICAR MOWR collaborative project on on-farm water management. Since on-farm management has a strong interface with the irrigation system management, integrated water management research at farm and systems level has been planned by involving centers of AICRP in water management located in various irrigation commands in the country. The major issues at the system level are water supply augmentation and operational flexibility to make the system more responsive to water demand. This will revise diagnosis of hydraulic and operational performance of the irrigation system for developing appropriate interventions and strategies and for evolving farmer's participatory management models at irrigation systems level. Under this theme, collection of relevant data viz. Design of canal system, operation schedules, historical data, operational policies, etc. and total information about the command with respect to topography, soils, cropping pattern, socio-economic constraints, physical constraints, ground water potential has been planned. Information on the above parameters will be generated and digitized as a part of gigantic National Agricultural Technology Project (NATP) on "Digitization of Database for Natural Resource Management".

#### viii. **Database on Soil Resources**

'Land Information System' (LIS) encompasses wide range of information on land parameters at a zone/region/country. The base of land information system is a uniform spatial referencing system for the data in the system, which also facilitates linking the data within the system with other land related data. In recent times, LIS has been viewed as combination of human and technical resources together with a set of organizing procedures, which result in collection, storage, retrieval and dissemination along with the use of information in a systematic manner (Dale, 1991). The first meeting on soil information system was held in 1975 under the commission V of the International Society of Soil Science. Thereafter the expert group had discussion in Australia in 1976, Bulgaria in 1977, Paris in 1981 and Norway in 1983. Amongst fore runner in the natural resource database, USA, Canada and Australia have been successfully employing advance GIS and computerized system. The U.S. Development of Agriculture under the Soil Conservation Service (SCS) has established three soil geographical databases at three levels. These are survey unit, the state and the nation. The Australian Resources Information System (ARIS) developed by CSIRO has data sets linked to administrative and grid cell mapping units, providing wide range of applications. The system permits linking of soil-vegetation combination to other attributes of geographical location. In Canada the Geographical Information System (CGIS) and Canadian Soil Information System (Can SIS) are developed by the government agencies for planning of

environmental and agricultural projects. Soil being the one of prime components of nature the attempt on creation of information system on this database is obvious. Database management system for land use, bio-diversity and water resources is also being developed in many countries. A knowledge based software programme for structured storage and retrieval of user-defined land use data sets has been developed at the ITC, The Netherlands (Bie et al. 1996). On a global scale, world soils and terrain digital database (SOTER) program has been initiated by the International Society of Soil Science (ISSS) on 1:1 million scale and world soil degradation on 1:10 million scale map inputs. Soils and terrain digital database have already been accomplished for Argentina, Uruguay and Brazil. The work in the field of Natural Resource Management System evolving GIS technology is at a nascent stage though the awareness and utilization of technology is growing rapidly. In India, several general purpose as well as specific task oriented systems has been developed over the years. Way back in 1976, the town and country planning organization of the ministry of Housing, Govt. Of India made an attempt to evolve an operational framework for establishment of Urban and Regional Information System (URIS). The Department of Science and Technology has conceptualized the Natural Resource Database Management System (NRDMS) integrating demography, infrastructure, agro-economic and social database to aid in systematic development at district level. The Regional Remote Sensing Application Centers of Dept. Of Space, Govt. of India are poised for development of Indian Geographic Information System (INGIS). The Department of Environment established Environment Information System (ENVIS).

ix. **Database on Plant Genetic Resources**

Under various projects of the institute, information on plant genetic resources are generated at different locations and thus it is difficult to get comprehensive information in ordered manner. However, the type of data available through these sources cannot be used to make micro-level analysis, which can help in changing policy measures. The digitization and creation of database in this field is already initiated in institute but this needs to be combined with other related resources and geographical spread and related technologies can help in pooling the entire source at one place, which can be disseminated to all needy agencies at a faster pace.

x. **Database on Animal Genetic Resources**

The Indian sub-continent is known for its rich biodiversity. The animal genetic resources of India are represented by a broad spectrum of native breeds of cattle, buffaloes, goats, sheep, swine, equines, camels and poultry. In addition to these animals, yak, mithun, geese, ducks, quails and pet animals are also part of our genetic resources. As early as 1938, Royal Commission on Agriculture had emphasized the need for the conservation of quality indigenous animal germplasm. It was advocated that systematic resource on various livestock breeds were essential for their planned growth and sustainable utilization. With the emergence of crossbreed population of cattle, sheep and other livestock, several traditionally reared indigenous breeds have gradually started losing ground. Some of the native breeds have suffered genetic erosion with a steep decline in the population. The NBAGR has set up a fully operational database unit on indigenous farm livestock genetic resources, which is being continuously upgraded and enlarged in its scope, and content and also in number of databases. The institute is being working in identification, evaluation, characterization, conservation and utilization of livestock and poultry genetic resources of the country.

xi. **Database on Fish Genetic Resources**

While building the NBFGR's Indian finfish database various difficulties were faced due to various inventory procedures and extensive taxonomic disparities available in the literature. Some of them were solved through linkages. The World Bank technical report on fresh water

fish biodiversity (Kottelat and Whitten, 1996) has clearly stated that Indian fish taxonomy suffers from extensive literature not evaluated significantly. So the training in inventory and taxonomy will result in better quality of data. In addition to the NBFGR's fish database, some other databases are also available viz. ICLARM fishbase, reefbase, California Academy of Science, Catalogue of fishes. But they are also lacking more valuable information on biology, micro distribution etc. These databases cover the fishes of the World. Database is also essential and utilized in various in situ and ex situ conservation programmes. The development of fish database is also essential to meet India's obligation under CBD. The British Columbia Fishery, Canada has already prepared digital watershed for arranging fish distribution and physical habitat data. Under BC Fishery System each watershed area has got unique 45-digit code on which information of fish is spatially arranged. The NBFGR, Lucknow has done detailed physical habitat inventory for two rivers (Ladhiya and Kosi) for which all the information is spatially arranged on GIS map. Lot of information on water bodies is existing in conventional as well as digital maps with different organizations are as follows:

- The Survey of India is having toposheet maps at 1:25,000; 1:50,000; 1:250,000 and 1:1 million scale for whole of India. The 1:2,50,000 scale maps are available in digital form also.
- The National Remote Sensing Agency is having satellite imagery of whole India at different time scale.
- The forest survey of India is having maps of forest resource of India at 1:2,50,000 scale at different time scale (2 year interval).
- The All India Soil Survey and Land use is having watershed map of India at 1:1 million scale with each watershed area coded. The digital watershed map is under preparation.
- The National Atlas Thematic Mapping Organization has prepared drainage and watershed resource map of India at the scale of 1:6M.

#### xii. **Database on Socio-economic Resources**

The existing data digitization activity compiled under World Bank supported Sustainable Rain fed Agriculture Development project covers district level agricultural, population, and selected infrastructure, physical and agro ecological statistics from 13 states. The existing data gaps and continuous updating of this database will be targeted. Additionally more socio-economic database, presently collected by multiple institutions/agencies at national and state level like Department of Economics and Statistics, Central Statistical Organization, Fertilizer Association of India, Planning Commission, Ministry of water resources and Central ground water board will be covered in the data base digitization. More significantly, the project would target representative farm households in different production and agro-ecosystems for continuous monitoring and documentation of the interactions between resources, technologies, institutions and policies at both individual and aggregate farm household levels. Multiple production and resource use impacts of the technologies at farm household level will be documented for feeding into PME and Impact Assessment studies. Integration of agricultural and socio-economic database with bio-physical database will facilitate upscaling or downscaling of technology intervention experiences to feed into the ongoing as well as future designing of Production System Research programs.

#### xiii. **Database on Agroforestry Resources**

The Agroforestry unit ,IGFRI , Jhansi has taken significant strides to develop various models of agro-forestry systems both on-station and on-farm research so that one could be in position to establish an agroforestry system as per needs in a specific agro ecological region. The demand of the day in to promote biomass productivity per unit area per unit time of the arable as well as wasteland for boosting the economic status of farmers so that they could be self dependent for their daily basic needs of food, fodder, fuel wood and timber. The diagnostic and design survey was conducted by most of the centers under All India Coordinated Research Project. Integration of Prunus, Grewia and Morus with agricultural

crops like soybean, blackgram and vegetables under agri-silvi-horticulture system was found popular among the farmers in Solan. Silvi-horticulture system in which pineapple in cultivated in association of *Eucalyptus citriodora*, *E. Teriticornis*, *Leucaena leucocephala* and *Parkia roxburghii* in Manipur. Intercropping of turmeric in plantation of *Areca cateche* is quite popular and maximum yield (201.5 q/ha) of fresh rhizome has been recorded in Assam. The silvipastoral studies conducted at NDUAT, Faizabad revealed that grasses viz., *Pennisetum purpureum*, *Brachiaria mutica* and *Cenchrus ciliaris* planted in association with *Dalbergia Sissoo* performed well on saline sodic soil. The centre has collected 20 germplasm of *Madhuca indica* and *M. Africana* that are being evaluated for their morphological attributes. *Leucaena leucocephala*, *Albizia procera*, *Dalbergia sissoo*, *Azadirachta indica* and *Eucalyptus tereticornis* were rated as promising species on nutrient poor sandy soil of Pusa (Bihar). Studies conducted at PAU, Ludhiana indicated that wheat yield was reduced due to popular in agrisilviculture system. The reduction in yield was only 17% in 5x10 m spacing while it was 59% in 5x4 m spacing. Studies conducted at Hissar indicated that *D. sissoo* at 10x10 m spacing caused insignificant reduction in grain yield of sorghum and wheat. However, the fodder yield of sorghum and cowpea was increased by 10 per cent. Vam fungus *Glomus mosseal* inoculation in *Acacia nilotica* increased biomass by 65 per cent in seedling stage. *Eucalyptus* and poplar attained maximum height, girth and biomass in 6 years when grown with rice wheat/guinea grass-oat and rice-berseem/cowpea-berseem sequence at Karnal. A comparative study on tree growth revealed that *Prosopis juliflora* attained 3 m height in 12 months while *Acacia nilotica* attained 2.5 m in that period. Study on rice based agrisilvicultural system revealed that *Casuarina equisetifolia* reduced the yield. The grain yield of sole rice was 30.83 q/ha while the yield was reduced to 27.83 q/ha in combination with *casuarina* in Konkan region. The application leaf extract of *Terminalia tomentosa* increased the yield of rice by 3 q/ha. The yield of red gram grown in association of teak planted in 5x2 m spacing was increased. *Eucalyptus* showed faster growth followed by neem than that of *sissoo* and teak.

#### xiv. **Database on Farm Mechanization**

Digitization of collections are usually initiated due to one or more of the following reasons:

- To make the collection available on the Internet
- To simplify the handling of the data
- To preserve the collection

The three main application areas usually have different requirements to the quality of the collection on digital form. To make a collection available via Internet, one should minimize the amount of data to be transferred to the end user, and consequently a low or medium quality will often be accepted to obtain rapid access. When the objective is to simplify the handling of the collection, the digital format must have a quality high enough for normal use. When a collection is digitized for preparation, the quality of the digital format must be high enough to represent all the relevant details that may be found in the original objects. Not much information is available on digitization. The search made in the Internet gave few references mainly concerned with digitization of Libraries and other general aspects. In India, not much work has been done especially in the Agriculture sector.

## 5. **Existing Data sources**

There are many databases available at various centers. The existing data bases on plantation crops maintained at CPCRI include:

### i. **Database on plantation crops statistics**

CPCRI developed a menu-driven database (STATSOFT v.1.2 Oct '95) on plantation crops and

spices viz. coconut, arecanut, cardamom, cashew, cocoa, coffee, ginger, pepper, oil palm, tea, turmeric, and rubber. This database covers various parameters like area, production, yield, export and import (quantity and value) for world, country wise and various states/districts of India. The data can be retrieved on latest year, over a period and whole period given in the database. This database provides information up to 1998-99.

## **ii. Coconut Genetic Resource Database (CGRD)**

In the CGRD data about coconut cultivars are divided in two main parts: passport data and priority characterization, and evaluation data. It takes into account the IPGRI descriptors of the coconut palms and the methods detailed in the STANTECH Manual. The data the CGRD contains passport and characterization data of 1316 accessions conserved in 25 sites in 18 countries. The CGRD project was initiated in 1994. The project is funded by the French Government and implemented by the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) in collaboration with COGENT member countries. The software CGRD is upgraded periodically. Its objective is to facilitate data storage and exchange among the members of the COGENT network. This will enable coconut breeders to access the latest data on coconut cultivars.

## **iii. Coconut descriptors**

CPCRI published Coconut descriptors Part I and Part II. Coconut descriptors Part- I (in print media) describe 48 accessions (exotic and indigenous) as per IPGRI minimal list of descriptors supported by relevant data and figures. The accessions were catalogued based on 13 vegetative, 21 reproductive, 20 nut and 2 biochemical characters. The text covers Accession data, plant morphology, reproductive biology, harvest data, fruit characteristics and biochemical traits. The Part-II of the descriptor is in electronic media. It has description on 26 cultivars (20 exotic and 6 indigenous). Besides the above, various research and developmental institutes are maintaining web sites, which provides information on different aspects of the plantation crops. These sites will function as a source of data. The Food and Agricultural Organisation maintains the web site [www.fao.org](http://www.fao.org), which provides production statistics as well as research data. The web site [www.kar.nic.in/cashew](http://www.kar.nic.in/cashew), maintained by National Research Centre for Cashew (NRCC) Puthur is a good database on cashew. The web site of National Research Centre on Oil Palm (NRCOP) Pedavegi, [www.ap.nic.in/nrcop](http://www.ap.nic.in/nrcop) gives a good account on Oil Palm. Kerala Agricultural University's web site, [www.kau.edu](http://www.kau.edu) provides data on research and institutions engaged on research activities. The web site of CGIAR ([www.ipgri.cgiar.org](http://www.ipgri.cgiar.org)) is another comprehensive database on coconut genetic resources. The Asian and Pacific Coconut Committee maintain the web site [www.apcc.org.sg](http://www.apcc.org.sg) with a lot of authentic information on coconut. The co-operative giant Campco's web site [www.campco.org](http://www.campco.org) provides data information on cocoa and arecanut. The Coconut Development Board's web site [www.coconutboard.nic.in](http://www.coconutboard.nic.in) is another authentic data source. The Malaysian Cocoa Board has a web site [www.koko.gov.my](http://www.koko.gov.my), which depicts various aspects on cocoa. The Existing databases on water resources include Data on water resources are scattered in different sources in different forms. It includes both printed material and electronic version. A number of national and international organizations and institutes collect, collate and publish water resources data. Brief description of data sources is given below:

### **Printed Material**

- Water and Related Statistics – 2000, Central Water Commission, New Delhi.
- Ground Water Resources of India-1998, Central Ground Water Board, New Delhi.
- Pricing of Water in Public System in India –1999, Central Water Commission, New Delhi.
- Report of the Second Bihar State Irrigation Commission-1994.
- Publications of different NGOs.

- Indian Agricultural Statistics, Vol I and II – All India, State – wise and District – wise 1992 – 1993, Directorate of Economics & Statistics, Govt. of India, New Delhi.
- Indian Agriculture in Brief, 27th Ed. – 2000, Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India, New Delhi.
- Agricultural Statistics at a Glance-2000, Directorate of Economics & Statistics, Govt. of India.
- Compendium of Environment Statistics – 1999, Central Statistical Organization, Govt. of India.
- Data Book on Mechanization and Agro-Processing Since Independence-1997, CIAE, Bhopal.
- Publications of Department of Agriculture/ Water Resources/Irrigation of State Governments.
- Report on Census of Minor Irrigation Schemes-93/94, Part-I through Part-VI.
- mAnnual progress reports of various ICAR institutes and AICRP centers.

#### **iv. Electronic- databases/Information system**

Data on water resources and related components are available in different institutions in spreadsheet (namely Lotus 1-2-3, Excel etc), in database software (like dbase, FoxPro etc) in RDBMS (like Access, Oracle etc) or in custom-made software. These are in bits and pieces. There is a need to integrate and consolidate the databases.

#### **v. Internet resources**

Following sites provide important information about water. However, except NIC site no site provides data on water resources of India.

- Victorian water resources data warehouse: <http://www.vicwaterdata.net>
- Water Portal of UNESCO: <http://www.unesco.org/water>
- USDA ARS Water Database : <http://hydrolab.arsusda.gov>
- NIC database: <http://gist.ap.nic.in>

#### **vi. The Databases existing at NBSSLUP, Nagpur include:**

Soil maps of SRM (Soil Resource Mapping) project on 1:250,000 scale for all states and their attribute databases are existing in the Institute. Respective SPC's (Sub Project Coordinator) of SRM projects at state level are the repository of the datasets.

The Data Sources of the Databases existing at NBAGR, KARNAL include:

- State Animal Husbandry Department:
  - Statistical Abstracts
  - Statistical Bulletins
  - Integrated Sample Survey Reports
  - Other reports
- Directorate of Economics and Statistics:
  - Livestock Population
- National Accounts Statistics, CSO, Department of Statistics:
  - Value of output from livestock sector
- Department of Animal Husbandry:
  - Farms
  - Other infrastructure
- Ministry of Commerce:
  - Import/ Export of animals/ Germplasm
- Literature:
  - Journals
  - Annual Reports

- Books – Dairy India

**Existing data sources on Fish Genetic Resources include:**

Lot of information on water bodies exists in conventional as well as digital maps with different organisations as follows:

- The Survey of India is having toposheet maps at 1:25,000; 1:50,000; 1:25,000 and 1:1 million scale for whole of India. The 1:2,50,000 scale maps are available in digital form also.
- The National Remote Sensing Agency is having satellite imagery of whole India at different time scale.
- The forest survey of India is having maps of forest resource of India at 1:2,50,000 scale at different time scale (2 year interval).
- The All India Soil Survey and Landuse is having watershed map of India at 1:1 million scale with each watershed area coded. The digital watershed map is under preparation.
- The National Atlas Thematic Mapping Organisation has prepared drainage and watershed resource map of India at the scale of 1:6 M.
- The ICAR has made map of different agroclimatic zones of India, which is more concerned with agricultural crops.

**vii. The available databases on forestry includes:**

- Databases in forestry (trees)
  - FORESTWORLD
  - TREEBASE
  - SMARTFOREST
  - PROSPECT
- Databases in agriculture (crops)
  - SOYBASE
  - SINGANE
  - PEARSCAB
  - Plant Genome Databases
  - USDA Maize Database
- Databases in agroforestry
  - AFT database of ICRAF (International Centre for Research in Agroforestry, Nairobi, Kenya) - bibliographic one

**\* NO DATABASE is currently available on agroforestry in India.**

However, recently (February, 2001) Indian Forester, Dehradun introduced an encyclopedic forestry database on aspects of forests and forestry in India. The Indian Forester Information System (IFIS) is a CD-ROM based package that encompasses the wealth of research published in Indian Forester since its inception (1875). This application package enables the user to search related topics based on multiple keywords as well as on authors. The various data sources identified for the current project include:

- National Research Centre for Agroforestry, Jhansi
- Centres of AICRP-AF (25 SAU's & 10 ICAR Institutes- List attached - annexure)
- Research Centres of ICFRE (Indian Council of Forestry Research & Education)
- ICAR Institutes viz IGFRI, CRIDA, CAZRI, CWCR&TI, CSSRI, CARI
- ICAR Research Complex for NEH region
- Kerala Forestry Research Institute, Peechi, Trichur
- IFGTB, Coimbatore

- i. Forest College and Research Institute, Mettupalayam, Coimbatore
- j. BAIF, Pune

- **State Forest Departments:**

It was decided that priority has to be given to the six tree species identified by Planning Commission Report "Report of Task Force on Greening India for Livelihood security and Sustainable Development" – Planning Commission – Government of India, July- 2001 (Agroforestry Promotion pp 158-159). These species are namely Polplar deltoids (irrigated ecosystem), Eucalyptus species (irrigated/water logged ecosystem, Casurina equisetifolia (coastal ecosystem), Acacia nilotica (rainfed ecosystem), Prosopis cineraria (arid ecosystem) and Bamboo species (humid tropics ecosystem). These six tree species are common in most agro climatic regions and have been chosen by Planning Commission on the following counts; indigenous and highly adapted in farming system, short cycle of harvest and multipurpose nature, industrial value and market potential. It was decided by the house to initially collect and feed comprehensive nation wide secondary data only on these six species and if the time permits and sufficient data and information are available, other species may be considered.

- **Existing Database at CIAE, Bhopal:**

- A computerized database has been developed at Central Institute of Agricultural Engineering, Bhopal for accessing information on 126 equipment and technologies.
- Farm Machinery Research Digest. Published by AICRP on Farm Implements and Machinery, CIAE, Bhopal (1997).

## 6. **Proposed Databases**

Based on the proceedings of the Requirement Analysis Workshop held during 8th to 10th January 2002, various databases were recommended and finalized for each center which include databases on Plantation Crops, Spices Resources, Horticultural Crops, Cropping System, Climatic Resources, Water Resources, Soil Resources, Plant Genetic Resources, Plant Genetic Resources, Plant Genetic Resources, Socio-Economic Resources, Agroforestry Resources and Agricultural Mechanization. The data structures for each of the above databases are mentioned below. Data-fields, data-types, frequency of updating, period of availability, gaps in data storage levels, geographic coverage etc., for each of the parameters in the above databases are designated. This will form the basis for the creation and population of various databases.