

PERSPECTIVE PLAN

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A perspective plan for developing new technologies and practices should be prepared keeping in view our targetted food production of 225 - 240 million tonnes as well as targets in allied fields like fisheries, horticulture, animal husbandry etc. by the end of this century. Due emphasis should be given on dryland farming, oilseeds and pulses while preparing this Plan.

PERSPECTIVE PLAN

1. PREAMBLE

- 1.1 The major mandate of the Council is to plan, undertake, aid, promote and coordinate agricultural, animal husbandry and fisheries education, research and its application through promotion of transfer of technology.
- 1.2 Researches in agricultural sciences during the last 3 decades have given the nation required confidence to not only meet our major foodgrain requirements, but also future challenges of producing 225-245 million tonnes of foodgrains by the year 2000 A.D., and also to meet our necessary requirements of allied products to meet the national needs. Improvements in crop plants, through the concerted efforts of the inter-disciplinary teams of scientists, have enabled our country to attain self-sufficiency in a number of crops such as sugarcane, potato, cotton, wheat, tobacco, jute etc. Achievements in the fields of plant breeding, crop management, plant protection, seed production technology, horticulture, animal husbandry and fisheries had been spectacular as evident from the data in Table-1.

Table 1 : Production of principal crops and livestock products

| Crop | Unit | 1950-51 | 1986-87 |
|-------------------------|----------------|-------------|--------------|
| Rice | Million tonnes | 20.6 | 60.4 |
| Wheat | Million tonnes | 6.5 | 45.5 |
| Sorghum | Million tonnes | 5.5 | 8.9 |
| Maize | Million tonnes | 1.7 | 7.4 |
| Total cereals | Million tonnes | 42.4 | 132.3 |
| Chickpea (gram) | Million tonnes | 3.6 | 4.4 |
| Pigeonpea (arhar) | Million tonnes | 1.7 | 2.3 |
| Total Pulses | Million tonnes | 8.4 | 11.7 |
| Total Foodgrains | Million tonnes | 50.8 | 144.0 |

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Table - 1 (Contd)

| Crop | Unit | 1950-51 | 1986-87 |
|----------------|----------------|---------|---------|
| Groundnut | Million tonnes | 3.5 | 6.0 |
| Mustard | Million tonnes | 0.8 | 2.6 |
| Total oilseeds | Million tonnes | 5.2 | 11.4 |
| Cotton | Million bales | | |
| | of 170 kg each | 3.0 | 7.0 |
| Sugarcane | Million tonnes | 57.0 | 182.4 |
| Potato | Million tonnes | 1.7 | 12.7 |
| Jute | Million bales | | |
| | of 180 kg each | 3.3 | 7.3 |
| Milk | Million tonnes | 17.0 | 44.5 |
| Eggs | Million Nos. | 1.032 | 16,518 |
| Fish | Million tonnes | 0.75 | 2.94 |

Comensurate with progress in the past, the pace remained relatively slow in crops such as rice, rabi sorghum, bajra, pulses, oilseeds and in dryland agriculture, fodder and the productivity of fish and livestock.

1.3 Major efforts are being made in the Seventh Plan to achieve the desired targets in the following areas :

- (a) Conservation of genetic resources for improving productivity
- (b) Increased production of oilseeds
- (c) Increased productivity of horticultural crops
- (d) Developing integrated farming systems
- (e) Improvement in dry farming technology
- (f) Increased production of fodder, fuel, agro-forestry and also the energy management
- (g) Application of biotechnology for increased plant and animal productivity

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1.4 The thrust areas identified by the Council to meet the challenges of the Twenty first century are given below :

- (a) Increasing agricultural production on sustainable basis through proper utilization of natural resources and management of the environment.
- (b) Realisation of potential for the available infrastructural facilities basic to agricultural production.
- (c) Emphasis on natural resources to reduce dependence on agrochemicals and to augment energy needs.
- (d) Increased emphasis on rainfed agriculture keeping in view the fragility of our eco-system.
- (e) Diversification of agriculture specially in intensive agriculture areas.
- (f) Post-harvest handling, storage and processing to add value, reduce losses and cost of transportation.
- (g) Continued efforts on conservation of plant, livestock and fish genetic resources.
- (h) Increased emphasis on manpower development.
- (i) Development of management information system.
- (j) Increased emphasis on adoption of biotechnology in agriculture and allied areas.

In order to achieve these objectives, divisionwise efforts being undertaken/ proposed to be undertaken relating to the most critical areas are narrated below.

2.0 CROP SCIENCES

2.1 Critical Area Approach

Considering the importance of oilseed crops for reducing the import of oil from 'present level of about Rs.1000 crores per year, Oilseed Technology Mission was launched in April, 1986 by Prime Minister. The strategy is to make India self reliant in vegetable oils in the shortest possible time. A production

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target of 16.0 mt. of oilseeds for 1990 has been fixed and it is envisaged to produce 26.0 Mt of oilseeds by 2000 A.D. These targets are to be achieved by evolving better crop production and protection technologies, and providing optimum input support with adequate marketing, pricing, processing facilities. In crop technology, time bound, targets for scaling up yield potential by 20-50%, reducing crop period by 5-25 days, increasing oil content by 6-25%, breeding varieties resistant to various biotic and abiotic stresses etc. have been undertaken. During the last 2 years, as many as 35 varieties of oilseeds have been evolved. A number of these varieties possess inbuilt resistance to diseases and pests. A few varieties yield as much as 20 to 25% higher seed and oil yields. The breeder seed production has gone up by over sixty percent during the last 2 years. The integrated mission approach has started showing results as the oilseed production is expected to be over 12.0 Million tonnes during 1987-88 despite facing one of the worst droughts of the century.

The production of foodgrain crops is presently stagnating at the level of about 150 million tonnes, whereas same is required to be increased to 175 m. tonnes by 1990, as per special foodgrain production programme launched recently at the initiative of the Prime Minister. The requirements for the foodgrains will increase to about 225-235 m. tonnes by the year 2000 A.D. Obviously, to achieve this target, a mission mode approach is proposed to be taken up with increased emphasis on improving the efficiency of existing water resources and increasing the use of inputs basic to production agriculture.

It is expected to create an irrigation potential of around 100 m.ha by 2000 AD and presuming that realisable irrigation potential will be around 90 m.ha of which around 50 m.ha with assured irrigation should be available for foodgrain crops. On an average, presently the productivity in these crops has not exceeded 2.0 tonnes per ha, whereas experiments conducted

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at the farmers' fields have revealed the production potential on an average more than 4 tonnes/ha in majority of foodgrain crops. It is proposed to achieve through a Mission Mode a production level of 3.0 t/ha in another 10-12 years.

Total area under foodgrain crops over the last ten years has ranged between 124-131 m.ha. With 50 m.ha under irrigated crops 75-80 m.ha will be under rainfed condition representing three broad situations of fairly important area coverage namely dependable rainfall (> 1000 mm.) moderately dependable rainfall ($600-1000$ mm.) and low rainfall (< 500 mm.). Efforts in the proposed mission will be on improving productivity of/ ^{rainfed} crops to attain 1.5 t/ha yield from dependable rainfall zone, 1.25 t/ha from the moderately dependable rainfall areas whereas from the remaining low rainfall areas, around 10 m.ha would be retained under millets & pulses with established high drought tolerance. The remaining area of about 15 m.t. will be diverted to silvipasture system.

In this way, by reducing the total area under foodgrain crops from present 131 m.ha to 110 m.ha, it will be possible to achieve the production target of around 225 mt. foodgrains by 2000 AD.

The efforts would also be focussed to augment our protein requirements, from the currently available rate of 40 gm per person per day, to a minimum dietary allowance of about 50-55 gm per person. The pulses production is expected to increase substantially under limited irrigation conditions as well as from the non-traditional area.

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Sharp focuss in research \angle be to provide the technology back stop through the mission mode approach, for evolving varieties tailored to suit 127 different agro-climatic zones. Seed production, integrated pest management and continuing refinement and improvement of the package of practices for lowering cost of production be the other priority areas needing Council's attention.

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2.2 Major Thrust Programmes

As reflected earlier, major effort will be to bridge the existing gaps in on-going programmes and to ensure required thrust for achieving the set targets. In brief, areas of high priority for the next decade will be:

- (a) Breeding better varieties/hybrids of various crops to fit into the prevailing and potential cropping systems, and development of matching crop production and protection technologies to optimise productivity, stabilise production and enhance net monetary returns per unit area, time and input;
- (b) Genetic improvement in quality traits of wheat, rice, tobacco, jute, cotton, oilseeds, pulses, etc. Better varieties of sugarcane with higher sugar content and recovery, particularly to suit the north Indian conditions. Emphasis would be on the development of export-oriented varieties of crops for diversified uses as value-added products.
- (c) Breeding crops for tolerance to abiotic stresses, especially drought, salinity, alkalinity, frost, cold and heat and also breeding for location-specific environments such as deep water and upland conditions in rice etc.
- (d) Development of seed production strategy for achieving higher seed replacement targets.
- (e) Development of efficient integrated pest management strategies.
- (f) Collection and conservation of germplasm of agriculturally important crop plants from unexplored areas.
- (g) Use of bio-technology in increasing agricultural production.
- (h) Development of fodder and pasture crops with greater emphasis on seed production of grasses and legumes.

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3. HORTICULTURE

3.1 Present Status

Horticultural crops cover around 11.0 million ha which constitutes only 6.7% of the gross cropped area in the country, yet they contribute more than 18% of the gross value of the agricultural output. Our present day consumption of these commodities is quite low, as against dietary recommendation of 92 gms of fruits and 250 gms of vegetables, the present rate of consumption is only 46 gms of fruits and 92 gms of vegetables.

The fruits and vegetables account for 6 to 7% of total agricultural export in terms of gross value. Also some of the horticultural crops can contribute significantly to meet the edible oil requirements of the country. Coconut, oilpalm and olives are a few crops which have very high potential.

3.2 Targets

The production of fruits and vegetables per year has to be 33 and 91 million tonnes against the present level of 24 million tonnes and 44 million tonnes respectively.

The production will have to be further increased to improve the export earnings from these crops. Our present share of world market is only 0.45% which must be increased to atleast 3.5% in a phased manner to yield an additional export earning of Rs.900 crores as against Rs. 188 crores in 1984-85.

A substantial part of the deficit in edible oil is proposed to be met through replacement of diseased coconut plantations and bringing under oil bearing preplantations around 2.5 to 3.0 lac ha.

3.3 Major Thrust Areas

- (a) Developing technologies for crop diversification in the semi-arid and arid rainfed areas.

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- (b) Development of improved varieties resistant to biotic and abiotic stresses including the use of biotechnological approaches.
- (c) Induction of dwarfing genes in perennial crops.
- (d) Intensifying work on oilpalm in the tropics and olives in the temperate areas.
- (e) Develop rapid methods of plant propagation and seed multiplication of improved varieties, using tissue culture and other techniques.
- (f) Develop appropriate on-farm post-harvest handling, storage and transport system.

4.0 SOIL SCIENCE & AGRONOMY

4.1 Major Thrust Areas

In the past, efforts to increase agricultural production though successful, have taken place at the cost of impoverishment of our resources. A major thrust in the coming years will be

at developing technologies for increased agricultural production with adequate emphasis on the conservation of resources and maintenance of soil fertility for sustained productivity.

Broadly, the research efforts will concentrate in the following three areas :

- (a) Resources Inventory
- (b) Resource Conservation
- (c) Efficient Production Systems.

(a) Resources Inventory

For any long term planning and efficient use, proper inventory of resources is a basic need. The ongoing efforts on preparing detailed inventory of (a) soil resources, (b) climatic regions and (c) water resources will be strengthened to complete the process of detailed inventory of these resources in the various

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agro-climatic regions of the country. These inventories along with information on characterisation of each environment will help to develop appropriate and efficient cropping and land use systems and for effective transfer of production technologies.

(b) Resource Conservation

While aiming for high production technologies in the next decade, the conservation of our resources will need high priority. The research programmes will aim to generate appropriate technology which will ensure promotion of:

(i) Conservation farming : The research efforts will be strengthened to generate improved soil and water conservation practices for various soil type - topographic situations in the country for ensuring sustained productivity. The approach to conservation farming will involve appropriate mix of cultural, biological and engineering practices.

(ii) Rehabilitation of degraded lands : A large fraction of soil resources have lost their productivity to varying degrees due to mismanagement of land and resulting in desertification processes. Researches to provide technology for restoring production potential of degraded lands as salt affected soils, eroded/ravinous areas, water logged soils and desert soils will be strengthened.

(iii) Environmental conservation : The side effects on environmental pollution following the adoption of high input-high production technologies will be monitored and kept to a minimum by adopting appropriate environmental conservation programmes along with production technologies. Researches on limiting the excess use of agricultural chemicals, use of degraded land for disposal of industrial wastes and city effluents will be intensified by the relevant Institutes and Coordinated Projects.

(c) Efficient Production systems

It is now realised that the transfer of technology will have to shift from emphasis on cropping strategies alone to emphasis on overall farming system of a region taking into account the natural assets and liabilities that are unique to a particular region. Therefore, the reorientation of research efforts will be for optimising production through :

(i) Increasing the productivity and income from dryland farming areas. The thrust areas of research will be on (i) Process on characterisation of soil-environmental features of 127 agro-climatic zones, (ii) contingency cropping practices for various kinds of weather aberrations, (iii) stress physiology of dryland crops, (iv) optimising energy management and (v) water harvesting and recycling. The gains of improved technology on the land and water resources will be quantified on model watersheds for extending this approach over the entire dryland farming areas.

(ii) Alternate land use systems for increasing agricultural production, income generation and reducing the risk involved in arable farming.

(iii) Integrated nutrient management involving maximum recycling of organic wastes, crop residues, grass manures and biofertilizers alongwith chemical fertilizers. The emphasis will be on screening and evaluation of efficient nitrogen fixing micro-organisms, VAM fungi for phosphorus mobilisation and efficient strains of micro-organisms for quick decomposition of organic wastes.

(iv) Efficient use of chemical fertilizers : Research efforts will be strengthened for minimising the loss of nutrients in the applied chemical fertilizers through better understanding of various transformation processes and of promoting the use of fertilizers based on effective and efficient soil testing procedures.

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(v) Increasing productivity of acid soils : Adequate attention has not been paid in the past for increasing the soil quality and productivity of acid soils in the country. Basic and applied research work will be intensified in the areas of amelioration of soil acidity, nutrient deficiency and toxicity and evaluation of efficient cropping systems.

(vi) Development of technologies for overcoming soil related constraints to production.

(vii) Optimising use of available resources with emphasis on water use efficiency both for irrigated and unirrigated areas.

5.0 AGRICULTURAL ENGINEERING

5.1 Present Status

The onset of Green Revolution brought the role of Agricultural Engineering (AE) into greater focus. Indigenous Agricultural Engineering technologies are required for land and water resource development and exploitation, selective mechanisation of production agriculture; achieving timeliness, precision in metering and placement of material inputs, remove drudgery and impart dignity to farm work. Post harvest technologies appropriate at rural threshold are needed for conservation of produces and by-products, production of value added products transport and marketing for due profitability and sustainability of intensive high productivity agriculture. Agricultural productivity and post-harvest activities and rural living are closely linked with energy inputs. As we approach 21st century energy is going

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to be critical. We have to have energy efficient technologies conserving commercial energies, supplementing and substituting with new and renewable sources of energy.

5.2 Achievements

Agricultural Engineering applied and adaptive research efforts have led to numerous results of practical value, some field exploited and commercialised as indicated below :

- (a) Soil and Water Engineering : Rationale have been developed for design, construction and renovation of dugwells, water-lifting, conveyance, and agricultural drainage. R & D efforts have yielded results of wide applicability like protection of tubewells farm corrosion and encrustation, improved foot and reflex valves, engine safety device, low lift high discharge propeller pumps.
- (b) Farm Machinery and Power : A wide range of manual, animal and power operated seedbed, preparation equipment, seed drills, seed-cum-fertiliser drills, planters, Transplanters have been designed. Equipment have been developed to practice minimum tillage, intercropping, ridge and furrow sowing. For harvesting, improved sickles, vertical conveyor reapers, power threshers, potato and groundnut diggers have been designed.
- (c) Post-harvest Technology : Low cost post-harvest technologies appropriate at rural threshold have been developed and field tried to minimise losses to cereals pulses, and oilseeds and produce value added products at the farm and rural entrepreneur level. Post-harvest technological support was given towards development of cotton and jute varieties. Technologies have been developed for diversified uses of cotton, jute and lac.

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(d) Energy Management in Agriculture : Energy audits have been carried out of major crops, crop rotations, and villages, eco-system. Energy requirement varies from a low of 2.000 MJ/ha of rainfed rice in West Bengal or Madhya Pradesh to as high as 70,000 MJ/ha for groundwater irrigated rice in Coimbatore. Designs have been developed for low cost dryers, solar water heaters, solar cookers, water stills, biogas plants, wood and crop residue gassifier, aerogenerator etc. operational research have been carried out as integrated energy and nutrient systems.

5.3 Major thrust programmes

The thrust would be directed, on short term basis, towards consolidating results of ongoing programmes and finding solution to mechanisation, post-harvest technological and energy management needs relating to oilseeds, pulses, and millets. On long term basis, efforts would be directed to scientific data base, packages of improved equipment for irrigated and dryland agriculture, agro-forestry horticulture, and livestock husbandry, post-harvest technologies appropriate at rural threshold; rationalised computer aided ergonomically sound equipment designs, quality manufacture; proven action plan for technology transfer. Agricultural structures and Environment Control would receive special attention. Specific thrust area activities would be as under:

1. Selective Mechanisation

Operations search will be carried out on rice production in eastern India, dryland crops, hill agriculture, horticulture and agro-forestry and improved tools, implements and machines developed to increase productivity through timeliness in operation, precision metering and placement of inputs, and removal of drudging. Existing equipment will be improved in terms of ergonomis, safety, durability and unit cost. Modern concepts in design, manufacture, machinery management, industrial liaison and technology transfer will be given due attention.

(2) Post-Harvest Engineering and Technology for Minimisation of losses and value Addition :

Post-harvest losses associated with various produces and by-products, prevailing post-harvest practices, profit sharing will be critically appraised, Dryers, cleanliness, graders, primary milling, storage, handling and transport equipment and practices appropriate at on-farm and rural entrepreneur level will be developed, field tried, operational researched. Based on successful unit operation technologies agro-processing models for identified production catchments will be developed and pilot introduced. Existing machinery will be improved for higher efficiency. For greater profitability and sustainability technologies will be developed for diversified uses particularly for cotton, jute, and lac etc.

(3) Agricultural structure and Environment Control :

Structural and environment control constraints to agricultural productivity, produce handling and management will be established and solutions appropriate at farm and community/entrepreneur level developed and pilot introduced.

(4) Farm Power and Energy :

Taking clues from energy audits efficient man-machine-material systems that minimise wasteful uses of energy will be developed. Areas where productivity suffers due to shortage of farm power and energy or ecological balance is in danger technologies will be made available reducing dependence on commercial energies supplementing and substitutive with new and renewable sources of energy. Utilisation of animate energy sources will be rationalised.

6.0 ANIMAL SCIENCE

6.1 Present Status

The research projects of the Division are mainly directed towards (1) evolving high yielding strains of livestock including poultry, (2) evaluating the utilisation of conventional and non-conventional feed resources, (3) studying the problems of reproduction and adaptation, (4) developing effective immuno-prophylactics and diagnostic methods and (5) improving techniques for processing of milk, meat and animal fibre.

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The existing research programmes encompassing the critical areas are given below :

- (a) Genetic studies of Holstein crossbred cattle as well as Karan-Swiss and Karan-Fries with a view to generate superior crossbred germplasm.
- (b) Studies on draught and dual purpose indigenous breeds of cattle and buffaloes.
- (c) Large scale progeny testing of bulls by suitably linking organized farm facilities in the country
- (d) Improvement of important indigenous breeds of buffaloes
- (e) Development of a suitable system for animal disease monitoring, surveillance and forecasting
- (f) Application of bio-technology for developing and improving diagnostics and prophylactics
- (g) Evaluation of feed resources, developing effective systems for efficient feed utilization.
- (h) Developing indigenous dairy products, increasing shelf life of raw milk and milk products and adding value
- (i) Research on improving meat production.

6.2 Major Thrust Programmes

The thrust areas of research will be towards strengthening research capability in the ICAR Institutes and State Agricultural Universities with major emphasis on :

- (a) Description, evaluation and conservation of indigenous breeds of livestock
- (b) Developing suitable selection criteria for generating superior crossbred germplasm utilizing modern technologies such as embryo transfer

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- (c) Provision of better nutrition and management practices with improved feed and fodder resources
- (d) Research on physiology and adaptation
- (e) Utilization of biotechnology for developing more effective diagnostics and prophylactics
- (f) Conducting research on application of modern technologies such as those for raw milk preservation, ultra heat treatment and membrane technology.

7.0 FISHERIES SCIENCE

7.1 Present Status

During the Seventh Five Year Plan, reorganisation and strengthening of Fisheries Research and Education under ICAR has been taken up by dividing the existing facilities into resource specific institutes and sharing the assets and the man power. As a result 7 Research/Education Institutes and one National Research Centre on Coldwater Fisheries have been established. Approval of UGC to impart "Deemed to be University" status for the Central Institute of Fisheries Education (CIFE), Bombay has been obtained.

7.2 Major Thrust Programmes

- (a) Increasing productivity through semi-intensive aquaculture upto 15 tonnes/ha/yr. of fish and 4 tonnes/ha/yr. of shrimp;
- (b) Development of technologies for mono-culture of fish for high production through intensive aquaculture.
- (c) To standardise breeding of carps independent of monsoon and rearing of fish seed,
- (d) To standardise techniques for maturation and breeding of cat fishes, murrels, trout, Mahasheer, Mussels, Oysters and fresh water and marine shrimp species.

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- (e) To develop technologies for breeding seabass, milk fish and mullets, Pearl spot and certain bait fishes.
- (f) To develop package of technologies for higher productivity.
- (g) Standardisation of integrated aquaculture systems
- (h) Survey of multi species tropical fish stocks in coastal and off-shore regions.
- (i) To identify pure line stocks for germplasm preservation.
- (j) To upgrade selected species for better growth and controlled breeding through genetic manipulation.

8.0 AGRICULTURAL EDUCATION

8.1 Present status and Future Thrusts

The long range development objective of Education function of ICAR is to establish an institutional system of higher agricultural education in India that will provide the scientific/technical manpower required for manning the research, educational, managerial and developmental segments of agricultural development effort of India.

(a) India has been building up its institutional system of higher agricultural education in a planned way through the various five year plans. The existing institutional system for higher agricultural education comprises 26 State Agricultural Universities, 8 research institutes of ICAR performing an educational function in addition to their research functions, 3 agricultural faculties of the Central Universities, IIT, Kharagpur and 12 agricultural faculties of the State level general Universities.

(b) The overall annual intake capacity at the under-graduate level is approximately 13600 spread over 11 degree programmes. Likewise, the overall annual in-take capacity at post-graduate level is approximately 4600 spread over 50 degree programmes.

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(c) All the major states of India have now been brought under the state agricultural university system. Some smaller states of the North-East Hill Region are yet to be brought under the umbrella of state agricultural university system. A plan is being formulated for the establishment of a composite college of agriculture in each of these states.

(d) The institutional capacity already established is quite adequate to meet the scientific/technical manpower requirements during the next 10 years. Some shortage is being experienced in Veterinary Science which can easily be restored by further utilization of the installed capacity.

(e) The range of degree programmes being offered by the existing system is also adequate. The structure of under-graduate curricula has been so designed that it permits partial specialisation through elective programmes of the under-graduate degree courses to meet the location-specific requirements of individual states.

(f) At the post-graduate level, also the range of degree programmes being offered is adequate. However, it would require appropriate expansion in certain fields, viz. agro-forestry, agricultural communication, agricultural business management, agricultural meteorology, bio-technology, computer applications, educational technology, rural development, agricultural marketing, agro-industry, etc.

9.0 EXTENSION EDUCATION

9.1 Existing Status

Realising the importance of integrated functioning of research, education and extension education system, the ICAR initiated first-line extension programmes on a limited scale

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in mid sixties. With the expansion of the extension programmes, the ICAR established a separate Section of Extension Education in the year 1971 at the ICAR Headquarters. Initially, this Section was a part of the Division of Soils, Agronomy and Agricultural Engineering. However, with further expansion of extension activities, in 1984, the Extension Education section was raised to the status of a fullfledged Division with the overall responsibility of implementing four major transfer of technology projects of the Council viz. National Demonstrations Project, Operational Research Project, Krishi Vigyan Kendra and Lab-to-Land Programme. These projects are fully developed to serve as first-line demonstrations to show the maximum genetic production potentialities of latest agricultural technologies to the farmers and extension workers. The newly created Division of Agricultural Extension is headed by the Deputy Director General (Agril. Extn.) who in turn is supported by three Assistant Director-Generals and Senior Scientists.

9.2 Major Thrust Programmes

The major thrust programmes in the next decade will be as follows :

- (a) The National Demonstrations Project will be directed towards demonstrating production potentialities of new agricultural technologies as related to pulses and oilseeds under resource constraint situations. There would be an added emphasis on strengthening the extension aspects of these demonstrations by involving large number of farmers through organisation of conventions, field days etc. Gradually the programme will be oriented towards farming systems demonstrations with a focus on diversification aspects of agriculture.

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- (b) In the Operational Research Projects, efforts will be made to initiate more projects on technologies related to dryland agriculture and production of pulses and oilseeds. It will also be our endeavour to initiate ORPs on integrated farming systems with added emphasis on animal husbandry, fodder production, fisheries etc.
- (c) The KVKs will be further strengthened to improve the quality of training imparted to farmers, farm women, rural youths etc, by way of adding facilities of audio-visual aids and production of different media of communication. In training programmes, more emphasis will be laid on production of cereals, pulses and oilseeds under resource-constraint conditions.
- (d) The component of agricultural engineering which is otherwise weak in the transfer of technology projects will be strengthened by organising more training programmes.
- (e) The extension component in all the transfer of technology projects will be improved so that the technologies being used in these projects are further disseminated to the farmers and a new extension methodology is generated which could be used by the extension agencies on a large scale.

10. MANPOWER

10.1 Present Status

Human resources constitute the backbone of all inputs in any organization to attain its goals. Likewise, ICAR depends upon the quality and quantum of work output by its scientific force. The schemes of the ICAR are implemented by the scientists with the assistance of technical, administrative and other categories of staff located in the Institutes, agricultural universities,

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National Research Centres etc. The total man-power sanctioned upto VII Plan is 33039 posts of which about 6400 are scientists located at different institutes, national research centres, project directorates, as well as those employed in the coordinated research projects operating in different agricultural universities/institutions.

10.2 Growth of Man-Power

In order to derive the maximum return from the investment made, scientists and the supporting staff must maintain an optimum working stoichiometry for efficient and effective research output. The Personnel Policies in the ICAR are always tailored to meet these specific needs. The growth of man power during 5th to 7th Plan periods reveals that these have been only marginal increases in various categories of scientists during the three plans.

| | <u>Table</u> | |
|------------|-------------------|---------------|
| | <u>Scientists</u> | <u>Others</u> |
| Vth Plan | 6068 | 21854 |
| VIth Plan | 6165 | 24982 |
| VIIth Plan | 6272 | 26767 |

Within the ICAR system, there are at present about 6400 scientific positions, of which about 2000 position are vacant. A careful examination of the available scientists and their specialization and experience reveals that in few subject matters areas like livestock with biotechnology and agricultural engineering, the shortage is acute and we may have to provide some incentives to attract talented candidates for positions in these areas.

10.3 Manpower Development

At the time of establishment of State Agricultural Universities, there was a massive effort to train the scientists for

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advanced degrees in U.S.A. and other European and Commonwealth Countries. This avenue has completely dried up and we may be facing vacuum in next few years as most of our trained scientists will be retiring.

It is generally recognised for scientific growth that cross interaction of ideas is vital. The general criticism against our scientific community is excessive inbreeding in education and training of this community. Most of the scientists continue to seek their three degrees (Bachelor's, Master's and Doctorate) in the same institution. This will have to be discouraged after the award of two degrees from the same institution. Another suggestion could be for placement of faculty/scientist in other states after completion of 7-10 years for atleast a year.

The Government should also undertake a massive programme under the World Bank and bilateral agreements for advanced degrees in best laboratories of the world. The step has already been initiated for NAARM to improve its professional skills by establishment of an Advance Centre in Research & Education Management in this academy. Its capability will have to be enlarged and may be similar institute needs to be created in the universities for continued education and discharging research of agricultural universities under the ICAR.

10.4 Future Requirement

Keeping in view the existing vacancies and other positions released would be redeployed for newer areas and newer institutes and units to the extent that is possible without affecting the on-going programmes. Considering the additional demands and new thrust areas, in the coming VIII Plan and for the year 2000 A.D., an additional scientific manpower strength to the tune of 1000 will be the approximate requirement.

11.0 FINANCIAL SUPPORT

11.1 Present Status

There is an all round appreciation for achievements in Agriculture Sector. However, the financial allocations are not matching to support R & D in the country. The allocation to the Agricultural Research, Infrastructures in the Fourth, Fifth and Sixth Five-Year Plans varies from 0.36 to 0.38% of the total Plan allocation. However, the same was drastically reduced to 0.27% during the Seventh Plan. The Working Group constituted by the Planning Commission recommended an allocation for Rs. 920 crores. The final allocation was to our dismay approved at a very low level of Rs. 425 crores only. This has handicapped our existing infrastructure development to provide the critical supply in large areas where R & D Institutes are lacking till today. For example, the entire North East Hill Region of the country.

Inspite of our capacity to utilize the funds allotted we are being handicapped to utilize even the limited allocation of Rs. 425 crores by restricting our Annual Plan Outlay to a very low level.

The Scientists are most reluctant to take up position in Regional Stations of Institute as well as the Research Institutions of the North East Hill and Andaman Nicobar Islands etc., because these Institutes do not even have laboratories and adequate equipment where scientist can satisfy their creative urges. Many of these places lack in adequate residential facilities.

11.2 Future requirements

The experiment to create physical plants in terms of development of agricultural experimental stations, building of laboratories and residential complex, modernisation of facilities

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both in SAUs and ICAR Institutes can be met from the World Bank assistance through the NARP Phase III programme. The expenditure for the coming 12 years priorities will be around Rs. 500 crores. In order to meet adequate operational budget for the existing Institutes and to focus on critical research areas through establishments of Research Centres, the requirements for the Eighth and Ninth Five-Year Plans could be postulated around Rs. 1000 and Rs. 1500. respectively.

These priority areas were considered by a sub-committee on research mandate and priority research missions under the chairmanship of Dr.M.S. Swaminathan. The sub-committee made the following recommendations.

- 4.1 The Sub-Committee considered the priority areas for research suggested by the Review Committee separately for crops, animal and fishery sciences [vide paras 10.6 to 10.8 of the Report] and recommends them for appropriate intensification of efforts by the ICAR. Apart from these, the Sub-Committee suggests the following additional priorities for proper strengthening:
- a) The crucial role of water management in Indian agriculture should be properly recognised, and therefore, more stress given for research in this area is needed besides initiating ORPs based on accumulated experience. ICAR should develop coordinated strategy for water management covering rainfed, arid, irrigated and mountain ecosystems. There is need for coordinated efforts among the several Water Technology Centres now existing in different parts of the country and the Institutions of the Central Water Commission.
 - b) Another area requiring intensification of research efforts is hill agriculture covering integrated development of horticulture, agroforestry, animal husbandry, and conservation of soil and water resources. There is need for acknowledging the urgency involved in arresting erosion in the hills, and the negative and sometimes disastrous effects erosion upstream has on down stream agriculture.
 - c) There is also need for scientific planning for integrated development of coastal agriculture involving horticulture, animal husbandry, fisheries, post harvest technology etc. One of the ICAR Institutes could be located in such an area for this purpose. This Institute should also emphasise on export-oriented opportunities available in these areas since export from coastal areas would help to cut down transportation costs.

- d) Another area of priority would be improving the methodology for on-farm testing of technology from a farming systems perspective.
- e) Emphasis is also required for investigation on delivery systems connected with agriculture and allied fields. These will include delivery of inputs like water, chemicals and fertilizers, subsidy, credit etc. Appropriate methodologies for the improved functioning of these systems under conditions of illiteracy prevalent in rural areas are urgently needed. Research on tailoring delivery systems to suit specific agro-ecological and socio-economic conditions has not received the attention it deserves.
- f) There is an equally urgent need for research on diversification of Indian agriculture to maximise income from land holdings, improve employment potential and promote ecological stability.
- g) In the area of animal sciences, development of improved and new immunoprophylaxis and diagnostic agents, and research on duck development need to be included in the thrust areas.
- h) Research on Home Science should be reoriented with the primary focus being on the productive role of the women. The Sub-Committee feels that 'Home Science' as a title of the discipline needs to be substituted by an appropriate name so as to cover primarily studies relevant to the productive role of the women. Methods of reducing drudgery and promoting efficiency in women specific occupations need greater attention. The Sub-Committee, therefore, recommends that the ICAR's Scientific Panel on Home Science be asked to consider this and suggest an appropriate terminology which will bring out more clearly the role of Home Science Colleges in the economic uplift of farm women.

i) The thrust areas for research in Home Science should also include :

- i) Management of energy, water, time, money, food resources by farm women;
- ii) Synergistic relationship between health, nutrition and farming;
- iii) Physical activity pattern, diet variation, seasonal changes in farm women;
- iv) Infant feeding and child care practices among landless families; and
- v) Institutionalisation of child care, management of Anganwadis & study of child growth and growth monitoring. //

V. TRANSFER OF TECHNOLOGY

The transfer of technology from the laboratory to the field is a complex process. It involves the identification of the needs of the target population, the development of appropriate technologies, and the implementation of these technologies through various channels. The success of this process depends on the active participation of the target population and the support of the government and other stakeholders.

PRIORITY THRUST AREAS FOR RESEARCH AT THE NATIONAL LEVEL

10.6 In crop and resource-management research, the ICAR should consider the following thrusts for drawing up research agenda and policies for the future.

1. *Increasing productivity and efficiency of irrigated farming through greater emphasis on research on soil and water management:* India has invested heavily on the development of irrigation over the last three decades, but the production of foodgrains per hectare per year from these irrigated areas is miserably low, hardly 1/5 to 1/4 of the potential; thus the focus on research in increasing crop productivity and cropping intensity in the different irrigation command areas assumes first priority. If an emphasis is laid on research on soil and water management and constraints to production in irrigated areas are removed, it is possible to maximize crop productivity and minimize soil degradation, primarily with labour-intensive methods.

2. *Rainfed farming and dryland technology:* Despite all the efforts for exploiting irrigation potential, more than half the cultivated area in India will be dependent on rainfed farming and dryland technology. Dryland agriculture will determine the stability and sustainability of agriculture in the country and the ICAR should deploy its resources and technical might to achieve this goal taking into account the socio-economic constraints of the areas. Serious efforts should be made to ensure doubling of the production from the rainfed agriculture.

3. *Improving efficiency of inputs in agriculture:* Whether it is irrigated or rainfed agriculture, the use of costly agricultural inputs such as fertilizers, pesticides and energy becomes essential. Improving the efficiency of the use of water both in irrigated and rainfed farming is equally important. Highest priority should be given to research on improvement of efficiency of these inputs. The economics of farming will be dependent on these.

4. *Breaking yield barriers of wheat and rice and increasing productivity and stability of yields of pulses, oilseeds and rabi sorghum:* Special attention should be given to research on *rabi sorghum*, groundnut, rapeseed, chickpea and pigeonpea and breaking the yield barrier in wheat

and rice which have reached a plateau. The productivity, stability, efficiency and economics of cultivation of these crops must improve.

5. *Concern of fuel and fodder:* Research should be intensified on agro-forestry and silvi-pastoral, and agro - horticultural systems to solve the fuel and fodder problem, and improve the productivity and sustainability of agriculture.

6. *Fighting drought and nutritional stresses:* Drought and plant nutrient deficiency are the most serious abiotic factors reducing crop yields. Special research efforts are needed to manage these stresses for improving the stability of production.

7. *Management of biotic stresses:* Diseases and pests are great yield-reducers and their management calls for special research thrust. Thus research for judicious, economic and safe use of pesticides, biological control of pests, use of pesticides of plant origin, incorporation of multiple genetic resistance to pests and diseases by systematically pyramiding resistance genes in improved crop varieties is essential.

8. *Processing and marketing:* Reduction of losses inflicted by pests in storage of agricultural produce and development of technology for adding value and enhancing storability and marketability of products should receive adequate attention.

9. *Recognizing the importance of genetic resources:* Intensive efforts should be made to increase the germplasm collection, maintenance, evaluation and utilization for the benefit of agriculture of today and the future by working with the SAUs as well as with international organizations such as the FAO, IBPGR and other international centres.

10. *Strengthening research in less-developed areas and on the problems of poorer segment of agricultural population:* It is necessary to strengthen research efforts in backward areas having weak research infrastructure for minimizing regional imbalances in agricultural production and productivity and meeting the needs of different ecological regions and of the small farmers and poorer segments of the agricultural population.

11. *Energy management:* An intensive research effort should be made to utilize non-conventional energy sources.

12. *Farm machinery and power:* More research is needed on the development and use of improved implements for agricultural operations specially for achieving precision, efficiency and timeliness of operations and also removing drudgery of farm operations carried out by rural women.

13. *Research in home science:* Special thrust should be given to the evaluation of nutritional efficiency of new varieties of cereals and other

14. *Marketing research*: Research efforts are needed on the marketing aspects of various agricultural commodities.

10.7 In Animal Science Research, the following thrust areas are identified:-

1. *Genetic improvement of livestock*: Intensive efforts should be made on developing breeding strategies for increasing the productivity and efficiency of production of livestock and generating superior germplasm.

2. *Animal genetic resources conservation and management*: Basic research required on genetic resource identification through cytological, immunogenetic and biochemically polymorphic characteristics and *in-situ* and *ex-situ* (cryo-preservation of sperms and embryos) conservation needs to be initiated.

3. *Intensification of research on non-conventional feed resource*: Since feed is the most important limiting factor and there is little possibility of increasing the area under cultivated fodder production, dependence on crop residues and agro-industrial byproducts will have to continue. Identification and evaluation of new non-conventional feed resources and developing more effective methods of their utilization, specially through manipulation of rumen environment and utilization of bypass protein and energy, should receive increased attention.

4. *Development and utilization of bio-technological innovations for animal production and health*: Research and application of newer biotechnologies related to multiple ovulation embryo-transfer technology, specially sexing, cloning, micro-manipulation, development of transgenic animals, for intensifying genetic gains, and molecular biology and DNA recombinant technology are required for developing cheaper and more effective diagnostics and vaccines.

5. *Disease surveillance and monitoring*: Research should be intensified on standardizing the methods for disease surveillance and monitoring and possibly forecasting of important animal diseases and evaluating the available control and eradication measures. This will also include establishment of high-security animal disease laboratory facilities for tackling emerging and exotic diseases.

6. *Intensification of research on meat production and processing technology*: More research is needed on different aspects of meat production, slaughter techniques, live-animal and carcass evaluation, and meat processing and preservation.

7. *Dairy development*: Different aspects of increasing milk pro-

duction, reducing bulk using membrane technology, ultra-high-temperature treatment of milk and labour- and energy-saving methodologies in handling fluid milk and preparing intermediate and final indigenous dairy products should receive great emphasis.

10.8 In fisheries research, the following thrust areas are identified:

1. *Culture fisheries*: More research is needed on seed production of quality fish, feed formulation for monoculture genetic studies of cultivated and culturable fish, steps for domestication and development of genetically superior strains with desirable characteristics. Emphasis should be laid on increasing production in ponds and tanks by manuring and fertilizing appropriate to quality of "natural pond bottom soil" and strengthen the system of polyculture (composite fish culture) already developed in the country. Major thrust is to be given to running-water aquaculture.

2. *Capture fisheries*: Developing balanced fish population based on prey-predator relationships and the effect of river pollution on stock of fish and aquatic biotic factors should receive adequate attention.

3. *Fisheries technology*: Emphasis should be laid on the standardization of product development of various types. Gear and crafts should be developed for exploiting pelagic, column and demersal resources of our seas. Development of devices like fish feeders, aerators, water heaters and sluices should receive more attention.

4. *Fish genetic resources*: Special efforts are needed for developing a gene pool of indigenous cultivated and culturable species of different ecosystems.