NCAP Perspective Plan

VISION 2025

राष्ट्रीय कृषि आर्थिकी एवम् नीति अनुसंधान केन्द्र

NATIONAL CENTRE FOR AGRICULTURAL ECONOMICS AND POLICY RESEARCH

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

NEW DELHI

VISION 2025
Perspective Plan

NATIONAL CENTRE FOR AGRICULTURAL ECONOMICS AND POLICY RESEARCH
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NCAP Vision 2025: Perspective Plan

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FOREWORD

Indian agriculture must continuously evolve to remain competitive and meet the growing and diversified needs of different sections of the society. In order to achieve this objective, we need to capitalize on the emerging opportunities. The Indian Council of Agricultural Research (ICAR) visualizes an optimistic agricultural scenario in the next twenty years. To realize this scenario, an in-depth analysis of the strengths, weaknesses, opportunities and threats was undertaken for the entire agricultural sector. This also helped us in placing our research and technology development efforts in perspective, so that we succeed in our pursuit of delivering better than the best. Accordingly, researchable issues are identified, strategies are drawn and programmes are developed to have relevant projects. This exercise also aimed to gear-up the research system and to commence the programmes with XI Five Year Plan.

It is envisioned that higher and sustainable agricultural growth would be driven by improved technologies. Therefore, the research system needs to be sensitized about the changes that are taking place at the national and global levels, and the role of R&D to leverage agricultural growth. National Centre for Agricultural Economics and Policy Research (NCAP) will play a proactive role in this direction, and provide policy options to enhance effectiveness of technological interventions.

NCAP, since its establishment in 1991, has made significant contributions to agricultural policy research and capacity development. Its research work on science and technology policy, investment in agriculture, diversification towards high-value agriculture, trade and markets, seed industry, has received tremendous recognition and appreciation internationally.

The Centre has paid adequate attention to the problems of disadvantageous regions and sections of the society. Dissemination of research findings through its own publications and development of capacity for policy analysis are other important achievements. With active support form the Centre, the Council is able to participate effectively in the policy making process and demonstrate the role of the research system in agricultural development.

This document articulates NCAP's vision, and outlines perspective on research, capacity strengthening and policy advocacy. I am sure that the Centre will be able to operationalize the perspective plan with support and guidance from the peers and stakeholders, and eventually emerge as an island of excellence in policy research. To develop the Vision 2025, efforts and valuable inputs provided by my colleagues at the ICAR Headquarters and by the Director and his team at the institute level for over an year deserve appreciation.

Mangala Rai
Secretary, Department of Agricultural Research and Education, and
Director General, Indian Council of Agricultural Research
Krishi Bhawan, New Delhi 110 001, India

March 2007

PREFACE

The Perspective Plan document articulates the collective vision for the NCAP. It also elaborates on the strategy to accomplish this vision and fulfill the mandate of the Centre. The document contains the opportunities and perceived challenges in Indian agriculture in the next two decades, and our strategy and approach to address them. NCAP intends to undertake empirical policy research on issues of topical debate by evolving a culture of working in partnership and network mode. It also takes the responsibility of capacity strengthening in the national programme towards policy analysis and modelling, and disseminating policy options to the stakeholders through appropriate fora.

NCAP has completed fifteen years of its acclaimed meaningful existence, and has appreciably met the expectations of its sponsors, the Indian Council of Agricultural Research, and other stakeholders through creditable academic research and effective policy advocacy. The strong foundation of its glorious past has made the young NCAP much stronger to meet the future research needs more effectively. This document contains our commitment to address the new challenges such as issues related to biotechnology, intellectual property rights, climate change, carbon trading, natural resource management, biodiversity, agri-business and retailing, institutional innovations, and agri-trade. We are more concerned to the underprivileged and less favoured areas, and are committed to improve the capability of smallholders in sharing the benefits of the emerging opportunities in agriculture.

This Perspective Plan revisits the earlier vision document steered by late Dr Dayanatha Jha, former Director, NCAP. It has been finalized after several rounds of discussions with the peers, stakeholders and professional colleagues. We are specially grateful to Dr Mangala Rai, Secretary, Department of Agricultural Research and Education (DARE), and Director-General, Indian Council of Agricultural Research (ICAR), for providing valuable suggestions in developing this document. We received continuous support from Dr V K Taneja, former Deputy Director General (Animal Sciences), Dr S Ayyappan, Deputy Director General (Fisheries and Animal Sciences), Dr Mruthyunjaya, National Director, National Agricultural Innovation Project, and Dr J P Mishra, Assistant Director General (Economics, Statistics and Marketing). We offer our sincere thanks to them.

This document was also shared with the members of the Quinquennial Review Team, the Evaluation Team and the Institute Management Committee. We are particularly grateful to Dr S S Johl, Dr G K Chadha, Dr P V Shenoi, Dr V N Mishra, Dr Kanchan Chopra, Dr Mahesh Pathak, Dr R S Deshpande, Dr Mahendra Dev, and Dr P G Chengappa for their constructive suggestions in revising the perspective plan and the research agenda.

Dr Suresh Pal did the pains taking exercise in developing the document, undertaking several iterations to edit and revise the draft versions and bringing out in the present form. I sincerely thank him for his invaluable contribution. I also express my thanks to Dr Pratap S Birthal, Dr. P Adhiguru and other colleagues for their contributions in developing this document. Mrs Sonia Chauhan and Dr (Ms) Rashi Mittal helped in compilation of information from various sources and Mr Ajay Tanwar assisted in patiently processing the document. I appreciate their contributions.

I am sure that the document would provide a deeper insight to the stakeholders about NCAP vision and strategy. However, it is open for constructive comments and suggestions. I look forward to receiving continuous feedback from professionals, peers and other stakeholders.

Through this document, we dedicate our services to the poor farmers in the less favoured areas of India.

P K Joshi
Director

New Delhi
19 March 2007

EXPLANATION TO ABBREVIATIONS

ADB	Asian Development Bank
AERs	Agro-Ecological Regions
AESRs	Agro-Ecological Sub-Regions
AgGDP	Agricultural Gross Domestic Product
AIMA	All India Management Association
AMIs	Agricultural Marketing Institutions
AMS	Aggregate Measure of Support
AOA	Agreement on Agriculture
APAARI	Asia Pacific Association of Agricultural Research Institutions
APEDA	Agricultural and Processed Food Products Export and Development Authority
APMC	Agricultural Produce Marketing Committee
ASEAN	Association of Southeast Asian Nations
ASP	Active Server Pages
CAC	Codex Alimentarius Commission
CGIAR	Consultative Group on International Agricultural Research
CGP	Competitive Grant Programme
CIMMYT	International Maize and Wheat Improvement Centre
CMFRI	Central Marine Fisheries Research Institute
CPR	Common Property Resource
CWI	Consignment-Wise Inspection
DARE	Department of Agricultural Research and Education
DDG	Deputy Director General
DMI	Directorate of Marketing and Inspection
EEI	Economic Efficiency Index
EFC	Expenditure Finance Committee
EU	European Union
FAO	Food and Agriculture Organization
FCI	Food Corporation of India
FMCs	Field Management Committees
FSMS	Food Safety Management Systems
FTE	Full-Time Equivalent
FYP	Five -Year Plan
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GIS	Geographical Information System
GOI	Government of India
HACCP	Hazard Analysis Critical Control Points

HFNS	Household Food Nutrition Security
HRD	Human Resource Development
HTML	Hyper Text Markup Language
HVC	High-Value Commodity
IARI	Indian Agricultural Research Institute
IASRI	Indian Agricultural Statistics Research Institute
IATCBP	Indo-Australian Training and Capacity Building Project
ICAR	Indian Council of Agricultural Research
ICLARM	International Center for Living Aquatic Resources Management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICSSR	Indian Council of Social Sciences Research
ICT	Information and Communications Technology
IDS	Institute of Development Studies
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IIFT	Indian Institute of Foreign Trade
IMC	Institute Management Committee
INARIS	Integrated National Agricultural Research Information System
IPM	Integrated Pest Management
IPQC	In-Process Quality Control
IPRs	Intellectual Property Rights
IRMA	Institute of Rural Management, Anand
IRRI	International Rice Research Institute
ISEC	Institute for Social and Economic Change
IT	Information Technology
IVRI	Indian Veterinary Research Institute
KSAMB	Karnataka State Agricultural Marketing Board
KVKs	Krishi Vigyan Kendras
MC	Management Committee
MNCs	Multinational Companies
MOU	Memorandum of Understanding
NARS	National Agricultural Research System
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Marketing Federation
NAIP	National Agricultural Innovation Project
NARIs	National Agricultural Research Institutes
NATP	National Agricultural Technology Project

NBSSLP	National Bureau of Soil Survey and Land Use Planning
NCAP	National Centre for Agricultural Economics and Policy Research
NCC	National Codex Committee
NDRI	National Dairy Research Institute
NGOs	Non-Governmental Organizations
NIC	National Informatics Centre
NPC	Nominal Protection Coefficient
ODI	Overseas Development Institute
OIS	Online Information System
PME	Priority setting, Monitoring and Evaluation
PVP	Plant Variety Protection
QRs	Quantitative Restrictions
QRT	Quinquennial Review Team
R&D	Research and Development
RAC	Research Advisory Committee
RMP	Research Management Position
S&D	Special and Differential
SAARC	South Asian Association for Regional Cooperation
SACs	South Asian Countries
SAUs	State Agricultural Universities
SDC	State Development Co-operation
SEI	Social Equity Index
SKY	Samridhi Kisan Yojana
SLSI	Sustainable Livelihood Security Index
SPS	Sanitary and Phytosanitary
SSD	Sub-Surface Drainage
STC	State Trading Corporation
STE	State Trading Enterprises
STW	Shallow Tubewell Schemes
TBT	Technical Barriers to Trade
TE	Technical Efficiency/ Triennium Ending
TFP	Total Factor Productivity
UNEP	United Nations Environment Program
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
UP	Uttar Pradesh
US	United States of America
USFDA	United States Food and Drug Administration
WTO	World Trade Organization

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EXECUTIVE SUMMARY

1. National Centre for Agricultural Economics and Policy Research (NCAP) was established by the Indian Council of Agricultural Research (ICAR) in 1991 to strengthen agricultural economics and policy research in the national agricultural research system (NARS). Integration of economics in planning and evaluation of agricultural research, and policy-oriented empirical research to promote science-led agricultural growth, are the twin pillars of the Centre's strategy.

2. The Centre's mandate is to

   - Conduct policy-oriented research in network mode on (a) technology generation, diffusion and impact, (b) sustainable agricultural production systems, (c) interaction between technology and other policy instruments like incentives, investments, institutions and trade, and (d) agricultural growth and development with focus on the role of technology.
   - Strengthen capacity in agricultural economics and policy research in the national agricultural research system.
   - Enhance ICAR participation in agricultural policy decisions through policy-oriented research and professional interaction.

3. The Centre has an approved cadre strength of 25 scientists (6 Principal Scientists, 8 Senior Scientists and 11 Scientists). Currently, 15 scientists are in place. In addition, there is one National Professor and one National Fellow. By 2010, a full complement of 25 scientists would be in place. The disciplines and specializations of staff will be governed by the research thrusts and specialized areas. The Centre would also strengthen network research in agricultural economics to harness the potential available in State Agricultural Universities (SAUs) and ICAR institutes. Researchers with experience and established scientific reputation in priority areas of NCAP will be invited from India and abroad, for a period ranging from 3 months to 12 months as visiting scientists. The Centre will also initiate to have 2-3 positions of post-doctoral fellows to work on NCAP-identified priority research areas.

4. The Centre has completed one and a half decade of its existence, and has made significant contributions to areas like research resource allocation, high-value agriculture, innovations in farm-firm linkages, application of information and communications technology, domestic market reforms, international trade, intellectual property rights, integrated pest management, aquaculture, seed systems, watershed management, water-food security, crop-livestock interactions, etc., through in-house and collaborative research with national and international research institutions. Some of the important international research partners of the Centre are: Consultative Group for International Agricultural Research (CGIAR), Overseas Development Institute, Food and Agriculture Organization, United Nations Environment Programme and the World Bank. By the end of 2006, the Centre has published 217 research papers in professional journals and 21 books, in addition to making presentations in the professional and policy advocacy meetings. The Centre also publishes Policy Papers, Policy Briefs and Workshop Proceedings articulating professional

views on the contemporary themes. So far 23 Policy Papers, 25 Policy Briefs and 14 Workshop Proceedings have been published. NCAP is at the take-off stage, and with modest support from ICAR, it will move rapidly to fulfill its mandate and expectations.

5. Inadequate attention to agricultural economics in the NARS in the past has hindered the growth of the discipline and quality of research work. Poor linkages with mainstream economics research organizations have also been responsible for very little policy influence. These weaknesses have led to gaps in human resource development that have emerged in some areas such as international trade, macro-economic policies, environmental economics, agricultural growth and development, policy modelling, etc. These constrain the capacity of the system to cope with the emerging problems. A reorientation of research agenda along these lines on the part of agricultural economists in the NARS will greatly contribute to the overall efficiency of the system. This will require support and leadership. NCAP is uniquely placed to play this role. Through its linkages with SAUs, it can achieve a more relevant blend of micro and macro perspectives in policy analysis. Efficiency in the management of agricultural technology is the prime task of NARS. Agricultural economists can contribute to this by undertaking research on identification of research needs, prioritization of research and resource allocation, and other agricultural research policy areas. Understanding of the technology transfer process and constraints inhibiting it is critical. The other areas that need to be researched relate to efficiency of modern inputs (water, agricultural chemicals, plant varieties and fertilizers) used in crop and animal production systems, input-output price policies, poor input delivery system, and other socio-economic constraints, which affect adoption lags and technical inefficiency. Finally, monitoring and evaluation of the impact of technological change in terms of growth, equity, sustainability, and international competitiveness would be essential.

6. While market studies have a very broad relevance, NARS needs to concentrate on growth- related areas such as high-value products, commodities with export potential, and factor-product market constraints. There is a poor understanding of supply, demand, prices and market conditions, especially for commodities which were traditionally minor but will now become important. Because of their better understanding of the underlying production and technology conditions, the NARS has comparative advantage to undertake such work. The impact of price policy, quality enhancement, processing and grading on prices and incomes constitute other important research areas.

7. The NARS is an important repository of information on the health of our natural resources, specific agents causing their degradation, and technological options available to prevent degradation and rehabilitate the degraded resources. Agricultural economists within the system must address the economic and social dimensions of this problem. This is a frontier area and NCAP must play a catalytic and leadership role in developing capacity in this field. Specifically, impact assessment, trade-offs between productivity growth and sustainability, climate change and environment-adjusted costing of technologies and programmes are important research areas. A lot of work is being done on these areas outside the NARS; NCAP should aim at integrating such research into the system's research agenda.

8. The paradigms which governed institutional development and agricultural transformation have undergone a sea change in recent years. Private initiatives and private sector participation have become the key words. Serious empirical studies on this theme, particularly relating to agriculture, are needed. On the other hand, new constraints have emerged in several areas (like investments, financing, insurance, marketing, trade and agro-processing) where public intervention is a pre-requisite. Several institutional innovations have 'pubic good' attributes; these are not amenable to private initiatives and require group action. Moreover, even in the public sector, the interface between policies, economics, governance, sociology and technology is changing and posing new challenges to institutional and organisational development, such as better management of the public distribution system, management of common property resources (CPR) and technologies, role of panchayats, etc. There is a need to understand, document, and analyse these phenomena so that a more relevant paradigm is evolved, and NCAP can shoulder these responsibilities.

9. Agricultural growth pathway is defined by the interaction of technology, policies, incentive structure, investments, and resource endowments. Understanding of these forces, their patterns and determinants is essential for agricultural planning. Agricultural development needs to be studied in a long-term perspective, emphasizing farm-non-farm linkages, structural changes in agriculture, and other adjustment processes characterizing agricultural transformation. Longitudinal, field-level studies in all major agro-ecological zones of the country are needed to keep track of these developments and interpret their implications for agricultural technology and other policies. This tradition has, unfortunately, gone out of vogue and the Centre could revive such basic research by helping ICAR and SAUs to initiate this activity on a sustained basis. The following major research themes are derived for NCAP:

- Economic evaluation of prospective agricultural technologies
- Agricultural biotechnology and intellectual property rights
- Yield gap analysis and constraints to higher yield
- Agricultural research resource allocation and policy
- Impact assessment of agricultural technologies
- Efficiency and comparative advantage in agricultural production
- Impact of natural resource degradation and coping strategies
- Climate change and carbon trading
- Projections of food demand and supply with focus on high-value and processed commodities
- Globalization and its impact on agriculture
- Management of agricultural risks
- Institutional innovations in agriculture and agri-food markets
- Information and communication technologies
- Agricultural diversification and smallholders
- Public and private sector investments in agriculture
- Sources of agricultural growth and regional disparities

10. For human resource development, three major initiatives are planned. First, the Centre will strengthen its documentation and dissemination unit which will serve the needs of agricultural economists working in the NARS. Second, NCAP will offer training programmes alone and in collaboration with other institutions in India and abroad. Third, the Centre will undertake capacity strengthening of its staff in policy modelling.

11. Strengthening policy research capabilities through research and training activities outlined above would improve the existing situation. Publications of the Centre will also contribute fill this gap. In addition, the Centre will organise seminars/conferences on important themes and make explicit attempt to convey policy messages by evolving a policy advocacy network.

12. Linkages with other policy research institutions such as the Agro-Economic Research Centres, institutes of the Indian Council of Social Sciences Research (ICSSR), universities, international agricultural research centres (IARCs), agro-biological divisions of ICAR institutions and SAUs, policy and planning units in the Ministries of Agriculture, Rural Development, Commerce, and Finance and the Planning Commission will be strengthened. Concerted efforts will be required to develop these linkages over the next five years on a priority basis. Organization of seminars, workshops, training programmes, undertaking collaborative research, dissemination of policy research and greater personal interaction will be the mechanisms for developing these linkages. Multi-disciplinary research will be a major strategy to fully exploit the Centre's comparative advantage.

13. The Centre has the capacity to analyse and interpret policy implications of technology-generating activities. It has already created an institutional base for prioritisation of research, as dictated by national concerns. The Centre will further improve its credibility as a policy research group and will provide an effective mechanism for policy dialogue between ICAR and policymaking fora. With an ultimate aim to emerge as an island of excellence in agricultural economics and policy research, nationally and globally, the Centre shall mobilize all its strength to realize the following vision:

Vision: **Leveraging Innovations for Attaining Efficient, Inclusive and Eco-friendly Agricultural Growth through Agricultural Economics and Policy Research**

Mission: **To strengthen agricultural economics research for providing economically-viable, socially-acceptable and environmentally-feasible policy options for science-led agricultural growth.**

14. The Centre's contributions will be determined by its ability to create and nurture leadership around competent professionals, uncompromising quality standards, effective decentralization, and healthy conventions to create productive, dedicated and efficient work culture. This commitment has to be shared by the entire staff, and reiterated as the Centre grows. Plans and perspectives are important, but it is this commitment of the staff that makes any organization more strong. We dedicate ourselves to this Vision.

1. PREAMBLE

The National Centre for Agricultural Economics and Policy Research (NCAP) was established by the Indian Council of Agricultural Research (ICAR) to strengthen agricultural economics and policy research in the national agricultural research system (NARS), comprising ICAR, its affiliated institutions, and the State Agricultural Universities (SAUs). NCAP, intended to serve as 'eyes and ears' for the Council, monitors and interprets the research implications of changes in ground realities as well as macroeconomic environment. The Council recognizes that strong agricultural economics input is essential for improving the realm of agricultural research, as research tasks are becoming more complex and market-driven.

ICAR has unmatched capability and long experience in creating effective agro-biological research institutions. The establishment of NCAP was its first attempt in social science research, an area where ICSSR, universities, autonomous organizations and ministries have been responsible for building and nurturing research institutions relevant to socio-economic and policy research. The Council, based on its needs and comparative advantage, has identified a complementary and non-competitive role for this Centre.

The agenda proposed in the perspective plan may appear over-ambitious. Yet, in view of the national mandate, immense complexities of Indian agriculture, increasing importance of science and technology and urgency of solutions under fast changing business-climate, it is necessary to set high aims. It is envisaged that the research outputs of the Centre must attain international standards. The success of this Centre will depend upon hard and dedicated contributions of its staff combined with developing synergies and exploiting complementarities and linkages with national and international institutions. The Centre had prepared a well articulated Vision 2020 document in 1997. That document is still valid but, with the rapidly-changing economic climate, there is always a need for reviewing, reassessment and renewal. This vision document offers a chance to move effectively, confirm and expand the understanding of the latest business thinking with a focus on improving the business strategy and responsiveness continuously. This document after revisiting the first vision document of 1997, articulates a perspective plan for winning performance, encompassing research, capacity strengthening and policy communication activities for NCAP.

2. MANDATE

The Centre was officially established in March 1991, the last year of Seventh Five-Year Plan. The original mandate of the Centre included: (a) agricultural policy analysis and research; (b) research priorities and allocation of research resources in the ICAR; (c) economic analysis of major agro-biological research programmes and technologies of the ICAR; and (d) interplay of technology, institutions and ecology in growth, equity and sustainability.

The successive Research Advisory Committees (RACs) and the Quinquennial Review Teams (QRTs) of the Centre have articulated a vision, which necessitates recasting of the mandate to better reflect the expected role. The proposed mandate of the Centre covers:

- Policy-oriented research in network mode on (a) technology generation, diffusion and impact; (b) sustainable agricultural production systems; and (c) interaction between technology and other policy instruments like incentives, investments, institutions and trade, and (d) agricultural growth and development with focus on the role of technology.
- Strengthen capacity in agricultural economics and policy research in the national agricultural research system.
- Enhance ICAR participation in agricultural policy decisions through policy-oriented research and professional interactions.

As regards the first mandate, the Centre would promote basic policy research more vigorously, and capitalize more on the comparative advantage of micro-level understanding of agriculture in a network mode (as opposed to macro-level, where there are more players, elsewhere). In the coming years, the Centre would emphasize on the networking by involving more partners in the NARS. The remaining two mandates will be addressed through organization of training programmes, workshops and in-house publications on the agricultural policy issues of national importance.

3. GROWTH

3.1 Infrastructure

The Centre is located in the Pusa campus in New Delhi. The Indian Agricultural Research Institute (IARI), Indian Agricultural Statistics Research Institute (IASRI), and a number of international research institutes under CGIAR system are in close vicinity of the Centre. This offers locational advantage to the Centre in terms of opportunities for interdisciplinary and interinstitutional interactions and research as well as access to libraries , computational facilities and other infrastructure available at these institutions.

3.2 Budget

After a token allocation of Rs. 10 lakh in 1991-92, the expenditure of NCAP has increased to Rs 2.81 crore in 2006-07. Higher allocations were made through Plan and Non-Plan funds. Substantial increase in Plan funds in three years (1999-2000, 2004-05 and 2005-06) was for the construction of its office building (Table 1). So far Centre has not faced any resource crunch.

3.3 Manpower

The VIII Plan had a provision for seven scientific, nine administrative, four technical and three auxiliary staff for NCAP. Subsequently, a cadre of 20 scientific staff was approved. In 2006, the Council approved a cadre strength of 25 scientists for the Centre. Of these, fifteen scientists, and eight administrative, five technical, and two supporting personnel are presently in position. In addition, a National Professor and a National Fellow are also posted at the Centre. All scientific positions in the Centre have been created through redeployment of approved positions in the Council and no new posts have been sanctioned.

Table 1: Growth in NCAP expenditure : 1992-93 to 2006-07

(in lakhs Rs)

Year	Plan	Non-Plan	Total
1992-93	9.82	0.51	10.33
1993-94	20.99	5.93	26.92
1994-95	28.95	4.29	33.24
1995-96	49.86	5.55	55.41
1996-97	40.00	13.10	53.10
1997-98	51.25	18.12	69.37
1998-99	57.55	62.78	120.33
1999-00	185.23	59.64	244.87
2000-01	64.87	55.74	120.61
2001-02	59.50	55.96	115.46
2002-03	39.70	81.61	121.31
2003-04	48.23	92.81	141.04
2004-05	206.37	100.85	307.22
2005-06	224.90	124.68	349.58
2006-07	146.80	111.65	293.24

Table 2: Growth in personnel 1992-93 to 2006-07

Year	Number of staff in different categories			
	Scientific	Technical	Administrative	Supporting
1992-93	2	-	-	-
1993-94	3	-	3	2
1994-95	3	4	9	2
1995-96	6	3	9	2
1996-97	13	5	8	2
1997-98	17	5	8	2
1998-99	18	5	9	2
1999-00	18	5	8	2
2000-01	17	5	8	2
2001-02	17	5	8	1
2002-03	16	5	8	2
2003-04	15	5	8	2
2004-05	15	5	8	2
2005-06	15	5	7	2
2006-07	15	5	8	2

4. RESEARCH ACHIEVEMENTS

The Centre has completed fifteen productive years. Despite small faculty, it has made considerable contributions to the mandated areas. Important areas included agricultural research resource allocation, R&D policy, seed system development, potential of agricultural diversification and high-value agriculture, rainfed agriculture, agricultural trade liberalization, livestock development, fishery policy, vulnerability assessment and privatising farm extension. Several research papers have been published by the Centre in professional journals, and presented at professional meetings.

The Centre has also initiated publication of Policy Papers based on ICAR-sponsored and its own research, and Policy Briefs articulating professional views on important themes. By the end of 2006, the Centre has published 21 books, 23 Policy Papers, 25 Policy Briefs, 217 research articles and 14 Workshop Proceedings (Table 3), research projects and has disseminated them to more than 700 interested individuals and institutions. About 13 completed projects have been brought out as research reports.

Table 3: NCAP's publications: 1995-2006

Publications	1995-2000	2001-06	Total
Books	13	8	21
Policy Papers	12	11	23
Policy Briefs	13	12	25
Research Articles	134	83	217
Workshop Proceedings	8	6	14
PME Notes	6	8	14

Scientists of the Centre actively participate in policy discussions relating to agricultural development. These have covered areas such as national research policy, prioritisation of agricultural research, research resource allocation, human resource development, and formulation of Tenth/Eleventh Five-Year Plans, besides active participation in the National Agricultural Technology Project (NATP), and formulation of recently-launched National Agricultural Innovation Project (NAIP). The Centre is also involved in guiding policies and programmes at several international fora such as South Asian Association for Regional Cooperation (SAARC), United Nations Economic and Social Commission for Asia and Pacific (UNESCAP), Asia Pacific Association of Agricultural Research Institutions (APAARI), etc. In pursuit of its disciplinary leadership mandate, the Centre has, through collaborative research and seminars/ conferences, initiated processes aimed at developing partnerships with institutes of the Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAUs), agricultural economics divisions/ units and premier institutions like Institute of Development Studies (IDS), Jaipur, Institute for Social and Economic Change (ISEC), Bangalore, Institute of Rural Management, Anand (IRMA), Indian Institute of Foreign Trade (IIFT), Planning Commission, GOI, State Governments, National Bank for Agricultural and Rural Development (NABARD), private sector institutions like Operational Research Group, New Delhi, Cirrus Management Services, Bangalore, Rapid Agri-Biotech Consultants, New Delhi, All India Management Association (AIMA), Delhi, etc.

The Centre has also established partnership with international institutions like International Food Policy Research Institute (IFPRI), International Rice Research Institute (IRRI), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Maize and Wheat Improvement Centre (CIMMYT), International Livestock Research Institute (ILRI), World Fish Centre (WFC), the World Bank, Food and Agricultural Organization (FAO), Asia Pacific Association of Agricultural Research Institutions (APAARI), Asian Development Bank (ADB), Overseas Development Institute (ODI), United Nations Environment Program (UNEP) and State Development Co-operation (SDC).

The activities undertaken by the Centre have generated professional and academic interest among policymakers, researchers and administrators, and have contributed to developing a credible research base and making the Centre's presence visible in the profession, nationally and internationally.

Dr. R. S. Paroda, Former Secretary, DARE and Director General, ICAR releasing first publication of NCAP

4.1 Major Research Achievements

Technology Policy

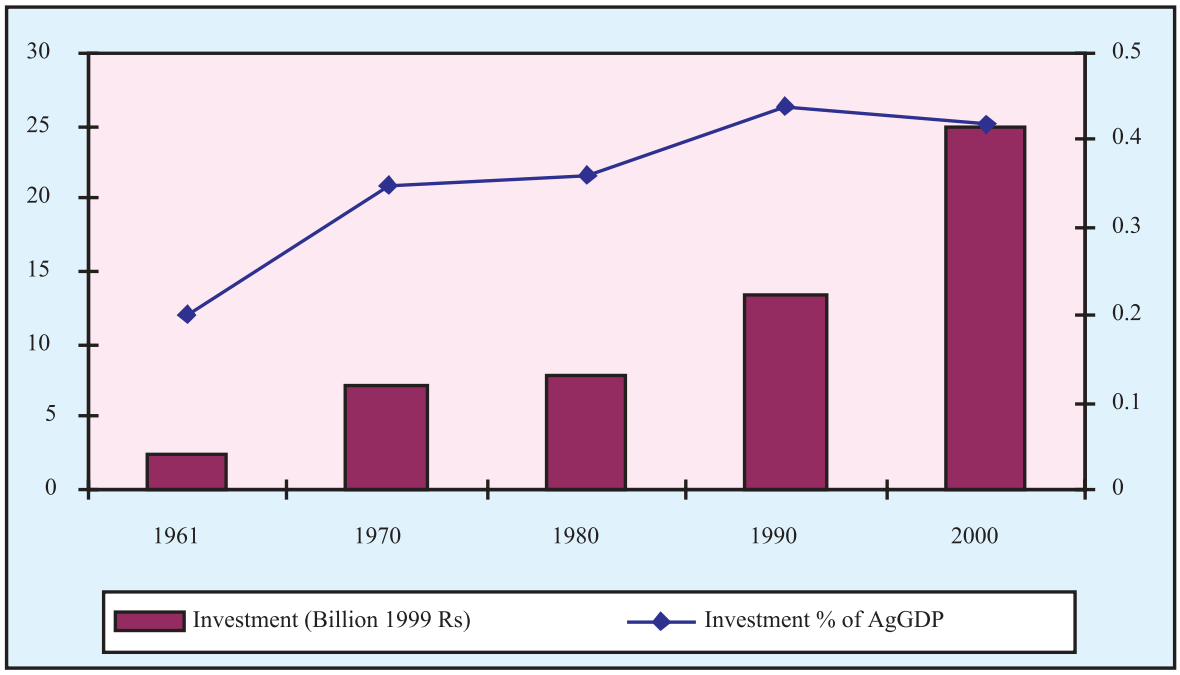
Agricultural research investment

India has consistently committed substantial public funds for research in all fields of science, including agriculture. The total government funding for agricultural research and education increased in real terms (1999 prices) from Rs 2.5 billion in 1961 to Rs 7.9 billion in 1980. It rose to Rs 25 billion in 2000; a ten-fold increase over the past four-decades period. An increasing trend is observed for both central and state fundings. Funding from the states grew rapidly during 1960s when a large number of SAUs were established. Central funding (for ICAR) has outpaced state funding (for SAUs) thereafter, and their shares became almost equal during 1980s and 1990s. Overall, the government funding grew at the rate of 3.2 per cent per annum during 1970s, 7 per cent during

1980s, but slowed down to 4.6 per cent during 1990s. Nearly three-fourths of the total resources were spent on research and the rest on education (mostly in SAUs) and on-farm testing, refinement and demonstration of new technologies.

The expenditure as percentage of agricultural gross domestic product (AgGDP) increased significantly during 1960s and 1980s, but remained around 0.4 per cent during 1990s. This slowdown in research intensity is worrying given that the average research intensity for all developing countries is 0.6 per cent and it is 1 per cent globally. A part of this difference could be attributed to the relative importance of agriculture, economies of scale and scope in agricultural research. But China, a country of comparable size and stage of development, spends 0.43 per cent of her AgGDP on research as against 0.29 per cent in India (excluding education). The intensity ratios for Latin America and Africa are more than double of India. Thus, there is a clear case of under-investment in agricultural research in India. Nevertheless, the actual government investment and size of agricultural research system have reached a level that requires a close social audit. It is reasonable to expect that uptrends in the research investment should not be accompanied by declining scientific productivity and payoffs.

Figure 1: Trends in government funding to agricultural research and education in India



Research prioritization of agro-eco-regions

Enormous diversity in agro-climatic, economic and socio-cultural environments in India necessitates the need to delineate the country into homogeneous regions for proper planning of agricultural research and maximize benefits therefrom. This study has delineated the country into five agro-ecosystems, viz. Arid, Coastal, Hill & Mountain, Irrigated, and Rainfed, with a number of production systems therein. The delineated agro-eco-regions and production systems cut across administrative boundaries. This suggests the need for closer linkages between research institutions, particularly State Agricultural Universities. Characterization of the agro-ecosystems and production systems has revealed a substantial

contribution of livestock in all the agro-eco-regions and production systems, suggesting thereby the need to consider the crop-livestock interactions in research and development strategies. The research strategies however may differ across regions, depending on the input-output relationships.

Aggregate level priority setting

Irrigated agro-eco-region should get 9 per cent more of the research resources (Figure 2). Half of the research resources should be allocated to livestock sector in the Arid agro-eco-region. Similarly, about 30 per cent of research resources should go to horticultural crops in the Coastal agro-eco-region (Table 4).

Figure 2: Existing and normative allocation of resources by agro-eco-regions

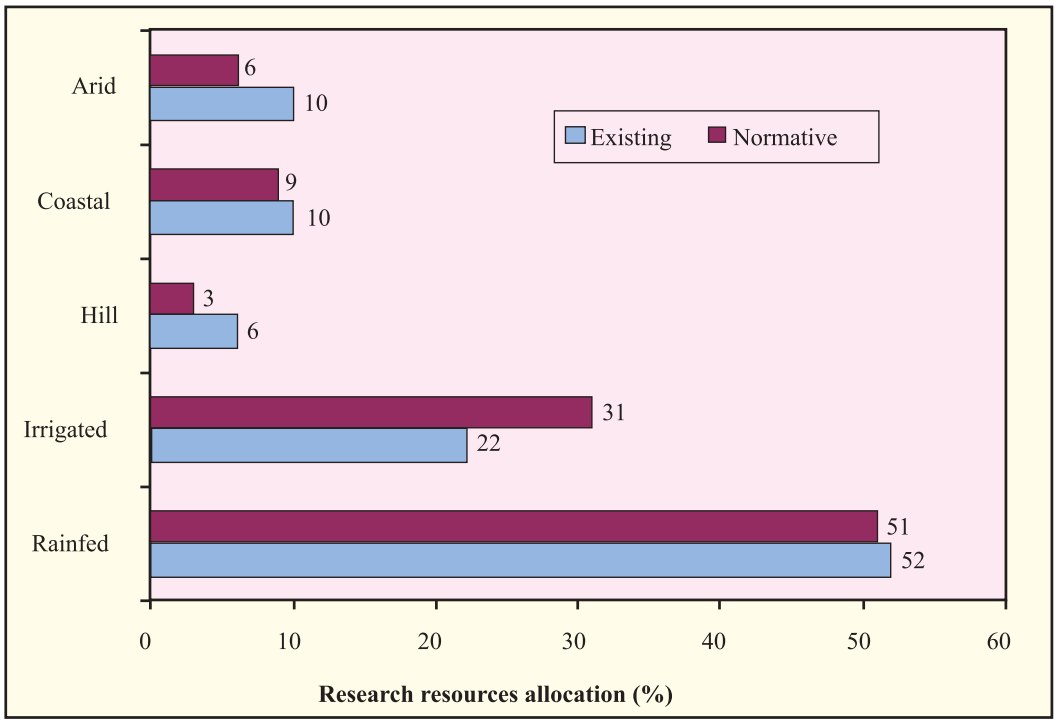


Table 4: Research resource allocation across agro-eco-regions by commodity groups

(in per cent)

Commodity	Agro-eco-regions					Overall
	Arid	Coastal	Hill	Irrigated	Rainfed	
Cereals	17	37	38	38	26	31
Pulses	4	1	Neg.	3	6	4
Oilseeds	24	5	2	4	13	10
Livestock	51	21	44	39	34	36
Horticulture	2	30	10	8	11	11
Other crops	2	6	5	8	10	8

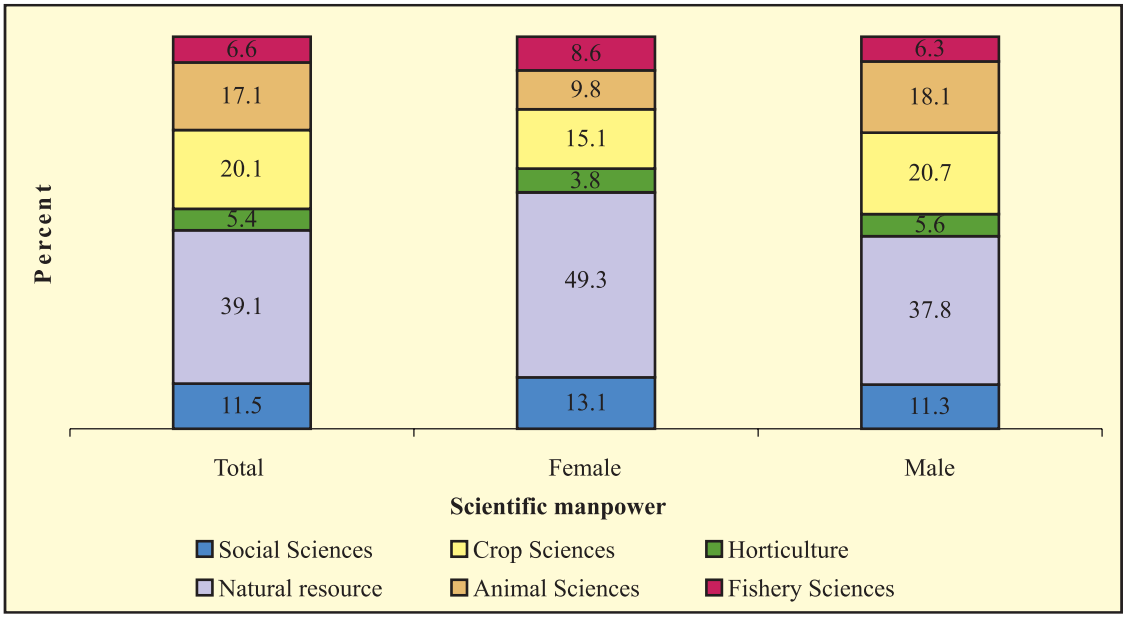
Profile of scientific manpower in ICAR

The 'Census of Scientific Manpower in Agriculture-2001' has covered 4697 scientists of the Indian Council of Agricultural Research (ICAR), representing almost its entire scientific strength.

The average age of ICAR scientists is now 45 years, with 43 per cent falling in above the average age level. The high average age as well as high proportion of scientists in the declining productivity phase necessitates induction of young scientists in the research cadre. With regard to gender, barely 12 per cent of ICAR scientists were women till recently. This is not surprising since a historical gender-bias existed in agricultural education, which has been redressed only recently. An in-depth scrutiny has revealed that nearly two-thirds of the women scientists are below 40 years of age, and the in proportion declines in higher age groups. About 92 per cent of total scientists are operational scientists, pursuing research, education and extension whole time. Only 8 per cent hold research management positions.

Areawise 45 per cent of the scientists are engaged in crop sciences research, including horticulture, followed by natural resource management (20 per cent), animal sciences (17 per cent), fisheries (12 per cent) and social sciences (7 per cent). Since crops constitute the core of agriculture, this appears quite rational.

Figure 3: Distribution of ICAR scientists by disciplines and gender 2001



On an average, there are 48 scientists per ICAR institute. About half of these institutions have less than 30 scientists and they account for about one-sixth of the total ICAR scientists. With an average size of 7 scientists in 27 institutions, one wonders whether the critical mass criterion is violated. On the other extremes, only 4 ICAR institutes share about 22 per cent of the total scientific strength, with an average size of about 300 scientists. These numbers suggest the need for some rationalization

in allocation of scientific manpower to improve research efficiency. In this climate of rightsizing, any across-the-board adjustment should be guarded.

Resource allocation for agricultural research in NARS

Ever since the identification of agricultural R&D as a high pay-off venture, analysts have been making a case for higher investments on it. Over the past thirty-odd years, agricultural research investment intensity in India has more than doubled. Though it still falls short of the modest goal of one per cent of agricultural GDP, the huge size of agricultural sector has made the Indian National Agricultural Research System (NARS) one of the largest in the world in terms of skilled human resources. Rapidly growing research agenda on the one hand, and scarcity of public funds in the reforms era on the other, have focused attention on efficiency in resource allocation. And this was the aim of a national study on resource allocation for agricultural research sponsored by the ICAR during 2000-05.

Such analyses in the past have been based on indirect indicators, mainly scientific publications data, since reporting and monitoring yardsticks used in public systems concentrate on budget heads and not on technical programme content, and rarely on human resources. The core objective of this study was to collect and compile current data on allocation of research resources by commodity, resource and agroclimatic regions of the country, and to identify opportunities for redeployment of resources, based on such objective criteria as efficiency, equity, market and trade issues, etc. This needed activity-specific data on resource deployment.

Though several studies have reported more than 10 per cent share of the private sector in agricultural R&D investments, its share in manpower resources is much smaller. Nearly 95 per cent of the scientists are working in the public sector. The SAUs account for more than 56 per cent, but these have hardly been reviewed as intensively as in the central system. The study has also observed that ICAR scientists are more research-focused as compared to those in other institutions where teaching (SAUs), extension (other public), and management and extension (private) claim significant time of the scientists.

Commodity, resources and agro-climate are treated as independent dimensions for the resource allocation exercise. This is an analytical classification only, since most agricultural research projects embrace all these dimensions.

Table 5: Distribution of agricultural scientists in the NARS

Category	Number of scientists	Full-time equivalent (FTE)	
		Number	Per cent
Public	20921	9794	94.6
a) ICAR	4539	3069	29.7
b) SAUs	13633	5810	56.1
c) Others*	2749	915	8.8
Private	948	556	5.4
Total	21869	10350	100.0

* Includes institutions like other government departments, KVKs, and semi-government organizations.

Commodity focus of research. Indian agriculture is both large and diverse. Even after aggregation at lower levels, more than 160 commodities appear in the portfolio. Agricultural research in the country is dominated by the crop sector; four-fifths of all commodity-oriented research is dedicated to it at the national level. Livestock research claims 15 per cent and fisheries research accounts for only 5 per cent. Very broadly, the pattern is biased towards the crop sector. However, over the past decade or so, the central sector (ICAR) has been trying to rationalize this bias towards the crop sector and higher emphasis is being laid on livestock and fisheries research. The SAUs, and other public and private institutions continue to lag behind in the fisheries research. The private sector misses out on livestock research too.

Further, the foodgrain research is most important nationally and cereals dominate in this sub-sector. With attainment of higher level of food security, the relative importance of foodgrain research has gone down in recent years, but all institutions try to maintain the core capacity and critical strength in this area; as grassroots level institutions, the SAUs have greater rigidity in this regard. Interestingly, its share is also high in the private sector. Hybrids of maize and millets provided the entry point to the private sector in the country and these, alongwith hybrid rice, keep the cereals attractive.

Horticulture is the emerging sector in India. Though the ICAR-SAU system allocates more than one-fifth of manpower resources to this sector currently, 'other' public institutions and the private sector appear to have responded more aggressively in this regard. Oilseeds follow next in priority and public systems, particularly SAUs, accord relatively more importance to this group. In fibre crops research, the private sector institutions have been found paying relatively more attention.

Table 6: Allocation of research resources across major commodity groups by institutions (in per cent)

Commodity group	Institutions		
	Total Public	Private	All
Food grains	29.7	27.4	29.6
Horticulture	27.3	47.3	27.9
Oilseeds	9.3	4.9	9.2
Fibres	6.5	13.2	6.8
Commercial crops	4.9	2.3	4.8
Fodder crops	1.7	0.0	1.6
Total crops	79.4	95.0	79.9
Livestock	15.7	4.8	15.3
Fish	4.9	0.2	4.8
Total	100.0	100.00	100.0

Livestock and fisheries research, particularly the latter, receives higher priority in the public research system and, within this, in the ICAR. Broadly, horticulture, livestock, and fisheries have emerged as the high-growth, high-potential sectors of Indian agriculture. The central system appears to be the most responsive; others, including the private sector, have not been able to switch resources from the crop sector as efficiently.

Statistical tests have revealed that there was a fair agreement in the rankings assigned to various commodity groups by the central (ICAR), state (SAUs), and private research institutions, implying that all these institutions are guided by similar research objectives and appear to prioritize commodities in a similar manner.

Resource focus of agricultural research. Agricultural research is mostly mediated through production resources genetic material, land and water, agro-chemicals, energy and so on. Germplasm, soil and water resources claim more than 55 per cent of all research allocations (Table 7). This holds true across the board but the private-sector research is sharply biased towards germplasm and has hardly any contribution to soil-water research. Within the public sector, the ICAR-SAU system accords a relatively high priority to research on germplasm and soil and water. Feed and fodder resources, which are important for the livestock sector, appear to be neglected, even if the effort in commodity-oriented research is factored in.

Agro-chemicals (fertilizers, pesticides, weedicides, drugs/vaccines, other chemicals) rank second in the overall resource allocation list. The state system accords disproportionately high priority to them, particularly since these have high spillover potential; however, variations in local agro-climatic conditions necessitate considerable downstream research before optimal input-use strategies are finalized. Globally, private sector is the major player in this research; Table 7 does not show this pattern. Energy (power and machinery) resources account for 4.8 per cent of resource-focused research. As expected, private agricultural R&D pays significantly more attention to the latter as compared to other institutions.

Table 7: Resource-focused agricultural research by institutions (in per cent)

Resource group	Total public	Private
Germplasm	33.8	52.2
Soil / water	21.6	3.1
Agro-chemicals	26.8	16.9
Power / machinery	4.8	19.4
Feed / fodder	1.7	0.1
Socio-economic	8.7	1.7
Statistics/database	1.1	0.9
Others*	1.5	5.7
Total	100.0	100.0

* Include fungi /algae/ bacteria, insect/ pest/ parasite, weed /sea weed, grasses.

Non-material resources account for a little more than 11 per cent of resources, most of it relates to socio-economic variables. The ICAR-SAU system pays more attention and the private sector does not accord any priority to this area. We need to note that human, social, economic, and institutional resources have not traditionally been parts of agricultural research till a few decades ago and other institutions have played the major role.

Regional focus of agricultural research. Regionalization of Indian agriculture remains analytically challenging. The distribution of research resources in the 15 zones identified by the Planning

Commission for each institutional category, shows that the aggregate pattern is largely determined by variations in the research-base situation in the states (Table 8). The zones having a strong back up of the SAUs get a larger share. More than 56 per cent of ICAR resources are in six zones, viz. Zones 4, 5, 8, 10, 11 and 12; the last four of these have strong state support also.

The Himalayan region (Zones 1 and 2), the Middle Gangetic Plains and the East and West Coast regions (Zones 11 and 12) have high (58 per cent) concentration of other public institutions.

Table 8: Regional focus of agricultural research resources by institutions (in per cent)

Sl. No.	Region*	Total Public	Private	All institutions
1.	Western Himalayas	7.2	4.2	7.0
2.	Eastern Himalayas	5.3	4.0	5.2
3.	Lower - Gangetic Plains	3.3	4.2	3.3
4.	Middle - Gangetic Plains	6.2	9.3	6.3
5.	Upper - Gangetic Plains	6.1	9.3	6.2
6.	Trans - Gangetic Plains	12.3	6.0	12.1
7.	Eastern Plateau & Hills	3.7	4.6	3.8
8.	Central Plateau & Hills	8.8	6.8	8.7
9.	Western Plateau & Hills	7.6	8.6	7.7
10.	Southern Plateau & Hills	9.7	11.5	9.8
11.	East Coast Plains & Hills	8.8	8.8	8.8
12.	West Coast Plains & Hills	11.2	7.8	11.0
13.	Gujarat Plains & Hills	5.3	6.3	5.3
14.	Western Dry	3.5	4.6	3.6
15.	The Islands	1.1	3.9	1.2
	Total	100.0	100.0	100.0

*Planning Commission Zones.

Small farms and agricultural research

Indian agriculture is characterized by acute land scarcity. Average farm-size has been going down, as population pressure on agriculture remains oppressive. Very slow growth in non-agricultural employment has impeded the structural transformation of Indian agriculture. Relative factor scarcity dictates land-augmenting and labour-using technical changes. This is consistent with both growth and equity objectives.

The time path of agricultural growth shows substantial gains in land and labour productivity in the post-Independence period. Rapid gain in land productivity coincides with the green revolution phase. Subsequently, growth in labour productivity has been relatively stronger. This pattern is

consistent with the historical pathway in other land-scarce countries in Asia. What is notably different is that in other land-scarce Asian countries, there has been a concomitant increase in land-man ratio and a rapid decline in agricultural labour force. In India, on the other hand, the land-man ratio has deteriorated. The turnaround in the growth curve since 1980s is somewhat disturbing because it implies a relative slackening of land-augmenting in relation to labour-saving technical change. This does not augur well for small and poorer farmers. More vigorous efforts are needed to use frontier science to break the land productivity barriers.

Information flow in seed system

Since early 1980s, the private seed industry has been growing fast in the country. And with the presence of multiple seed agencies, availability of modern seeds has improved. But, the concern remains regarding how effectively seed is delivered to the farmers. Studies conducted for commercial pearl millet (Rajasthan) and rice (Andhra Pradesh) seed markets indicate that there is little flow of information to the farmers. 'fellow farmer' continues to be the most important source of information on varieties and hybrids, followed by seed dealers. Multiplicity of actors in seed system may be good for competition, but it may confuse farmers, particularly when there are dozens of hybrids and varieties. The seed agencies, particularly in the public sector, should strengthen the information system. Involvement of farmers in testing of promising seed material would be highly beneficial. Consumer education and prompt redressal of grievances are essential to make the seed system more responsive.

Intellectual property rights (IPRs) and seed industry in the developing countries

This study emphasizes that IPR regimes in plant breeding should provide incentives for diversifying and strengthening plant breeding and seed production systems. This implies that policymakers cannot consider IPR regimes in isolation from wider issues of national agricultural policy. The role of National Agricultural Research Institutes (NARIs) is a subject of debate in the light of generally declining national budgets and growth of the private sector. Many NARIs are uncertain whether to complement or compete with the private sector and hence are confused about how to take advantage of IPRs. Policymakers need to set clear guidelines in this area. NARIs need to distinguish between using IPRs in order to facilitate the use and delivery of their varieties, and seeing IPRs as a contributor to institute budgets through royalty income. Most NARIs seem to have little knowledge about the costs of obtaining and enforcing IPRs, and there is little realistic assessment within the NARIs of their capacity to compete with the private sector in producing commercially-viable products (or in rewarding and maintaining staff for this task). Most NARIs are too poorly organized to acquire access to complementary technologies on equitable terms or to assess their freedom to operate with protected techniques and tools. NARIs are no match to the legal and negotiation skills, and resources of the major technology firms. NARIs need assistance to formulate IPR policies and strengthen their legal and negotiation capacities.

Policymakers must recognize that systems of international germplasm exchange are being threatened by an almost exclusive focus on the possible financial advantages accruing to the control of germplasm, without appreciating the importance of facilitated access. They also need to ensure the development of the private domestic breeding sector. With few exceptions, domestic firms do not have the resources to invest in high technology and must depend on MNCs and advanced research

institutions that protect their inventions. There are a few examples of incipient consortia of local seed companies formed to negotiate access to technology, and national policy should support such efforts. There are still serious challenges with respect to delivering useful varieties, particularly of non-hybrids and so- called orphan crops, to smallholders.

The combination of limited and isolated markets with widespread seed saving means that even fairly strong IPR regimes are unlikely to attract commercial interests in the near future. Policymakers must find ways of combining (largely) public plant breeding, and appropriate formal seed delivery (most likely private or cooperative), and support the local seed diffusion mechanisms, to serve the farmers dependent on these crops. There are no indications in the case study countries to date that Plant Variety Protection (PVP) unduly contributes to a concentration in the seed sector. Early experiences in biotechnology patents in the case study countries are insufficient to establish any evidence for its concentration, despite the fact that most transgenics currently have one commercial source. However, it is important to support a critical assessment of developments in the coming years. This is an area in which industrialized countries could provide some useful guidance, given their longer experience in monitoring and regulating anti-competitive practices.

Plant variety protection and food security

The results of various studies from developed countries indicate that plant breeders' rights have differential impact across crops. Increasing role of the private sector in plant breeding is accompanied by appropriation strategies with serious implications. For example, increase in the varietal release-rate is accompanied by a shortening life-span of varieties and high level of market consolidation in the seed industry, which has been used to jack up seed prices. Studies from developing countries indicate that while, in certain cases, plant breeders' rights have facilitated access to improved foreign variety but these contributed little to food security. Developing countries should draw upon these experiences while framing and implementing their legislations for protection of plant genetic resources and their impact on food security. Developing countries should work collectively with a focus on maintaining their crop genetic diversity, developing localised seed delivery and production systems with the help of efficient institutional mechanisms. One implication of this is that developing countries need the capacity and full preparedness to participate much more effectively in the international IP negotiations on a regular basis than on exceptional basis. This would help in conservation and proper utilisation of plant genetic resources in such a way that food demands of the population are fulfilled locally and on a sustainable basis.

Pest management for food security

Insect pests, diseases and weeds restrict realization of the full potential of agricultural production. Farmers use different techniques to limit the crop losses. Since introduction of green revolution technology, the pesticide-use in Indian agriculture has grown rapidly till 1990. The growth in pesticide-use outweighed the growth in crop output up-to the first decade of green revolution, and thereafter, it registered a lower growth than that in the agricultural production, partly because of development of pest-resistant crop cultivars and emphasis on adoption of integrated pest management technologies. Though pesticides have contributed substantially to agricultural growth and food security, there is a growing concern about their adverse impacts on ecology and human health.

Keeping this in view, promotion and popularization of Integrated Pest Management practices and greater emphasis on development of pest-resistant cultivars are needed to curtail pesticide-use.

Integrated Pest Management (IPM) is being suggested as an alternative to chemical pesticides. Results based on experimental data on cotton, paddy and chickpea from different locations have provided a mixed picture. In the case of cotton in Gujarat, use of biotechnological inputs alone as well as in an integrated mode was found to have a better yield-saving potential over the chemical control strategy. In Tamil Nadu, biotechnological inputs proved effective when used in conjunction with chemical pesticides, while in Punjab, the chemical pest control strategy retained its superiority. Similar trends were obtained on evaluation of these strategies for their comparative economic advantage. In chickpea, on the other hand, integration of biotechnological inputs with chemical pest control emerged as a better option, technically as well as economically. In the case of paddy, use of biotechnological inputs alone did not show any advantage over chemical pest control. However, conjunctive use of biotechnological inputs and chemical pesticides proved better over chemical pest control strategy, technically as well as economically.

These findings have some important implications for research and plant protection policy. First, there is a need to standardise the technology considering the level of pest infestation and agro-ecological conditions. Development of pesticide resistance in the living organism and pest-control inputs based on them would help increase their efficacy further. Secondly, at present, markets for these products are limited and imperfect. Current prices do not seem to provide much incentives to adoption of these inputs. The research institutions as well as the industry should aim at reduction in cost of production of such inputs through commercial production.

Energy demand for rainfed crop production

The intensification-led growth demands more of commercial non-renewable energy in the form of fertilisers, diesel, pesticides and electricity. Compared to irrigated agriculture, rainfed agriculture uses less commercial non-renewable energy-based inputs. This study has examined the level and pattern of energy-use and its efficiency in soybean-based cropping system of Madhya Pradesh using farm level data. Soybean and wheat are the two most important crops in the soybean belt. Wheat is an irrigated crop and is the most energy-intensive crop (13980 mega joules per ha). Chickpea, which competes with wheat, requires about half of the energy used in wheat cultivation. Commercial sources of energy account for more than 90 per cent of the energy used in cultivation of these crops. Soybean, the kharif season crop grown largely under rained conditions, consumes 7142.5 mega joules per ha of which about 77 per cent comes from commercial sources. Maize, sorghum and blackgram compete with soybean and require one-third of the energy used in soybean cultivation. These crops largely derive their energy requirements from non-commercial sources. Further, energy-use efficiency is higher in coarse cereals and kharif pulses, but these are grown on a limited scale because of their low yield or price disadvantage or both, compared to the dominant crop.

Higher use of commercial non-renewable energy in dominant crops is because it is cheaper than non-commercial renewable energy. It may, however, be noted that some of the non-renewable energy inputs are highly subsidised. The study shows that there is scope for substitution of non-renewable energy with renewable energy, given a favourable policy regime compatible with market forces.

Sources of growth in livestock production

The livestock sector has recorded impressive gains in recent years. Its share in agricultural GDP has been rising. A study undertaken to estimate the contribution of technical change to the growth of livestock output in the country, has shown that technical change contributed about 30 per cent to output growth in the post-independence period. Period-wise results were more revealing. There was no contribution of technical change until 1970. However since then, the contribution of technology to output growth has been around 45 per cent. Backed by an improved market and institutional environment, investments in livestock research have begun to pay-off.

Similar conclusions are drawn from a study of the Karnataka's livestock sector. About two-thirds of the growth in cattle milk production and half of the growth in buffalo milk production is accounted for by productivity and this contribution has been rising over time. However, growth in meat output of almost all the species has been on account of increase in slaughter rates. There is a serious doubt whether the number-driven growth in meat production would be sustained in the long-run. To sustain the growth in the long-run, small ruminant breeding policy has to be reconsidered. Further, slaughter rates of cattle and buffalo are low, mainly due to socio-politico-religious factors. Slaughtering of cattle is banned and it is mainly the unproductive and infertile animals that find the way to slaughterhouses. In the case of buffalo, male calfs are slaughtered at a very young age, leading to a loss in potential meat production. Nevertheless, there exists a good potential for increasing the cattle and buffalo meat production for export. It demands policy intervention and public awareness.

Technological options for agricultural development in marginal areas

The success of the Green Revolution has shown that technological, institutional and policy dimensions are equally important for agricultural development; these fronts are yet to be made operational in the marginal areas. To begin with, policy reforms should be initiated to provide right signals and incentives for efficient institutions to emerge. Priority in public investment for infrastructural development, credible regulations, good governance, and incentives being pre-requisites for evolving efficient institutions for agricultural development, need focused attention of all stakeholders. Given the diversity in production environment of agriculture, a number of institutional arrangements may evolve for provision of goods and services to farmers. The government should encourage institutional development through appropriate policy and regulatory mechanisms, particularly for better information dissemination, risk management, market integration and value-addition. Reforms in public organizations through debureaucratization, decentralization and accountability enhancement are necessary for increasing their efficiency and serving farmers more effectively. The experiences should be used to evolve institutions capable of efficiently serving the large as well as small farmers.

Accelerating agricultural development in marginal areas is the necessary but not the sufficient condition for eradicating rural poverty. Considering the low labour-absorption capacity of the farm economy, generation of gainful employment in non-farm sector in the rural areas is essential for poverty alleviation. However, the growth of this sector has been rather negligible in the recent past. In fact, most of the growth in employment generation has been in the urban areas, leading to wider rural-urban inequalities. Development of livestock, horticulture and fishery sectors and emphasis on agro-processing are expected to generate employment opportunities in rural areas through direct absorption of labour as well as

strengthening of non-farm sector by fostering backward and forward linkages. In addition, concerted efforts should be made to equip and empower the rural poor, particularly women, by upgrading their skills, and providing them access to credit and newer technologies.

Public-private partnerships in agricultural R&D

In practice, problems and risks associated with incentives, contextual realities and nature of goods or services are important for developing and enforcing partnerships. Since R&D is a risky activity with high asset-specificity, contractual relations that shape the flow of knowledge are critical for establishing research partnerships. Macro-economic policies and social and economic institutions further influence the attitudes and pace of research partnerships. For example, greater reliance on market forces and enabling institutions like IPRs may facilitate research partnerships, while the public and private sectors will continue to maintain a negative perception in an inward looking economic environment.

The experiences gained so far echo the trends observed in the developed countries. It is quite likely that a number of the partnerships could be developed through market-based transactions and the public and private sectors could complement each other's role. However, there are certain factors, which necessitate the need for collaborative partnerships. Most of the national R&D companies may not compete with the multinationals in the new regime of IPRs and therefore, they would look forward to the public system for R&D support, even on benefit-cost sharing basis. This type of arrangements can work better if there is a timely response from the public system, and the mechanisms, particularly for cost-benefit sharing, are transparent and simple. Both the sectors should develop mutual trust and confidence and learn from the experience. In particular, the public sector should take lead in transfer of technologies, and wherever necessary, provide incentives and funding support for the delivery of sustainability-enhancing agricultural technologies, and capacity building at the grassroot level for technology adaptation. Finally, although it is necessary to honour secrecy of the agreements, it is important that benefits and experiences of the public-private partnerships are adequately documented and widely disseminated for encouraging others to learn, participate and follow.

Assessment of technical efficiency in India's oilseeds sector

In the Indian oilseeds sector, the mean technical efficiencies (TE) in different states range from 0.64 to 0.75 for groundnut, 0.65 to 0.67 for rapeseed and mustard, 0.59 to 0.73 for soybean and 0.69 to 0.76 for sunflower. The minimum and maximum values of TEs on the farms vary across states and oilseed crops. The results have revealed the existence of technical inefficiencies to the tune of 25-40 per cent at the average level and even more at the individual farm level.

The mean TE in oil production in small scale processing units (ghanis) under the private sector vary from 0.64 to 0.74. The variability is highest in the case of rapeseed and mustard. Even at the processing unit levels, inefficiencies are observed to the tune of 25-30 per cent in oil production from different crops.

The analysis of determinants of technical efficiencies has shown that soil quality, use of quality seeds, and education level of farmers are the important factors influencing TE in oilseeds production. These variables are significant and have expected signs. Provisions for timely supply of quality

seeds and latest technical know-how to farmers need due attention to raise the technical efficiencies in oilseeds production. Technical efficiencies in oil production are influenced mainly by oil recovery and availability of raw materials. Efforts should be made to modify machines for oilseeds crushing and to ensure the regular supply of raw materials (oilseeds) through institutional / contractual arrangements.

Impact of technology interventions and crop diversification

Technological progress in agriculture has made India self-reliant in food production, but the food security at the household level is yet to be achieved. A majority of farm households living in the tribal, backward and hilly areas still do not have access to adequate food and suffer from chronic nutritional-insecurity. Widening the food basket of these people through horticulture, livestock and fishery products will help improve their nutritional, income and employment levels. To achieve this, a mission mode project of NATP was launched in the tribal, backward and hilly areas, particularly in the states of Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan, Uttaranchal, Himachal Pradesh and the North- Eastern states. Improved seeds, balanced use of fertilizers, and newer sowing methods were adopted for life-support crops and horticulture, while for livestock, the interventions were in breeding, feeding (nutrition), health care, technical know-how, etc. Fish production alongwith post-harvest management and value-addition were also included in the programme.

Technological interventions, in general, could help in increasing the intake of food items. Though the consumption of food items is still below the recommended level, interventions could help in bridging the consumption gap. The gap bridged in the case of pulses varied from 1.6 per cent in pen culture to 34.3 per cent in post-harvest management. In the case of fruits, the consumption gap-bridge varied from 1.3 per cent under poultry programme to 32 per cent in post-harvest management; while in vegetables, it varied from 0.9 per cent in life-support crops to 24 per cent in freshwater aquaculture (Bastar). Positive changes have been observed in other food commodities like edible oils and milk.

Besides bridging the food-consumption gap, technological interventions could also help in improving the income level and employment status. The increase in income was nearly 37 per cent in the case of fisheries (freshwater aquaculture). Other programmes of integrated piggery, backyard poultry and pen culture have also shown positive changes, although a decline has also been noticed in the case of life-support crops, probably due to consecutive droughts. The increase in employment was 16 per cent in the crops sector over benchmark and nearly 10 per cent under integrated piggery programme. These impacts need to be examined further.

Intensification of livestock production

Livestock production is intensifying in India, albeit slowly. Intensification occurs in response to a number of interactive forces, including ecological, technological and socio-economic factors. Intensification of livestock production is, by and large, demand-driven, although other factors are also important in species-specific intensification. Striking regional differences are observed in the species-specific intensification. The intensification has been more in favour of buffalo and goat. Region-wise, intensification of cattle production is more in the high rainfall regions and that of

buffalo in the intensively-cultivated irrigated regions. Goat intensification is taking place in almost all the regions but less so in the intensively- cultivated regions. Sheep intensification is higher in the low rainfall (arid and semi-arid) regions having sufficient land area under grazing. From the socio-economic point of view, intensification is associated more with small farms.

This study has some important implications. Firstly, the structure of livestock production is undergoing a change. In the well-endowed regions, the structural shift is in favour of high-yielding stallfed animals like buffalo, while in the less-endowed regions, cattle and small ruminants continue to dominate. Secondly, due to the rising urban demand for animal-based foods, peri-urban and urban dairy and meat production systems are likely to be more intensified. Although this will create opportunities for the producers to enhance their incomes, it will occur at a cost to the urban environment. Intensification will add to urban environmental pollution and put additional pressure on civic amenities. Improving rural infrastructure (roads, transportation, markets, etc.) would help create strong linkages between rural production and urban consumption without much stress on urban environment and amenities.

Thirdly, since livestock intensification is significantly associated with small landholders, it has the potential to contribute towards improving the livelihood of the poor. The process may, however, come under stress due to their poor resource-base. Thus, to keep the process of intensification going, smallholder, livestock production needs policy support in terms of credit, insurance, technology, extension, markets, etc. Fourth, common property resources are critical to small ruminant production and evidence indicates that these have deteriorated quantitatively as well as qualitatively in India. This may act as a constraint to improvement in production of small ruminants. Therefore, there is a need to check deterioration of common property resources through policy, legal and institutional means.

Finally, India has a huge livestock population, and its increasing intensification may strain the carrying capacity of the natural resources. Nevertheless, the current productivity of Indian livestock is low, suggesting considerable scope for productivity-led intensification with less stress on natural resources. Thus, future growth in livestock production has to come from productivity increases rather than through increase in numbers.

Agricultural diversification and urbanization

Sustained economic growth and increasing urbanization are fuelling rapid growth in demand for high-value food commodities like fruits, vegetables, milk, meat, eggs and fish. The producers are responding positively to the emerging demand patterns by altering their production portfolios. On an average, high-value agriculture accounts for about 40 per cent of the total value of agricultural output. Although high-value agriculture is widespread in the country, there are substantial spatial differences. Intensive high-value agriculture is practised in about 11 per cent of the area, mainly in the coastal and hill regions. On more than half of the area, high-value agriculture is extensive in nature and is confined mostly to the central and northwestern regions. Irrigated regions in the north and the east have moderate incidence of high-value agriculture. Nevertheless, high-value agriculture is increasing faster than rest of the agriculture in the country as a whole. Characteristics of intensive high-value agriculture, in terms of commodity, agro-climate, land and labour endowments, are distinct. Fruits are the most important in the intensive High-Value Commodity (HVC) regions, followed by milk, vegetables and

poultry. In the extensive HVC regions, milk is the major commodity with vegetables, fruits and poultry being next in the order. In general, high-value agriculture is more prevalent in areas with high rainfall, low level of irrigation and mechanization, smaller landholdings and higher endowment of labour.

Urbanization is an important determinant of intensification and growth of high-value agriculture and infrastructural facilitates it. In general, the density of roads and markets is higher in the intensive HVC regions. Better connections between the urban demand centres and the near urban districts through national and state highways further confirm the role of infrastructure.

The findings imply that high-value agriculture is likely to emerge as an important source of agricultural growth, which has started showing signs of fatigue mainly due to deceleration in yield growth of foodgrains. High-value agriculture-led growth is expected to be more equitable as the smallholders have a greater tendency to diversify. Nevertheless, high-value agriculture may come under stress for want of adequate technology, infrastructure and policy support. High-value agriculture has greater production and market risks, and there is clearly a need to provide a cushion to producers against these risks. Mitigating production risks would require improved technologies, quality inputs and formal insurance mechanisms, which hitherto have a thin spread and are not easily accessible to the producers, especially the smallholders. High-value agriculture is capital-intensive, while the producers, especially the smallholders have limited resources of their own to invest. This implies increasing participation of financial institutions in high-value agriculture to sustain the growth momentum.

Access to markets is critical to the growth of high-value agriculture. In general, markets for high-value commodities are concentrated largely in the urban centres. This increases costs associated with transportation of produce from the rural production centres to urban markets, more so for the smallholder producers in the remote areas. Further, the prices of most of the high-value commodities are highly volatile and fall drastically even with a small increase in volume of their arrivals at the market place. Options to mitigate market risks and reduce transaction costs include establishment of special markets for high-value commodities in the rural areas and promotion of private sector participation in agriculture through institutions like producer's, associations, cooperatives and contract farming.

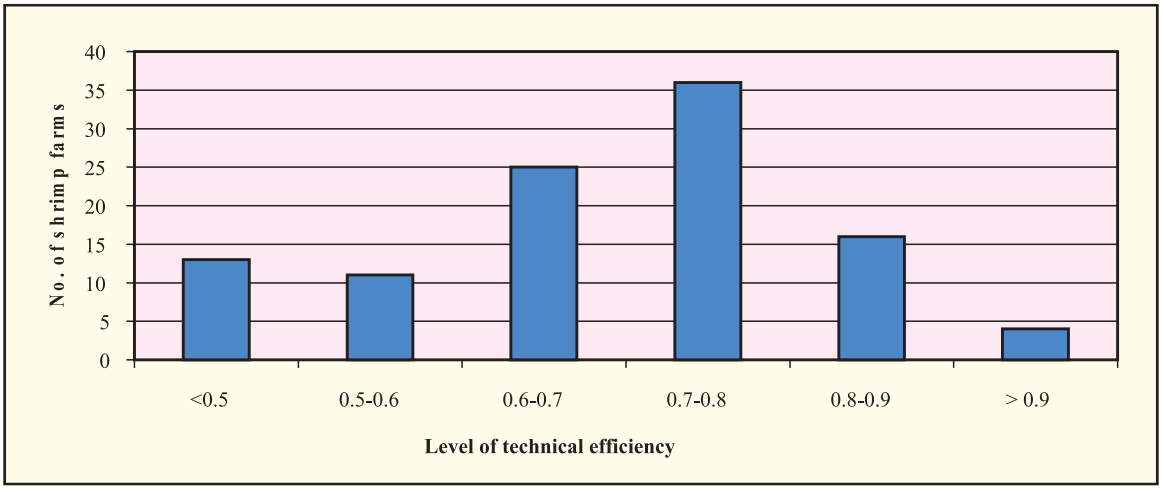
Infrastructural requirements of high-value agriculture are different from those of other food and nonfood commodities. Being perishable, high-value food commodities require refrigerated transport, cold storages and immediate processing after harvesting. These however, are woefully inadequate in the country. Considerable investment is required to facilitate such an infrastructure.

Technical efficiency in shrimp farming in India

This study is based on farm level data and has, employed stochastic production frontiers to measure efficiency. The average technical efficiency in shrimp farming has been found as 0.69, suggesting considerable scope to raise shrimp production even at the existing level of input-use and technology. There are considerable differences in technical efficiency across farms. About a quarter of the farms operate below 60 per cent of their potential. The inefficiency could arise due to a number of personal, household and farm-specific factors. Some important implications have emerged from this study. Large differences in productivity and efficiency across farms as well as states call for an exchange of expertise and experiences to improve and strengthen the aquaculture activity. Large

farmers appear to be more efficient, probably because of their higher capital-investment capacity. This calls for evolving a support system for small farmers to facilitate higher capital investment and adequate credit support as a mean for enhancing technical efficiency. Leased-in farms have been found less efficient than owner-operated farms. The leasing policy should be made tenant-friendly without compromising the security of the ownership. The terms and conditions of the tenure should encourage tenants to undertake long-term investment in the aquaculture activity. This would facilitate improvement in its productivity and technical efficiency. Further, the role of education and experience of farmers in enhancing technical efficiency in shrimp production has been clearly established. These results have important implications for the development of appropriate and comprehensive extension and research strategies in shrimp farming in India.

Figure 4: Distribution of shrimp farms by level of technical efficiency



Technical efficiency in freshwater aquaculture in Uttar Pradesh

The technical inefficiencies, observed at fish farmers across different size-categories, have indicated the presence of input-output slacks. The large-sized fish farmers are more efficient in utilizing the resources than the small ones. Technical efficiencies were 0.77 and 0.83 for small farms, 0.61 and 0.77 for medium farms and 0.75 and 0.88 for large farms. Moreover, all the farms have been found scale inefficient, as the scale efficiency score is less than one. About 25 per cent of fisheries farms in the study area have achieved technical efficiency of above 95 per cent. However, about 34 per cent farms have the technical efficiency level below 50 per cent, indicating that on these farms the consumption of inputs can be reduced up to 50 per cent without affecting the output. About 36 per cent of aquaculture farms have achieved the scale efficiency level of above 95 per cent.

Except labour-input on large farms, all other inputs are being utilized inefficiently across different categories. The highest amount of slack has been found on small farms in the utilization of other inputs, to the extent of Rs 944. Fish farmers could save 10 per cent in cost of seed, 6 per cent in labour expenditure, and 5 per cent in expenditure on feed and hence, increase in profitability. There is potential to reduce expenditure by about 30 per cent in the case of other inputs, without affecting the level of fish production.

Table 9: Average target inputs and estimated slack inputs among the fisheries farms

(in Rs per farm)

Particulars	Size of aquaculture farms			
	Small	Medium	Large	All
Seed				
Target	6220	2958	2221	4413
Slack	501	353	515	449
Per cent slack to target	8.05	11.93	23.19	10.17
Labour				
Target	6029	3424	3721	4722
Slack	488	266	-	283
Per cent slack to target	8.09	7.77	-	5.99
Feed				
Target	3362	2529	2247	2886
Slack	100	169	161	134
Per cent slack to target	2.97	6.68	7.17	4.64
Other inputs				
Target	2722	2232	1493	2354
Slack	944	466	587	714
Per cent slack to target	34.68	20.88	39.32	30.33

There are various factors that determine the level of technical efficiency of a particular farm. The size of pond does not seem to influence the level of technical efficiency significantly in the study area. Training and experience of the fish farmer in aquaculture increase the technical efficiency of the farm. The total number of family members is related negatively with technical efficiency, implying that bigger the family size, higher would be the inefficiency in utilizing labour-input. The distance from the output and input markets is related negatively to the technical efficiency of fish farms, implying that access to input and output markets help in improving the technical efficiency. The results have clearly indicated that experience, training and access to infrastructure affect TE significantly. These results have important implications for the development of appropriate and comprehensive extension strategies and infrastructural development for improving the technical efficiency of freshwater aquaculture.

Total factor productivity and socio-economic impact of fisheries technology

This study has assessed the total factor productivity (TFP) growth in the Indian fisheries sector (separately for marine and inland fisheries), and has examined the impact of fisheries sector on different stakeholders. The rate of return to public investments on fisheries research and development has also been estimated. The time series-cum-cross-section data by state for inland and marine fisheries resources, production, input-use, prices and investment on fish research and development have been compiled from various published sources and used in the study. Divisia-Tornqvist index has been used for computing the total factor productivity (TFP) for the inland and marine fisheries

sector. The TFP annual growth is estimated to be 4.0 per cent for the aquaculture sector and 2.0 per cent for the marine sector in India. Multi-market fish sector model developed at WorldFish Center has been used for India. Given a time horizon (2005-2015), projections for price, supply, demand, and export have been obtained under different fish technological scenarios.

The contribution made by technological change in the development of fisheries sector in India is found to be substantial. The analysis shows considerable impact of the fisheries sector development on the social welfare of both producers as well as consumers. Technological developments in fisheries would make the fish available at cheaper rates to the consumers and thus would improve their nutritional security while the producers' income would also be enhanced. The internal rate of return to investment on fish research and development is in the range of 42-55 per cent under different TFP scenarios.

Sustainable Agricultural Systems

Equity impacts of irrigation policies

There exist wide inter-state and inter-farm variations in the level of inequality in the current distribution of flow and lift irrigated area. In 1970/71, inequality in the distribution of irrigation was observed was recorded highest in Bihar and least in Maharashtra. In 1990-91, the inequality was in maximum Kerala and least in Gujarat. Different states in India have undergone changes in inequality over these two decades, depending on the level of surface and ground-water development, and other watershed-related conservation programmes. The level of inequality has come down significantly in all the states. The scope for minimizing the inequality in the distribution of irrigated areas across states is thus quantified and assessed by comparing the existing distribution of flow. Ongoing institutional reforms in the surface irrigation sector with the formation of water users' associations for decentralized management and use of water in states like Haryana, Andhra Pradesh, Orissa, Tamil Nadu, Rajasthan and Uttar Pradesh will help in minimizing such gaps to a large extent.

Impacts of agricultural land drainage

Soil salinity due to waterlogging is threatening agricultural production in roughly one million hectare area in North-West India. To combat this problem, sub-surface drainage (SSD) has been recommended and accordingly, huge investment is being made. An assessment of SSD installation in the Gohana Sub-Division of the Sonepat district of Haryana has revealed multiple benefits (within four-year interval) that includes substantial increase in crop yield, ranging from 29 per cent to 35 per cent increase in cropping intensity, from 117 per cent to 175 per cent diversification towards high-value crops; decrease in salt-content in the drained land by 10 per cent to 66 per cent as compared to 2.2 per cent increase in undrained lands; improvement in the water table by 0.2 m to 0.7 m; and increase in gainful employment by 85 mandays/ha. All these tangible benefits, coupled with some associated intangible benefits like improved sanitation and health, result in better quality of life. This technology maximizes the distribution of welfare gains to the weaker sections of society while conserving the land and water resources by reducing the income inequality. Despite these economic, social and environmental benefits, the adoption of this technology is still not very high. The specific constraints

identified are the indivisible nature of the technology and lack of group action by the beneficiaries. These happen due to the absence of appropriate institutional arrangements which have never been considered as a part of the technology development process.

Vulnerability and adaptation to climate change

The International Panel on Climate Change predicted an increase in extreme weather events such as drought, flood, cyclone and heat wave, with adverse impacts on rural livelihoods. The capacity to cope with them also differs from place to place and individual to individual, depending upon the endowments and entitlements. The study has at applied the concept of vulnerability assessment in rural livelihood in Orissa, which is prone to climate-change- induced natural disasters.

Any change rarely affects all households equally. All households were classified into six 'livelihood groups' based on sources of income, asset positions, and trajectories. The major livelihood groups were: Cultivators, Labourers, Rural artisans, Fishermen, Livestock keepers (dairying & poultry); and Salaried group. The vulnerability profile of the major livelihood groups in the study area has shown that all the major livelihoods are at risk, with labourer class being the most vulnerable.

Cyclones and floods occur regularly and cause damage to all the livelihood activities both farm and non-farm. The frequency of climatic disasters in Orissa is noted so high that people do not get sufficient opportunity to recover from one disaster before the next one strikes. Therefore, disaster preparedness is very important in this area. The common strategies adopted by households are: diversifying food and income sources; adjustment in crop practices; adjusting livestock-keeping practices; risk minimization through crop insurance and contract marketing; borrowing and building-up stocks and inventories; seeking institutional support like demanding relief and infrastructure; managing scarce water resources through pond making; etc.

Sustainability status and dimensions of agro-ecological regions in India

Sustainable agricultural development has to balance the future production growth in diverse agroecological regions (AERs) without degrading the natural resource-base. Indexing of appropriately identified variables to represent various dimensions of sustainability is one of the commonly used approaches to measure sustainability status. This methodology was used earlier for classifying 52 agroecological sub-regions (AESRs) of India, using 1995-96 as the data reference year. Three dimensions of sustainability, namely ecological, economic and equity dimensions were captured through a set of nine variables covering forest, groundwater, demography, productivity and poverty status by AESRs. This analysis was further extended to cover 1990-91 for temporal and spatial comparison of sustainability status of AESRs in the country. The set of variables were first integrated separately for the three dimensions of sustainable agricultural development and again indexed, using the ratio of the inverse of their proportional contribution as weighting scheme to generate sustainable livelihood-security indices for each of the AESRs. All AESRs have been categorized into six groups based on the sustainable livelihood indices and this grouping of indices has been done using quartiles.

The temporal analysis of ecological-security status of AESRs has revealed that, out of 12 agro-ecological sub-regions with low level of ecological security in 1990, at least nine AESRs continue to be in the same security group in 1995 also. These regions are: Konkan, Karnataka and Kerala coastal plains (AESR 19.3), Ganga, Yamuna Doab, Rohilkhand and Avadh plains (AESR 4.3), Rohilkhand, Avadh and South Bihar plains (AESR 9.2), Bengal Basin (AESR 15.1), South Tamil Nadu coastal plains (AESR 18.1), North Tamil Nadu coastal plains (AESR 18.2), Gangetic Delta (AESR 18.5), Foothills of the Central Himalayas (AESR 13.2), and North Bihar and Avadh plains (AESR 13.1). These need priority in terms of improving their ecological-security levels. Along with these, the ecological-security status of four AESRs, namely 4.1, 5.1, 2.3 and 18.4, which have come down in 1995 as compared to their 1990 levels, also need priority intervention.

The temporal analysis of economic-efficiency status of AESRs has revealed that out of 13 AESRs with low economic-efficiency rank in 1990, six AESRs continue to be in the same efficiency levels. These regions are: South Kashmir and Kumaon Himalayas (AESR 14.2), South Kashmir and Punjab Himalayas (AESR 14.1), North Bihar and Avadh plains (AESR 13.1), Deccan Plateau (AESR 3.0), Madhya Bharat Plateau, Western Malwa Plateau, Eastern Gujarat plain, Vindhyan and Satpura range and Narmada Valley (AESR 5.2), Central and Western Maharashtra Plateau and North Karnataka Plateau, and North-Western Telengana Plateau (AESR 6.2). These need to be accorded priority in investment to improve their agricultural system. The temporal analysis of social-equity status of AESRs has revealed that out of 13 AESRs with low social-equity level in 1990, nine AESRs continue to be in the same efficiency levels. These regions are: Meghalaya Plateau and Nagaland Hill (AESR 17.1), Middle Brahmaputra plain (AESR 15.2), Tamil Nadu uplands and plains (AESR 8.3), Marusthali (AESR 2.1), North Gujarat plain (AESR 4.2), Central and Western Maharashtra Plateau and North Karnataka Plateau and North-Western Telengana Plateau (AESR 6.2), Rohilkand, Avadh and South Bihar plains (AESR 9.2) Foothills of the Central Himalayas (AESR 13.2), and North Bihar and Avadh plains (AESR 13.1). These require priority attention for improving their social-equity status.

Integrated sustainable livelihood-security status by AESRs has shown that out of 13 AESRs with low sustainability-levels in 1990, six AESRs continue to be in the same sustainability-levels. These regions are: South Kashmir and Kumaon Himalayas (AESR 14.2), South Kashmir and Punjab Himalayas (AESR 14.1), North Bihar and Avadh plains (AESR 13.1), Foothills of the Central Himalayas (AESR 13.2), Madhya Bharat Plateau, Western Malwa Plateau, Eastern Gujarat plains, Vindhyan and Satpura ranges and Narmada Valley (AESR 5.2), Marusthali (AESR 2.1), Central and Western Maharashtra Plateau and North Karnataka Plateau, and North-Western Telengana Plateau (AESR 6.2). In particular, AESR 13.1, covering North Bihar and Avadh plains, which is lowly ranked in terms of all dimensions of sustainability, namely ecological-security, economic-efficiency and social-equity in both the time periods, deserves priority interventions for improving its sustainable livelihood-security levels. AESR 13.1 comprises 28 districts in Bihar, 8 districts in Uttar Pradesh and 2 districts in Jharkhand.

To sum-up, out of 52 AESRs considered in this analysis, 10 AESRs have shown declining status of sustainability and 11 AESRs have improved their sustainability levels, while the rest have maintained status quo during the 1990s.

Table 10: Sustainability dimension matrix of AESRs (1995)

Ecological Security Index (ESI)		Economic Efficiency Index (EEI)									Social Equity Index (SEI)
		High			Medium			Low			
High	High				14.3 14.4 19.1	14.5					High
	Medium	15.4			10.1	15.3			10.3 11.0 12.1	10.4 14.2	Medium
	Low	17.1									Low
Medium	High	19.2			16.2	5.3 10.2 12.2					High
	Medium	7.3 8.1 9.1	7.2		4.4	1.1 2.4 6.3 6.4 7.1 8.2				14.1 3.0 5.2	Medium
	Low			15.2		8.3 12.3			6.1 6.2	2.1 4.2	Low
Low	High	19.3				5.1 18.1 18.4					High
	Medium		4.3 4.1			2.3 18.5					Medium
	Low		9.2 15.1				13.2 18.2			13.1	Low
		High	Medium	Low	High	Medium	Low	High	Medium	Low	
		Sustainable Livelihood Security Index (SLSI)									

Markets and Trade

Trade liberalisation and Indian agriculture

This study has analysed potential impact of trade liberalisation on domestic wholesale and farm-level prices of rice, maize and rapeseed-mustard. Implementation of WTO agreement would have a mixed impact. The country would be net gainer in some commodities and net looser in others. In the case of paddy, trade liberalisation at the existing trade prices increases net return merely by 2.6 per cent but free trade with full Uruguay effect would lead to 17.6 per cent increase in the net return. When the latter scenario is combined with removal of subsidies, net income declines by 10.5 per cent. Trade liberalisation is found to be highly beneficial for maize. Net return over variable cost in the base scenario goes up by 63.6 per cent with liberalisation. Further liberalisation of trade towards full Uruguay Round would raise the net return by 81 per cent. In the case of rapeseed-mustard, liberalisation of oil imports would reduce the net return by one-fourth. Along with this if subsidies are removed, the net return declines by about 35 per cent.

Equity driven agricultural trade policies

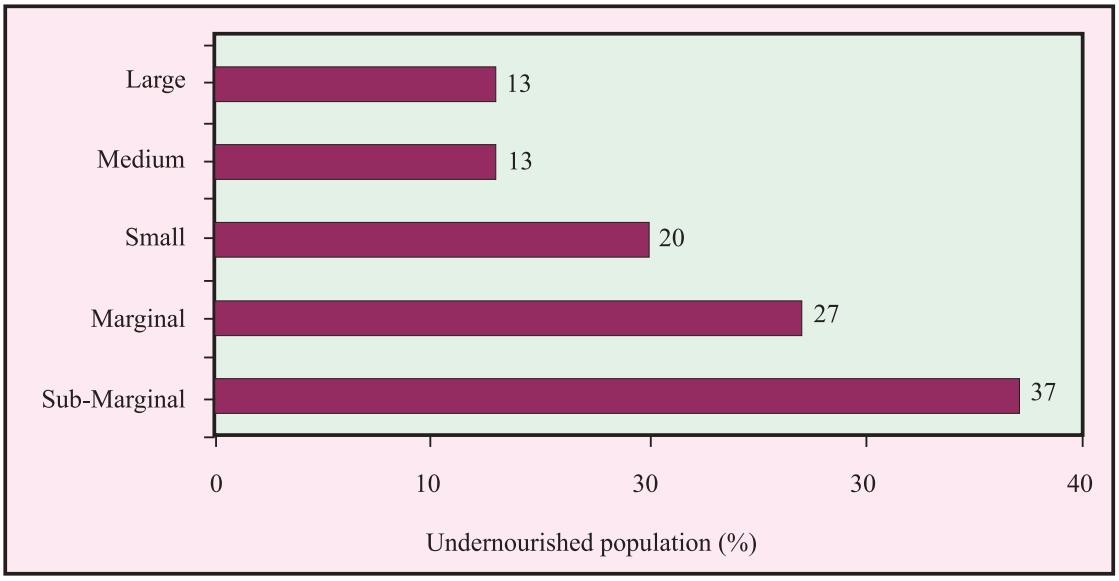
India has emerged as a major exporter of rice and its share in global rice trade has reached 20 per cent in some years due to liberalisation of exports. The trade in wheat shows violent year-to-year fluctuations. In some years, country exported wheat in huge quantities, while in others, it had to go for massive imports. The study has shown that export surpluses of wheat are of highly transitory nature and their disposal as export necessitated huge imports subsequently, to stabilise domestic prices and meet the domestic requirement. In recent years, international prices of agricultural commodities have plummeted to a very low level. This has hit India's agricultural exports, which had been rising at a fast rate, after initiation of economic reforms programme. International prices show very high volatility. If such shocks are transmitted to farm level, these would destabilise cropping pattern and cause uncertainty in farm income. Since a vast majority of Indian farmers are either small or marginal, they do not have resources and capability to shift from one kind of crop pattern to another swiftly. Under WTO obligations, such temporary imports and shocks can't be checked through quantitative restrictions (QRs). There is a need for alertness to impose appropriate tariffs to regulate unwanted imports.

Nutritional security of farm households

The study has diagnosed the status of nutritional security and has examined the influence of technological and socio-economic factors on nutrition intake using data from the 50th round of survey of the National Sample Survey Organisation. Assuming 2300 kcal/caput/day cut-off point for undernourished population, nearly 29 per cent of the rural farm-households were poor in 1993-94. This is the vulnerable group of rural farm households, who could not earn enough to support their minimum energy requirements. The most pitiable section among all the categories is that of sub-marginal farm-households; about 37 per cent of the them are living in penury status (Figure 5).

Nutritional security studied in the context of cropping systems, has revealed that about 20 per cent farm households are undernourished in the rice-wheat and wheat-based cropping systems. Their proportion was 35 per cent and 41 per cent in the rice and coarse cereals-based cropping systems, respectively. This implies that rice and wheat production technology has not only improved the

Figure 5: Extent of undernourished population by farm-size group



calorie intake but also diversified food basket. Irrigation plays an important role in providing nutritional security with proprotion of undernourished going down with increase in irrigation coverage. So is the ownership of livestock. Targeting need-based research and technology dissemination for the coarse cereals-based system in the southern and western regions, and rice-based system in the eastern and northeastern regions need special attention to address the problem of undernourishment. The livestock sector should also receive high priority with multiple objectives of diversifying agriculture, raising income and meeting the nutritional security of the poor farm households.

Trade liberalization and Indian dairy industry

Despite India emerging as the largest producer of milk in the world, its milk processing industry remains under-developed. India's exports of dairy products are competitive at the margin, due to inefficiency in processing. The performance of dairy industry has been marked with fluctuations over the past two decades. The number of manufacturing units in the organized sector has increased considerably. The net value added per factory has registered negative growth, after the initiation of reforms. The number of employees per factory has not shown any trend, however, it did show a marked decline during 1990s. The labour-capital ratio has declined since 1980, implying capital-intensive nature of the industry. During 1980s the technical efficiency did not show any definite trend, but, during 1990s, it has shown an improvement. The effects of economic reforms on dairy industry have been measured in terms of association between the protection level and performance indicators of the industry. Except the employment, other indicators such as gross output, net value-added, capital and labour productivity and technical and scale efficiency are negatively correlated with the protection level. These indicate that dismantling the protection structures would help improve the performance of the dairy industry. Though the efficiency of labour improves total employment in the dairy industry would be adversely affected.

Consumption of livestock products

Over the past two decades, the per capita consumption of various livestock products in India has increased considerably. The per capita consumption of milk and egg has almost doubled. Growth in per capita consumption of meat and fish has relatively been slow. Consumption rates and consumption pattern vary widely across income classes. There is a wide gap in the consumption rates of different food items between the rich and the poor. The gap is wider for milk than meat and fish. This, however, has been narrowing down. There are also considerable differences in consumption rates of rural and urban consumers; the per capita consumption is higher in the urban areas. But, the disparities in consumption rates of the rural and urban populations are weakening.

Demand plays an important role in the growth of livestock sector. In the past, growth in livestock sector was mainly demand-driven, and is likely to remain so. Emerging trends in consumption of livestock products have some important implications for the growth of livestock sector. The production of food is likely to come under heavy pressure. Increase in production needs necessarily arise from productivity improvements with suitable policies for optimization of livestock population that commensurate with the feed resources.

Food safety issues in fisheries

Fish and fish products account for 3 per cent of the total export and 20 per cent of agricultural export of India. Shrimps and prawn are major export species and contribute about 65 per cent to the total export earnings from fisheries. Trade liberalization has created opportunities for enhanced exports. However, the exports from developing countries including India, may be adversely affected by strict food safety measures adopted by the importing countries. The study has explored the opportunities of trade liberalization and cost of compliance of food safety measures.

Compliance with stringent hygiene and sanitary measures requires considerable investment. The investment requirements for HACCP plants vary from Rs 10 million to Rs. 25 million. Also, there is a recurring expenditure of about Rs. 2 million per year on maintenance of a HACCP plant. All these would lead to substantial increase in pre-export processing and handling cost. The small firms have been the worst sufferers and may lose market competitiveness. It has a bearing on government revenue, consumers, and producer surplus also.

Fish export is quite competitive. The nominal protection coefficients (NPCs) without compliance with food safety measures range from 0.46 for Sardines to 0.72 for Tuna. India enjoys substantial competitiveness in the export of shrimps and prawn also. Even after compliance with SPS measures, the fisheries export remains competitive, but the competitiveness declines by 14 per cent at the aggregate level.

With additional cost on compliance of food safety measures, the country loses foreign exchange equivalent to Rs 96 billion. In such a scenario, consumers are benefited, but the losses to producers are huge, resulting in a net loss in social welfare.

Agricultural markets in India: Implications for competition

The functioning of agricultural markets shows that markets for a large number of commodities are competitive in the segment where transactions are involved amongst agro-commercial firms. Markets are less competitive where business firms are dealing with consumers and producers. This is reflected in collusive behaviour of the buyers and imperfections at the retail level. This calls for improving competition in agricultural markets, particularly at the farm and retail levels. Alternative avenues for sale and purchase through cooperative marketing agencies have been found to dilute market power of private trade to some extent. Besides cooperative agencies, removing all kinds of restrictions on entry of private firms at various levels of agricultural marketing, particularly in purchase of farm produce, would help in improving the competition.

The main reason for high charges and lack of competition in agricultural markets seems to be the dominance small local players in the market. Though their number is large, it does not improve the market efficiency. Due to the large number and small operation, these players require large margins and can't take the advantage of scale economies. There is a need to attract big business firms to invest and operate in agricultural markets in bulk buying and selling. This would impart scale advantage that should help in better deals for consumers and producers.

There is no effective regulation for agricultural commodities at the retail level. Quality and price aspects are hardly displayed. In the case of fruits and vegetables, retailers charge the prices from each consumer based on his/her willingness to pay and in the process, extract as much consumer surplus as they can rather than charging uniform and competitive prices. There is a need to frame and implement regulations providing complete information about product quality and prices to consumers through visual display. In order to provide more competition at the retail level and benefit to both consumers and producers, innovative marketing mechanisms like 'Apni Mandi' and 'Producers Sale Counters' should be promoted in consumer markets.

WTO agriculture negotiations and South Asian countries

What was projected as a benefit for South Asian Countries (SACs) from Agreement on Agriculture (AOA) and the expectations based on that did not come true. SACs should work together in the ongoing negotiations on AOA to addresses their concerns adequately. A common agenda for SACs should suggest that the minimum support in the case of developed countries should be fixed at 5 per cent of value of output as product plus non-product support and Aggregate Measure of Support (AMS) commitment should apply at the product level. The negative support should appear as such in computing Aggregate Measure of Support. Green box should include purely non-trade distorting measures like training, inspection, extension services, infrastructural services, and public stockholding for food-security purpose. There should be a cap on green box assistance in the developed countries. All export subsidies should be eliminated at the earliest. Measures like export credit guarantee and insurance should be allowed only to the developing countries.

Tariff reduction should be based on bound tariff and not on applied tariff. SACs need not ask for unreasonably high tariffs, particularly those above 100 per cent. The developing countries should propose tariff reduction in three slabs (Table 11)

Table 11: Proposed tariffs for developing countries

UR bound tariff	Proposed bound tariff
Above 100%	2/3rd of bound tariff with maximum of 100%
50 to 100%	3/4th of bound tariff with maximum of 67%
Less than 50%	4/5th of bound tariff with maximum of 37.5%

There should be no quantitative restrictions (QRs), except in the case of balance of payments problem in less developed countries. SACs require some State Trading Enterprises (STE) to address food-security concerns, particularly of weaker sections of society. SACs should agree to abolish monopoly of STEs the in domestic or international trade. Special and differential (S&D) treatments to developing countries should include (i) enlarged green box for the developing countries, (ii) exemption to selected 'Special Products', related to food security and livelihood, from market access commitments, and (iii) Special Safeguard Mechanism to protect against flooding of imports and injury to domestic products.

Indian fisheries exports: Impact of trade policy reforms and food safety standards

This study was undertaken to examine the determinants and sources of fisheries export growth, and impact of liberalization, alongwith assessing the status of implementation of food safety standards and their implications for fisheries exports from India. A clear relationship has been observed between the fisheries export growth and the competitiveness, world demand for fisheries, and trade liberalization. The coefficients of these variables have been found to be significant. The long-run world demand elasticity of fisheries export has been observed as 2.23, and that of long-run competitiveness elasticity as -1.10. This implies that with the expansion of world fisheries markets and improvement in the

Table 12: The determinants of fisheries exports from India

Dependent variable: Fisheries exports		
Explanatory variables	**Coefficient**	**Standard error**
Constant	-16.1198	5.8916
Export diversification	-0.5007	0.3465
Competitiveness	-0.9306*	0.3808
World export	1.8876**	0.4339
Liberalization	0.4942**	0.1598
Lagged fisheries export	0.1547	0.2465
Adjusted R^2	0.9548	0.9407
Long-run world demand elasticity	2.23	
Long-run elasticity to competitiveness (price)	-1.10	

Note: ** and * indicate significance at 1 and 5 per cent levels, respectively.

competitiveness in fisheries trade, their exports from India can be enhanced substantially. The high value of competitiveness elasticity indicates the possibility of increasing export revenues in the process of making fisheries sector more competitive. The liberalization coefficient has shown that the removal of major trade policy distortions have significant influence on the fisheries export. The diversification of exports within the fisheries sector does not influence fisheries export significantly. The negative sign in its coefficient may be attributed to the fact that unlike the agricultural sector, the diversification in fisheries export has taken place in favour of low-value fishes.

Food safety and technical barriers follow the recommendations of Codex Alimentarius Commission (CAC) 1993 to adopt Hazard Analysis Critical Control Points (HACCP) as a process for managing food safety. The CAC recommendations were endorsed and made mandatory by the 1995 agreements on Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) measures. The SPS measures intend to protect human or animal health from food-born risks, animal or plant-born diseases, and pests or diseases. The TBT measures cover all technical regulations, voluntary standards and procedures and the issues ranging from car safety to engine-saving devices, the shape of food cartons, labelling requirements, nutritional claims and concerns, quality and packaging, etc.

Food safety issues are becoming a major concern in the fisheries exports from India to developed countries. India has been facing increasing number of non-tariff measures (mainly SPS and TBT) in its main importing countries. A close examination of detention of shipments by USFDA provides a better understanding about the application of SPS in the importing country. The US is perhaps the only country which provides information on detention of shipments based on pre-inspection basis. During 2002 (January to December), the number of refusals of food products originating from more than 100 countries were 9668. Out of these, 1040 shipments were originated from India. It was the third highest number of shipments rejected by the USFDA originating from a single country. Canada and Mexico faced the highest number of detentions. The top three categories of rejected Indian consignments included vegetables (22 %), fisheries (21 %), and processed foods (21 %), showing the importance of SPS issues in fisheries exports.

A majority of Indian consignments of fish products were detained/ rejected by the USFDA on the grounds of (a) Filth, i.e. the article appears to consist in whole or in part of a filthy, putrid or decomposed substance, (b) Presence of Salmonella, i.e. the article appears to contain a poisonous and deleterious substance, and (c) Unsanitary, i.e. the item was prepared, packed or held under in-sanitary conditions. Most detentions were for contamination of fish with filth, followed by the presence of salmonella. Thus, a majority of the rejections are attributable to lack of basic hygiene and microbial contamination. The average rate of reasons for rejection has been observed to be 1.76, implying that most of the consignments were found deficient on more than one grounds. Overall, the USFDA data confirm that SPS standards are important challenges for the fisheries exports from India.

Status of implementation of food safety measures in Indian fisheries sector

The EIC offers export inspection and certification services under the following systems: Consignment-Wise Inspection (CWI); In-Process Quality Control (IPQC); or self certification. Any one or more of the systems may be specified in the notifications of individual commodities. However, fish and fish products along with egg products and milk products are subject to mandatory export

certification based on Food Safety-based Management Systems (FSMS). The FSMS is based on international standards of food safety management systems such as HACCP/GMP/GHP and involves approval and surveillance of food processing units. As a result of EU ban on Indian fisheries products accompanied with US automatic detention/refusals of Indian shipments, certain seafood processing plants and freezer vessels have been re-inspected and approved for exporting to the EU countries, the USA and other countries. As on 31 August 2004, there were about 425 fish processing plants in India, out of which only 145 units have been approved for export to the European Union. Rest have been approved for processing fish and fish products for export to countries other than the EU markets . India has been making additions to the list of EU-approved fish processing plants every year; In 1997 (the year of EU ban), only 10 fish processing plants were allowed to export to the EU, this number rose to 145 in 2004. This reveals the serious concern of the Indian government and the fish processing industry in India to comply with the food safety regulations.

The liberalized trade in the fisheries sector has boosted fisheries export substantially. The future of fisheries export would be determined largely by the consistent compliance with food safety measures. Steps should be taken to devise appropriate institutional mechanisms to bring scattered small producers and processors under a network so that they can effectively participate in the emerging processing procedure to reap the benefits of expanding global fish trade. Vigorous efforts should be made to minimize the cost of compliance across the board by bringing more efficiency in fish production and processing. Maintaining quality and consistent compliance with international food safety standards should be propagated as a strategy to be ahead of our competitors in the global fish market. At the same time, efforts should be made through regional co-operation to argue for a transparent and participatory approach in preparation of international food safety standards.

Agricultural trade liberalization reforms: Effects on agricultural marketing institutions

In the liberalized era, the paradigm of agricultural marketing is changing and therefore the emphasis is on the improved performance of all marketing functions. Indian marketing organizations need to be relooked in the context of increasing surpluses in production, liberalization of domestic markets, and opening of the trade in agricultural commodities. This study has examined the effect of trade reforms on the existing mandates and functions of selected Agricultural Marketing Institutions (AMIs) in the light of new marketing challenges and trade reforms.

The results of reforms or changes in selected marketing institutions, shown in Table 13, reveal that all the institutions have initiated reforms, using IT, and are marching towards commercialization. The notable reforms are: Model APMC Act by DMI, introduction of Agmarknet, launching of Nafed Bazaars by NAFED on commercial business lines, and setting-up of National Codex Committee and widening of export basket by APEDA. It provides online information on international prices and export zones, and utilizes the services of private marketing agencies in framing the marketing strategies. Karnataka is the first state in India to initiate market reforms. Agricultural Produce Marketing Committee (APMC) Act was amended to allow cooperatives to set up regulated markets for marketing of agricultural produce. Coffee Board had a monopolistic control over the marketing of coffee in India but since 1995, marketing of coffee has become a private sector activity. Central Warehousing Corporation has appointed a Steering Committee to consider the introduction of modern technology in handling and transportation of foodgrains.

Table 13: Status of agricultural marketing institutions and trade liberalization reforms in India

S. No.	Agricultural Marketing Institutions	Status of reforms
1	DMI	• Marketing Research and Information Network: Agmarknet-a nation-wide information network for speedy collection and dissemination of market information for its efficient utilization was started in 2000. • It has evolved objective criteria to fix developmental priority of markets at state/ regional level. • It has framed a model act to provide guidance and bring out uniformity in state legislations which deal with agricultural marketing. • It has improved the AGMARK standard.
2	NAFED	• It has started many commercial business operations on competitive basis, e.g. Nafed Bazaars. • It has launched NAFED brand products in consumer packs.
3	APEDA	• It has developed a certification mark/standard called "Quality Produce of India" ('Made in India' logo) for agricultural products being exported. • It provides online information on international prices, agri-export zones, international trade, European Union regulations on export, etc. • It has framed standards for processed food produce and agricultural produce for the export promotion. • It has widened its export basket; plans to add liquor, medicinal plants and herbs to it. • Services of private marketing agency 'lintas' has been availed to evolve a marketing strategy for India. • It has identified new markets such as China and Australia. • Thrust on Agricultural Processing Zones to achieve the targets. • Initiatives undertaken include integrated training programmes, development of infrastructure and pre-and post-harvest protocols for specific varieties of fresh produce. • Advises farmers on hygienic standards for their produce. • Developing quality control standards for many processed foods. • National Codex Committee has been set up.
4	Karnataka State Agricultural Marketing Board (KSAMB)	• It established export promotion cell in 1994. • Floor price scheme for agricultural/horticultural commodities, from 24th November, 1999.
5	Regulated Markets	• The draft model legislation titled the State Agricultural Produce (Development and Regulation) Act, 2003 was formulated (Model Act)
6	Coffee Board	• Till 1995, it had monopolistic control over the marketing of coffee in India but after that, the marketing of coffee is strictly a private sector activity.
7	Central Warehousing Corporation	• The Steering Committee appointed in 1997 to consider the introduction of modern technology in handlingand transportation of foodgrains; submitted its report in 1998 and Government constituted a Task Force to implement the same. • Department of Food and Civil Supplies prepared a sub-project for training and capacity building in the area of bulk grain management and implemented it with the help of Indo-Australian Training and Capacity Building Project (IATCBP)

In general, the reforms introduced in these organizations are in the right direction, but these have to be many and in place soon.

The reforms in major areas of agricultural marketing are being initiated at the country level to face post-WTO liberalization environment. Some selected marketing institutions have initiated reforms and are marching towards commercialization using information technologies. This process is, however, slow and limited in coverage. Therefore, the reform canvas has to be widened and its pace has to be accelerated.

Institutional Change

Land reforms

Structure of landholdings and its implications has remained a major issue for policy debates. Two studies in West Bengal, the state with 90 per cent of the holdings classified as small and marginal, have indicated some important findings. The first on the country's most aggressive agrarian reforms in recent years - Operation Barga -has revealed that while it enhance farmers' social status and security of tenancy, it does not bring about improvement in production and productivity, or entrepreneurship. The second study on scope for surplus generation on small and marginal farms has shown that even though incomes could be raised substantially by optimum mix of resources and enterprises, marginal farms of less than 0.4 hectare could not generate sufficient income to rise above poverty level. The situation is somewhat better on larger farms, but even on farms of 2 ha, there is not enough scope for obtaining decent income levels. This analysis has included higher-valued options such as vegetables and livestock enterprises.

Informal rural credit system

Dualism has been an important characteristic of India's rural credit system. However, over the past few decades, the informal sector has shrunk considerably in size mainly due to growth in formal sector and technological change in agriculture. With these considerations in mind, in recent years it has been suggested that priority sector lending to agriculture should be phased out to make formal sector more resilient. In this process of policy change, however, it is important to take into consideration the regional variations in performance of agricultural growth and socio-economic characteristics. Evidences indicate that the informal sector largely caters to the consumption credit needs of poor households and is likely to remain an important component of rural credit system because of its operational flexibility and information advantage over the formal sector. Though the demand for consumption credit is inelastic and interest rate is higher on the informal sector lendings, technology-led growth of agriculture helps drive down the interest rate on informal lendings by way of inducing competition among lenders.

Privatising farm extension

This study concludes that participation of private sector in agricultural extension activities is limited to only few crops (especially horticultural crops) and select geographical regions (having high potential). Public sector continues to be the most important source of information for the farmers, though their emphasis on delivering technologies in non-foodgrain crops is low. Only about 42 per

cent of the farmers are really satisfied with the present extension support available to them. A good number of farmers (about 50%) are willing to pay for quality extension services, especially in the area of plant protection advice and training programmes for high-value crops. Public sector extension could either commercialise some of its services, or initiate quality services, and/or set the environment for more active private sector participation in the provision of extension services. It should concentrate on educational programmes for farmers, facilitating formation of farmers' groups, building linkages with other technology providers and initiating paid consultancy services by maintaining a cadre of qualified staff at the district and sub-district levels.

Innovation in system of partnerships

Several cases of innovation process associated with socio-economic change in the rural areas have been analysed, using an innovation systems analytical framework, with a view to provide lessons for the agricultural research community on ways of more effectively deploying agricultural science and technology as a part of the socio-economic development process. The set of principles emerged in this emphasize on Partnerships, Multiple knowledge bases, Innovation triggers, Innovation champions, Diversity and innovations in innovation, Reworking the stock of knowledge, Learning, Institutional learning and capacity development, Technology foresight, etc.

Benefits of institutional innovations in dairy farming

Contract farming has been recognized as important means to reduce the costs of production and marketing. Results of a study on dairy farming have revealed that the contract farming reduces transaction costs to the participants considerably. Also, there is no difference in the prices of milk received by the contract and non-contract producers, indicating little monopsonistic tendency of the contracting firm. Although, the production costs are almost similar for the contract and non-contract producers, the former realize higher net returns due to savings in transaction costs. There is considerable involvement of smallholders in the contract programme, and they are benefited the most, in terms of not only higher income but also input supplies and free extension services.

Costs and benefits of contract farming in poultry in India

The literature on contract farming emphasizes the role of insurance and credit in explaining the existence and success of contract farming arrangements. This is undoubtedly the case in the instance of poultry farming as well. In terms of value, the processor advances the bulk of inputs. The gains to contract growers (relative to non-contract growers) have been found higher, greater is the cost of funds. Contracting shifts a large portion of market risks from the grower to the processor. In addition to these aspects, the poultry case considered here highlights the efficiency factor that has not received much attention in the contract farming literature. It has been found that contract production is more efficient than production by independent growers. As a result, by contracting, processors generate an efficiency surplus that is almost entirely appropriated by them. Despite this, contract growers do gain substantially even though their returns are not much different from what are received by independent growers.

The fact that contract production in poultry has benefited growers substantially suggests that these growers are not bereft of bargaining power. But what is the source of this bargaining strength? Why

the processor does not offer growers a contract that is only slightly better than their reservation utility in their alternative enterprise (say as subsistence growers)? Poultry contracting needs the use of improved and standardized technology and production practices. This involves supply of inputs, close contact and training of the contract grower. Protection of this investment (in inputs and training) requires that default by growers should be minimum possible. This in turn is achieved by processors offering above reservation utility contracts akin to efficiency wages. In its absence, the threat of denial of future contracts is not a major deterrent to default and defection by contract growers. The study has suggested that contract farming is a useful institutional arrangement for the supply of credit, insurance and technology to farmers, all of which are otherwise highly demanding problems. For many commodities, however, contract farming in India is not legal because of the agricultural produce marketing acts which make it mandatory for the commodities under the act to be wholesaled in regulated markets. Removing these prohibitions would be important to widen the scope of contract farming. Some observers believe that contract farming should be regulated to ensure that processors live up to the promises made in the contract regarding the quality of inputs, provision of credit and the buy-back arrangements.

ICT-based initiatives in agriculture

In the changing agricultural scenario, there is a greater demand for information for making crucial farm management decisions in time. While the access to information from public sector is inadequate, private initiatives in the form of Information and Communication Technologies (ICTs) have emerged to fill the gap. This study has assessed whether ICTs have made any difference. The analysis indicates decreased cost of cultivation of crops and increased sale value due to easy access to better market intelligence on time. And transaction cost for getting information has also been reduced considerably. The beneficiaries opined that apart from economic impact, the initiatives are highly useful in accessing information on weather, crop production and protection, etc., which led them to take better decisions on time in crop management.

Some of the important obstacles to these initiatives are lack/ non-availability of and global content in regional languages, physical (e.g., electricity) and financial problems in establishment and maintenance of village level kiosks, lack of organizational and institutional structures and insufficient net work between the institutions in information management. It has suggested that policies/strategies are to be formulated with a roadmap for harnessing such ICTs initiatives by addressing the constraints that the institutions, specifically government agencies, would have to face in network and content development.

ICT-based initiatives: Differential features and needed strategies

Each ICT initiative is a unique model in the application of ICTs to agriculture and has merits and constraints of its own. Based on learning from these initiatives, some suggestions have been provided for greater success of ICT initiatives:

- Involve local people in content development (as in Village Knowledge Centre) to assess information needs and collection of indigenous knowledge, which can be synthesized with information from experts/ institutions.

- Prepare user-friendly content in the regional languages also with visuals.
- In kiosks, supplement the digital information with public address system, vernacular print media, and bulletin boards for wider dissemination.
- Use alternative technologies to substitute electricity (batteries and solar panel) and telephone connectivity (wireless network).
- Use space in rural institutions (Panchayat office, school, and temple) to overcome infrastructure barriers (e.g. Soya-choupal, Village Knowledge Centre).
- Appoint facilitators exclusively for information service; they should be motivated and accountable, well qualified with adequate knowledge on subject matter and computer operation.
- Facilitative role of institutions like village panchayats, agricultural extension offices, and Krishi Vigyan Kendras is desirable to enhance access to information (e.g. Helpline service).
- Sustainability from ICT-enabled information service can be achieved if and only if such service offers a wide range of assured higher economic benefits to the farmers (e.g. improved yield, cost reduction, etc.). Initiatives can be maintained in a sustainable manner through either win-win profit-driven option (e.g. Soya-choupal) or through continuous sponsorship (e.g. Village Knowledge Centre).
- Support these initiatives by other quality services and rural infrastructure (extension expert's advice, market access, transport service, roads, development schemes, etc.) to translate knowledge-based decisions into actions without bottlenecks.
- Encourage networking of institutions and public-private partnership for improving rural teledensity, information generation and dissemination, capacity building of the facilitators, etc.
- Public sector institutions have to play bigger role in synthesizing information while private sector institutions and NGOs disseminate it through information centres. Even though, the 'Ten point agenda' of the Union Ministry of Communications and Information Technology

Table 14: Differential features of selected ICT-based initiatives

Features	Public sector	Private sector	NGOs
Investments	Funds from central and state governments	Company expenditure organizations, state	Funds from international governments, etc.
Area of interest	Research, education, training and capacity building	Business goals with social orientation	Uplifting of remote/rural area households
Salient husbandry, services	Researcher-farmer linkage, Call centres	Input-output marketing, technology dissemination	Agriculture and animal social development work
Study areas	Based on the research and training needs, villages/districts	Commercial, strong marketing areas of the companies	Remote and socially under-developed areas
IT facilitator at the grassroot level	Government officials, trained local personnel	Local trader, professional personnel	Volunteers from local areas and service-oriented
Goals	To make a role model for agriculture and the allied developments	To generate economic benefits for the people as well as the company	To create awareness about socio-economic benefits of innovative technologies

has emphasized ICT as of extreme importance for bringing about all-round economic development, it needs to be pursued further by framing explicit ICT policy, which is well-integrated with sectoral policies (e.g. agriculture, rural development, etc.).

Institutional innovation as an instrument for rural prosperity

In Assam, Field Management Committees (FMCs) are constituted at the village level with about 50 voluntary members, who possess landholdings in the contiguous area. About 26,000 FMCs, have been involved in many beneficial activities. Although a majority of them are not able to show visible impacts, some of them are performing successfully.

The Government of Assam has recognized the FMCs as village intermediary for its schemes like million Shallow Tubewell Schemes (STW), Samridhi Kisan Yojana (SKY) and for several NABARD schemes. A sample of 25 FMCs in five selected districts of Assam was studied to understand their functioning and constraining factors. FMCs help the farmers in capacity building, access to information and forming cohesive groups. In doing so it has increased crop production and enhanced the adoption of modern technology, including crop diversification.

Extension policy at the national level in Asia

Extension is clearly facing challenging times in Asia. This study has drawn together experiences across Asia to find the extension policy and the extension policy process. Four cases of recent developments in extension policy and policy process (India, Indonesia, Iran and China) have been presented to illustrate the challenges involved in developing and implementing extension policy. The major findings from this study are:

- Extension policy in Asia needs to tackle two major sets of issues; the first concerns the content of extension policy in view of the broader role extension needs to play in the present context. The second issue concerns the nature of the policy process itself. Instead of prescribing reform, the policy process should ideally facilitate a continuous incremental change through experimentation, reflection and learning.
- The experiences indicate that reform processes informed only be prescriptions generated within or from outside are bound to fail. The message for extension policy in Asia is that the process of reform must be led from within.
- There is an urgent need to undertake an institutional analysis of historical and current approaches of implementing different extension approaches and building development capacity within the country on experimenting with different approaches and evaluating them. These learning-based approaches should inform policy development.
- The existing culture of extension organisations may prevent the emergence of learning-based approaches to reinvent extension. Changing these cultures may be the biggest challenge to reinventing extension in Asia.

Agricultural Growth and Modelling

Agricultural diversification in South Asian countries

A study was conducted to examine the nature, pattern and speed of agricultural diversification in South Asian countries during the past two decades, ending 1999-2000. The study has revealed that agriculture in South is gradually diversifying. Among countries, Bangladesh, Bhutan and Nepal have shown less diversity as compared to that by other countries. Bangladesh has specialized in rice. More than three-fourths of the area in the country is under rice. But the remaining one-fourth area is highly diversified. Nepal and Bhutan are aiming at higher degree of self-sufficiency in basic foodgrains than what it is today, and therefore, are concentrating more on cereals, particularly rice, wheat and maize. Table 6 shows that in most of the countries, crop diversification is coming from area expansion, with some exception of crop substitution in India and Sri Lanka. Incidentally, in Nepal, Pakistan and Sri Lanka, area expansion is also coming from deforestation, which is a cause of concern from environmental point of view. The evidence shows that agriculture is gradually diversifying in the sub-continent with some inter-country variations. Diversification is observed in favour of high-value commodities. Since their share in area and production has been too low in comparison to that under foodgrain crops, the extent of diversification was unnoticed.

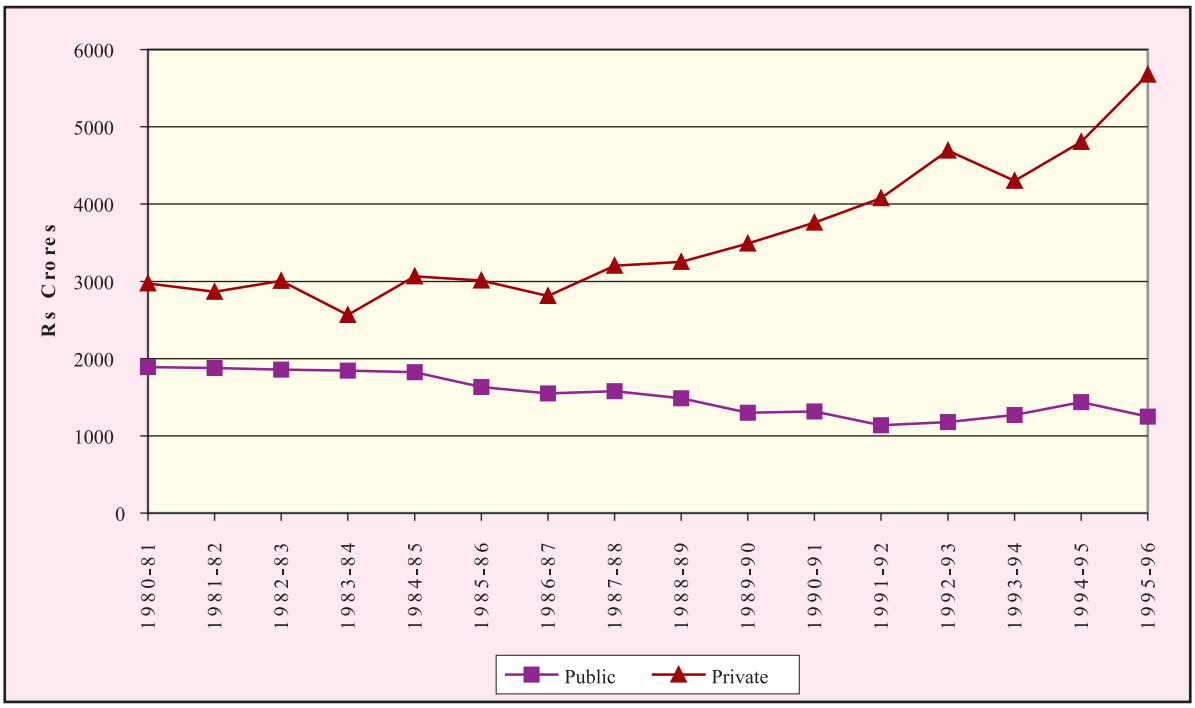
Regional disparities in agriculture

Concerted efforts were made during the decade of 1980s to spur agricultural growth in low productive and stagnant regions. It is an important policy concern to find out whether such efforts have yielded dividend and reduced the gap between rich and poor states. These results reveal that there is a tremendous variation in per hectare and per person agricultural income across states. Also, different states are found to be moving on disparate growth paths. Contrary to the claims about potential of east India, agricultural growth in this region except West Bengal, is showing signs of stagnation and deterioration. There is a clear evidence that since 1980-81, regional divergence in agricultural productivity and income has grown and the gap between underdeveloped and developed states has continued to increase.

Trends in agricultural investments

A new and broad series on public investment in agriculture at the country and state levels was constructed and used to analyse the changes in composition of public investment, and relationship between public and private investments. Capital expenditure on all major heads of agriculture in real terms has been declining. At all-India level, 9.22 per cent of net domestic product from the agriculture sector was invested for capital formation in agriculture during the first half of 1980s. However, during the second half of 1980s resources spent on agricultural infrastructure development declined to 7.40 per cent of NDP from agriculture and further to 5 per cent during 1990s. Union government's contribution to capital formation in agriculture constituted about 1.8 per cent of NDP from agriculture during the late 1970s. The contribution dwindled to 0.25 per cent during the 1990s. The lack of complementarity between the private and public investments stands prominently. Institutional credit and terms of trade for agriculture have turned out to be the strong determinants of private investments in agriculture. As private investment is found to be more effective than public investment in output growth, it would be prudent to encourage private investments through institutional credit support rather than relying mainly on public investment for inducing private

Figure 6: Public and private capital formation in agriculture as per CSO



investment and output growth. In particular, flow of institutional credit should be increased in low investment states like the eastern states.

Emerging crisis in Punjab agriculture

This study has examined the scope of agricultural diversification and its implications on employment, income, natural resources and ecology. Growth rate in agriculture GDP in Punjab registered a sharp decline during 1990s over 1980s and has been lower than the all- India level. So is the per capita income. The study has suggested three-pronged strategy of diversification to accelerate growth and to check degradation of natural resources, particularly water depletion. One, diversification through items of' mass production and consumption; two, concentration on area-specific enterprises of moderately high value; and three, limited diversification through non-conventional high-value commodities for consumption of the elite.

Growth and variability in rice production in eastern India

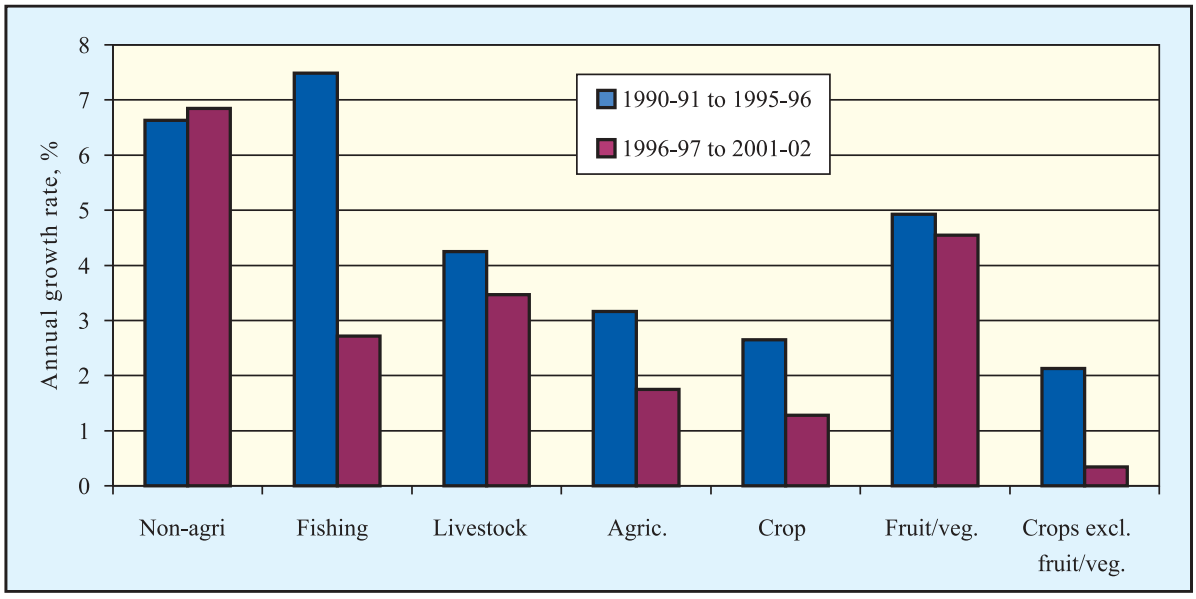
An impressive growth in yield and production of rice was noticed in all the eastern states, except Bihar, during the 1980s and early-1990s. Nevertheless, rice yield in eastern India is about half of that in the northern region. The variability in yield and production of rice has registered a significant decline in the eastern parts of Uttar Pradesh and Madhya Pradesh, whereas it has increased significantly in Bihar. About 5 per cent of rice area in the region has registered significant acceleration in yield growth with significant decline in its variability. A considerable decrease in yield variability with no change in the growth rate was noticed in 15 per cent of the area. No change in yield variability was observed in 73 per cent of the area, and 30 per cent of this area showed increase in yield

growth. These results indicate that growth and variability are not necessarily positively correlated. Once the farmers adjust to new technology, yield can increase at the same or even at lower degree of variability. This fact was supported by the results of regression analysis showing that fertiliser use, a proxy for high-yielding varieties and associate management practices, has negative and significant effect on rice-yield variability.

Agricultural growth during the reforms

The growth rate analysis has shown that initial years of reforms were somewhat favourable for agricultural growth, but the post-WTO period witnessed a sharp decline in the growth rate of almost all commodity groups, one by one. The current growth rates are too low to achieve the goal of 4 per cent growth in output, as envisaged in the National Agriculture Policy. If corrective measures are not initiated soon to reverse the deceleration process in agricultural growth then even the growth targets of 10th Five-Year Plan may not be met. Another disquiet aspect of recent growth process is that agriculture and non-agriculture sectors are on disparate growth paths. The probable causes for the slowdown in agricultural growth are adverse impact of depressed international prices on domestic prices, neglect of price intervention for underdeveloped region having large growth potential, slowdown in adoption of improved technology, and stagnation in public investments in agriculture for a long time.

Figure 7: Growth rates during pre and post-WTO periods



Determinants of capital formation and agricultural growth

Rate of return on private investments, which in turn depends on the terms of trade and technology, is found to be the most important determinant of private capital formation; the second being the addition of new farm-holdings. As most of the capital assets are indivisible and perfect sharing is not possible, addition of new farm-holdings, resulting mainly from divisions of earlier holdings, necessitates investments in new farm buildings, machinery, etc. Institutional credit to agriculture as short-term, medium-term or long-term loan has been found to be the other determinant of private

capital formation. The impact of subsidies on agriculture has been observed positive on private investments. There is asymmetry in effect of rising and falling public investments on private investments. Increase in public investment definitely induces increase in private investments while decline in public investment forces farmers to cope up with its adverse impact, again through increasing private investments.

The public sector investments depend mainly on fiscal resources. Increase in farm subsidies and decrease in revenue receipt from agriculture cause adverse impact on the public sector capital formation. One per cent increase in farm subsidies reduces the public sector capital formation by 2.5 per cent, while 1 per cent decline in revenue contribution of agriculture reduces public investments by 1.9 per cent. The study has shown a clear trade-off between resources transferred to agriculture on revenue account and allocation for agriculture on capital account.

Table 15: Impact of subsidy and GFCF in agriculture on AgGDP at 1993-94 prices

(value in Rs)

Particulars	Impact
Impact of one rupee spent in subsidy on AgGDP	3.19
Impact of one rupee spent in capital formation on AgGDP	0.61
Average life of public capital : Years	58.00
Impact of one rupee spent on GFCF on AgGDP over whole life of capital	
Absolute value in 58 years	35.21
Present value at 10% rate of discount	6.02
Present value at 8% rate of discount	7.42
Gain /loss due to one rupee going in subsidy rather than public capital formation	
At 10% discount rate	-2.83
At 8% discount rate	-4.23
Impact of shift of 1% subsidy amount of public sector capital formation of AgGDP, %	
At 10% discount rate	1.82
At 8% discount rate	2.73

The GDP agriculture is affected by both capital formation as well as subsidies, besides terms of trade. Instant return to one rupee spent in subsidy is much higher than that for the public sector capital formation. However, long-term return from capital formation is more than double of the return from subsidies. Diverting one per cent resources from subsidies to public investment raises output by more than two per cent. As there is a trade-off in resources going into subsidies versus resources available for public investment, diverting resources from subsidies to public sector capital formation is highly desirable to ensure growth in GDP agriculture.

Rice economy of India

The historical analysis shows that the phenomenal pace in increase of rice production has been uneven and the regional disparity is highly pervasive among the states and across the diverse ecosystems in India. Clearly, the gain due to modern rice technology has been discriminatory against the resource-poor areas, which are also dominated by small and marginal farmers. The regional dimension of rice production systems depicts a contrasting scenario. The irrigated rice in Punjab demonstrates a highly progressive picture. The decadal average production was 7.38 million tonnes in 1999-00, while the compound growth slided down from about 10 per cent in the early-1980s to 2.58 per cent in 1999-00. The rainfed rice in Orissa, on the other hand, shows a diametrically opposite and unequal picture. The average production was hovering around 5.8 million tonnes during the same period while the growth rate was stagnating below 1 per cent in most of the 1990s.

Table 16: Decadal compound growth of area, production and yield of rice in India

Particulars	1970s	1980s	1990s
Area	0.87	0.42	0.35
Yield	1.05	3.62	1.32
Production	1.92	4.04	1.68

In comparison to other zones, the productivity of rice in the northern zone (comprising Punjab and Haryana) is impressive, though there appears a slight declining tendency in recent years. The next best performance is in the southern zone, though the productivity is declining. The lowest performing is the eastern zone. During the past three years, the proportion of rice area has increased from 65 per cent to 68 per cent, despite low and fluctuating productivity. The green revolution has generally bypassed the less-developed rice production system in the eastern India, which is a matter of concern and needs to be addressed. While combined areas under wheat and rice are stagnating around 69 million hectares (57 per cent of area under foodgrains), at the same time, the productivity of rice in over two-thirds area has been hovering around 2 tonnes per hectare, which affects the household food-security of the millions of small and poor farmers, a phenomenon likely to reach an un-manageable situation in future. The low productivity and vulnerability to natural calamities push a large number of the population towards abject poverty. It, therefore, implies the need for productivity enhancement and providing more entitlement to livelihood to the rice-growing population, which is a major challenge to the agricultural research and development system.

Shifting production base from irrigated to rainfed areas

The spread of rice-wheat system has environmental implications. Punjab is seriously trying to shift area under rice-wheat rotation through crop diversification. If it is pursued on a large scale, then to compensate the loss of total production and the depleting central pool of foodgrains, in particular, the eastern India has to play a significant role. This would require at least three-times additional area compared to its reduction in Punjab at the given level of productivity of rice or the productivity of rice in eastern India should increase 2 to 3 times. Since the former option is untenable, apparently, the

future production increase must come from productivity enhancement. Improved performance of rice productivity in Assam and other parts of the rainfed areas, shows that there exits a huge untapped potential in the eastern India for the next green revolution to emerge from the rainfed areas.

The productivity enhancement of rice and rice-based systems with special emphasis on regional priority has become a necessary condition for increase in production. It however, requires a well-articulated design of system research in genetic improvement and stability in rice variety, better crop management and crop care techniques, effective post-harvest technology, and strengthening of the capacity building of the stakeholders. Not only developing of modern and new technology but also imbibing the traditional knowledge-base on the rice production systems need to be considered. Therefore, it calls for more in-depth understanding of the synergy among the varieties and on-farm dynamics of the existing production systems and their changing pattern.

4.2 Policy Communication

Besides publications of the Centre and of its scientists in professional journals, NCAP organized several national and international workshops/seminars/conferences, covering diverse areas of topical interest for providing a platform to the researchers, policy planners, policymakers and stakeholders to come together and deliberate on policy-related strategies. By the end of 2006, more than 50 policy-related meetings/seminars/workshops were held at or sponsored by NCAP, 6 of these were international. In these meetings, more than 1000 scientists, research managers, policymakers and policy planners participated. The specific instances of policy advocacy to the ICAR/DARE, other Departments, and international bodies are provided below:

ICAR / DARE

NCAP was established by ICAR with one of the mandates of advising the Council on technology policy issues. The Centre, over the years, has been successful in achieving this mandate, as given below:

- The research contribution of the Centre in the area of research resource allocation, namely that around 0.46 per cent of agricultural GDP is only invested in agricultural research as against the recommended level of 1-2 per cent by the World Bank, has been used by the Council for articulating the need for greater financial support to agricultural R&D.
- Another research finding that there will be a serious shortage of trained human resource in the ICAR system by 2007, is being made use of by the Council for taking necessary correctives.
- The contributions of the Centre in research prioritization in the NARS are well recognized, particularly beginning with the launching of World Bank supported mega National Agricultural Technology Project. The Council has taken a conscious decision to establish PME Cells in all of its institutions to strengthen this activity in the X Five Year Plan.
- The decision of the Council on assessing the impact of all of its 72 EFC/SFC schemes and technologies on the socio-economic well-being of the farmers is on account of research leadership provided by NCAP. The contributions of the Centre in promoting the public-private sector interface in research is yet another impact of NCAP on the Council / DARE.

Dr Dayanatha Jha, Former Director, NCAP welcoming Dr Manmohan Singh, the then Finance Minister of India

Other Departments (Central and State)

The research work relating to assessing the impact of removal of quantitative restrictions on Indian agriculture has been made use of by the Department of Agriculture and Co-operation of the Ministry of the Agriculture while providing the feed back to the Nodal Ministry, namely, the Ministry of Commerce. Subsequent contributions of the Centre to this area have been utilized by the Ministry of Commerce for preparations to the negotiations in agriculture at WTO.

One of the contributions of the Centre sponsored by Ministry of Food relates to the future food management in India.

The Centre has conducted following studies at the initiative of Planning Commission :

- Conducted a study on fertilizer demand projections for India and the report has been submitted to the Planning Commission.
- Completed a study on Development of Agriculture in Uttar Pradesh and has submitted the report to the Planning Commission.
- Carried out a study on Development of Agriculture in Bihar; the report, discussed in a seminar, has been submitted to the Planning Commission.

Based on the demand from the Ministry of External Affairs, the Centre headed a Mission to Bhutan for developing an 'Integrated Agriculture Development Proposal for Bhutan', to be funded by the Government of India.

The Centre's services were sought for developing the Integrated Water Resources Management Strategy for the Government of Madhya Pradesh. The Centre participated in a multi-disciplinary mission to formulate this proposal, which is under submission to the Government of Madhya Pradesh.

The Centre for Extension Education of IGNOU, New Delhi, has identified the NCAP for developing the programme framework for 'Agriculture Policy' to disseminate the salient features of agriculture policies to all the stakeholders of the system, namely panchayats/farmers, extension workers and policymakers for its effective implementation.

The Centre has developed a cafeteria of programmes to be used by the Ministry of Agriculture for helping all the states in developing specific programmes for women in agriculture.

NABARD has requested the Centre to develop strategies for the involvement of private sector in agricultural extension for formulating appropriate policy initiatives. The report has since been accepted and getting published by NABARD for a wider dissemination.

The Centre has contributed to the formulation of Water Vision of Andhra Pradesh by participating in a multi-disciplinary mission.

International

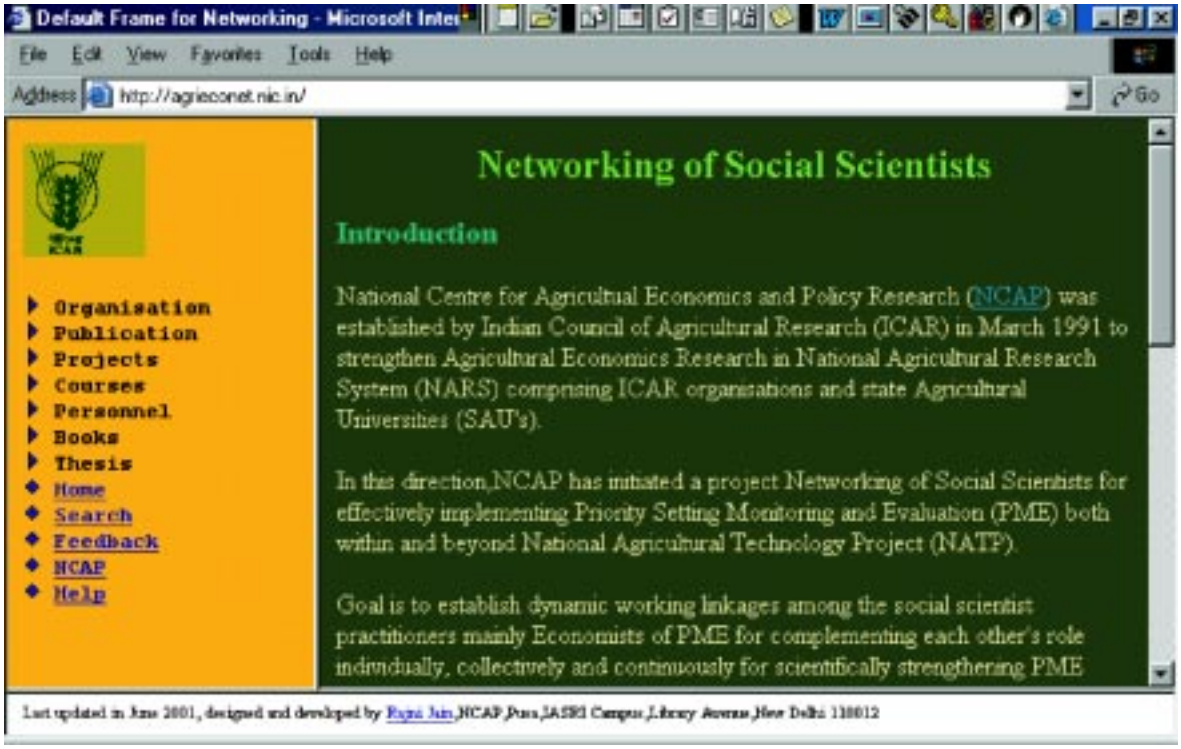
The contributions of the Centre particularly in the area of the research prioritization have been recognized by the Regional Organizations like APPARI at whose instance the Centre conducted studies on prioritization of agricultural research in Asia Pacific Region at both macro and micro levels.

Dr Mangala Rai, Secretary, DARE and Director General, ICAR Chairing SAARC Technical Committee on Agriculture and Rural Development (TCARD)

Similarly, the capability of the Centre in conducting policy studies has been well recognized by several CGIAR institutions like IFPRI, IRRI, ICLARM, ICRISAT, ILRI, IFAD, UNEP, ADB, etc. with whom the Centre has collaborations on policy research studies.

4.3 Networking of Agricultural Economists

Internet programming technologies have been used to develop Online Information System (OIS) for networking of Agricultural Economists. OIS provides the easiest way to link the documents and their sections in a non-linear manner with functional flexibility for timely connectivity and information exchange with all users anywhere across the globe. OIS has been developed in-house at NCAP, using the latest technologies for Internet programming like Active Server Pages (ASP), Hyper Text Markup Language, Java Script, VB Script, Visual Interdev, etc. The database is stored using MS-access 97. The system is hosted on the Internet using the web hosting services of National Informatics Centre (NIC) and it has become operational since December, 2000. It provides comprehensive information about the Departments of Agricultural Economics of more than 60 organizations of ICAR and SAUs. The information is available under the heads like mandates and thrust areas of the department, scientists and their professional bio-data, titles of publications from each organization under different areas of research, list of courses offered by each department and many more relevant details relating to Agricultural Economics Research and Education. Further details can be seen by browsing at the address http://agrieconet.nic.in. It is a user- friendly system and any help, if needed, is also available online. The OIS also serves as E-directory of Organizations, Faculty, Courses, Degrees, Publications and projects pertaining to Agricultural Economics. Besides providing international exposure, it will also help in improving the research quality by avoiding duplicity of research and will enhance resource- sharing by providing information on what is available where.



5. IMPACT

The Centre has addressed priority research programmes identified in its first Vision Document. These programmes were addressed through in-house core research, collaborative and consultancy modes. The relative importance of these modes of research is indicated in Table 17. This strategy helped in developing a credible research-base, gaining visibility and making significant impacts. Major impacts have been made by useful policy recommendations for accelerating technology-led sustainable agricultural development. Significant policy recommendations and other impact areas are summarized in Box 1.

Box 1: Major Policy Impacts

- Agricultural research intensity is 0.48 per cent, raise it to at least one per cent of AgGDP, and rationalize resource allocations (manpower and financial)
- Strengthen decision-support system in the NARS by institutionalizing improved PME mechanisms
- Develop innovation system by fostering public-private partnerships
- Enhance flow of information, incentives for promotion of new varieties and public plant breeding for competitive seed industry
- Implement selective region-specific tenancy and other land reforms
- Focus on institutional and policy reforms for accelerating agricultural diversification for higher growth and rural poverty alleviation
- Revise water price policy and strengthen people's participation for sustainable use of irrigation water
- Enhance public investment in agriculture, particularly in less-developed states, and ensure efficient use of public infrastructure
- Stimulate development and disseminate appropriate rice technologies for the eastern India to alleviate rural poverty
- Mixed impacts of WTO agreement on Indian agriculture were noted
- Rationalize governmental interventions in foodgrains markets
- Introduce analytical methods for PME
- Introduce quantitative methods for agricultural policy analysis
- Networking of agricultural economists
- Strengthen the selection of competitive research grant programme
- Introduce human resource development for policy analysis

The activities of the Centre have been critically reviewed (1991-1999) for the first time by a high-powered QRT, headed by an internationally eminent economist, Prof. V.S. Vyas. The QRT has reported that, " the Centre has largely fulfilled the expectations of its sponsors, and has provided adequate justification for its establishment by creditable academic research, serious efforts in dissemination and advocacy of its research output and supportive role to the other related institutions of the ICAR system. It has also organized itself in a manner that right environment for high quality and relevant research is created, responsibilities are shared and, proper accountability is ensured".

6. SCENARIO

Research planning has to be based on the vision of social goals, opportunities and constraints. Anticipating projected economic scenario over the next 25 years is a complex task, particularly in the context of Indian agriculture which is being overwhelmed by changes in domestic and world economic situations. The proposed Agricultural Policy Resolution and the WTO agreements provide a perspective on national and international economic orders in broad terms. The following paragraphs attempt a qualitative assessment of the agricultural scenario in the country in the years to come:

6.1 Demand Scenario

- Demand for foodgrains for human consumption will continue to grow, albeit at a declining rate. However, if there is significant progress in poverty alleviation, higher growth (more than 2 per cent) in foodgrain consumption may continue through 2025.
- Demand for grains for animal feed will grow at a rapid pace. This implies that total demand for grains will remain buoyant in the next two decades.
- Driven by higher (4-5 per cent) growth in income, demand for high-value commodities, viz. fruits, vegetables, edible oils, livestock and dairy products, semi-processed and processed food will grow fast in the domestic market. Rapid growth in urbanization, changes in occupational structure and globalization will accelerate these changes further.
- Opportunities in the world market will push demand for some commodities on a higher scale. Apart from traditional basket of agricultural exports, tropical fruits and flowers, processed agricultural and livestock products, marine products, selected foodgrains and animal feeds have high export potential. Africa, Europe and Asia will emerge as major new markets for agricultural exports from India.
- Value-addition, processing and other secondary sectors will grow rapidly with rising incomes, growing urbanization and increasing working women.
- Quality factors will become more important across the board. Compliance of SPS measures will be more challenging as high-income importing countries will put more stringent standards.

6.2 Supply Scenario

- Supply of agricultural land will be restricted, may even decline. The agrarian structure will be transformed as rural population and areas adjust to new circumstances.
- Exploitation of water resources for agricultural use will reach its limit.
- Commercialization of agriculture in response to changing domestic and world markets will induce drastic shifts in production portfolios and resource use. This may have implications for food security as well as agrarian relations. The regional dimensions of existing food production scene may change in favour of eastern India.
- The agriculture sector will witness labour-scarcity; better education and faster growth in the non-farm sector will induce rapid migration and occupational changes over the next 20 years.

Table 17: Addressing priority research programmes: 1996-2006

Areas	Programmes	NCAP core research	Collabrative research	Consultancy
I. Technology Policy	1. Evaluation of prospective technologies	**	*	--
	2. Constraints to technology transfer	**	--	--
	3. Agricultural research policy	***	**	*
	4. Research prioritization and imapct assessment	***	--	*
	5. Efficiency in inputs-use	--	--	--
	6. Seed system development	**	**	*
II. Sustainable Agricultural Systems	7. Economic /social impact of degradation	**	--	--
	8. Evaluation of sustainable systems	**	**	*
	9. Water-food scenario	**	--	--
III. Markets and Trade	10. High-value and exportable commodities	--	***	--
	11. Trade liberalisation and market reforms	***	--	*
IV. Institutional Change	12. Understanding collective action	**	--	--
	13. Institutional constraints	--	--	**
V. Agricultural Growth and Modelling	14. Investments in agriculture	*	*	--
	15. Growth analysis and modelling	*	--	--

Note: ***, **, * indicate high, moderate and low intensity of efforts, respectively

- Sustainability of natural resources and even agricultural growth will be a major concern. Development impinges on environment and subsequently, on sustainability of resources and agricultural growth. Land and water resources will face acute degradation and stress; supply of non-renewable resources like fossil fuels and phosphates will be constrained. Agro-chemicals will gradually be substituted by biological inputs. Management of these, including common property resources, will pose economic and political challenges.
- Infrastructure will continue to be a major constraint in the short-run, as availability of public resources will decline, in both domestic and export sectors.
- New institutional arrangements will evolve in factor and product markets. The role of the state will be redefined. The private sector will become important at least in the areas where they have interest and advantage.
- Technological change will emerge as the major driver of agricultural growth. The private sector, including MNCs, will emerge as powerful players in agricultural R&D.

6.3 Global Scenario

It is even more difficult to project the global scene. Some studies on the structure of post-WTO scenario suggest the following trends for developing economies:

- The food and agriculture sector will decline in relative importance in most developing countries, but food processing sector will expand. By the year 2010, the total foodgrain imports of developing countries will become double.
- The centre of economic gravity will shift towards the East Asian economies, as these will gain comparative advantage in production of capital-intensive products. Close economic ties with East Asian countries will enable India to capture some of the potential gains.
- Trade between developing countries will expand substantially. Exports from South Asia to ASEAN countries are expected to grow by 200 per cent in volume over the next ten years.
- Developing countries, which moved earlier and faster on economic liberalization, will gain more from free world trade.
- Several agricultural commodities will have export potential (horticultural crops, livestock, fibres, scented rice, durum wheat, oil cakes, spices, etc.). Supply-side constraints will inhibit exploitation of this potential. Ameliorating constraints and cost-reducing technical change would be critical for India's agricultural exports.
- Public investment in international agricultural research, will shrink and there would be greater restrictions on free flow of knowledge, information and genetic materials on account of new IPR regime.

These projections are not non-controversial. Some studies also indicate that WTO is loaded in favour of industrialized countries in Europe and the United States, and non-tariff barriers and aggressive R&D will be used to restrict opportunities for developing economies. The WTO does not provide adequate safeguards against these. It is also argued that large countries like India must

take a cautious perspective on trade-related issues. Regardless of who gains more from liberal trade, we take the position that significant opportunities exist for India, and that it should proceed with fiscal, economic and investment policies on this presumption.

6.4 National Agricultural Research System (NARS) Scenario

The NARS after a phase of rapid expansion, has entered an era of deepening integration and consolidation, shifting its research approach from

- Component-based to system-based
- Project-mode to programme-mode
- Single-objective to multi-dimensional goals
- Disciplinary to inter-disciplinary mode
- Supply-driven to demand-driven
- Conventional methodologies to frontier approaches, and
- On-station research to more participatory approaches, emphasizing partnerships.

The NARS is also reforming and expected to have following characteristics:

- Better integration with the economy, including the private sector
- More objective resource allocation
- More rational scientific manpower support system
- Greater thrust on research infrastructure, information systems, networks, national and global linkages
- Higher emphasis on human resource development, incentives and rewards, and
- Emphasis on quality, accountability, monitoring and evaluation.

While resorting to the above shifts, NARS is confronted with funding, human resource, and organizational and management problems. These need to be addressed for transforming NARS and making it more effective and efficient.

6.5 SWOT Analysis

Strengths

The national agricultural research system is the primary repository of agricultural technology - related information in the country. It is essentially a rural system. These provide a distinct advantage in pursuing studies on the agricultural economy. Figure 8 portrays these strengths in a simple conceptual framework. The system has a well-dispersed network of state agricultural universities, zonal research stations and a large number of ICAR units (regional research stations). By developing linkages with them, NCAP should be able to establish effective and quick access to ground realities. Such an access will be immensely valuable.

Weaknesses

Some pioneering work in agricultural policy area has been done by economists in the ICAR-SAU system by stalwarts like Dr A.S. Kahlon, Dr S. S. Johl, Dr V. Rajagopalan, Dr R.K. Patel, Dr S. S. Acharya and others. Economists outside the NARS have made significant contributions to agricultural policy research. Nevertheless, inadequate attention to agricultural economics in the national agricultural research system in the past, particularly in macroeconomics, trade and policy issues, has hindered the growth of the discipline. There is a weak link with mainstream economics; therefore, very little policy influence was made. Enormous HRD gaps have emerged in areas such as international trade, macroeconomic policies, environmental economics, developmental economics, policy modelling, etc. These impede the capacity of the system to cope with the emerging problems. This paradigm shift necessitates greater economic analysis of agricultural technology policy decisions. Specifically, issues like research prioritization and resource allocation, transfer of technology, ex ante and ex post evaluation of research, supply-demand factors, policy interface and interactions, etc. require to be integrated with the planning, strategies and activities of the NARS.

Opportunities

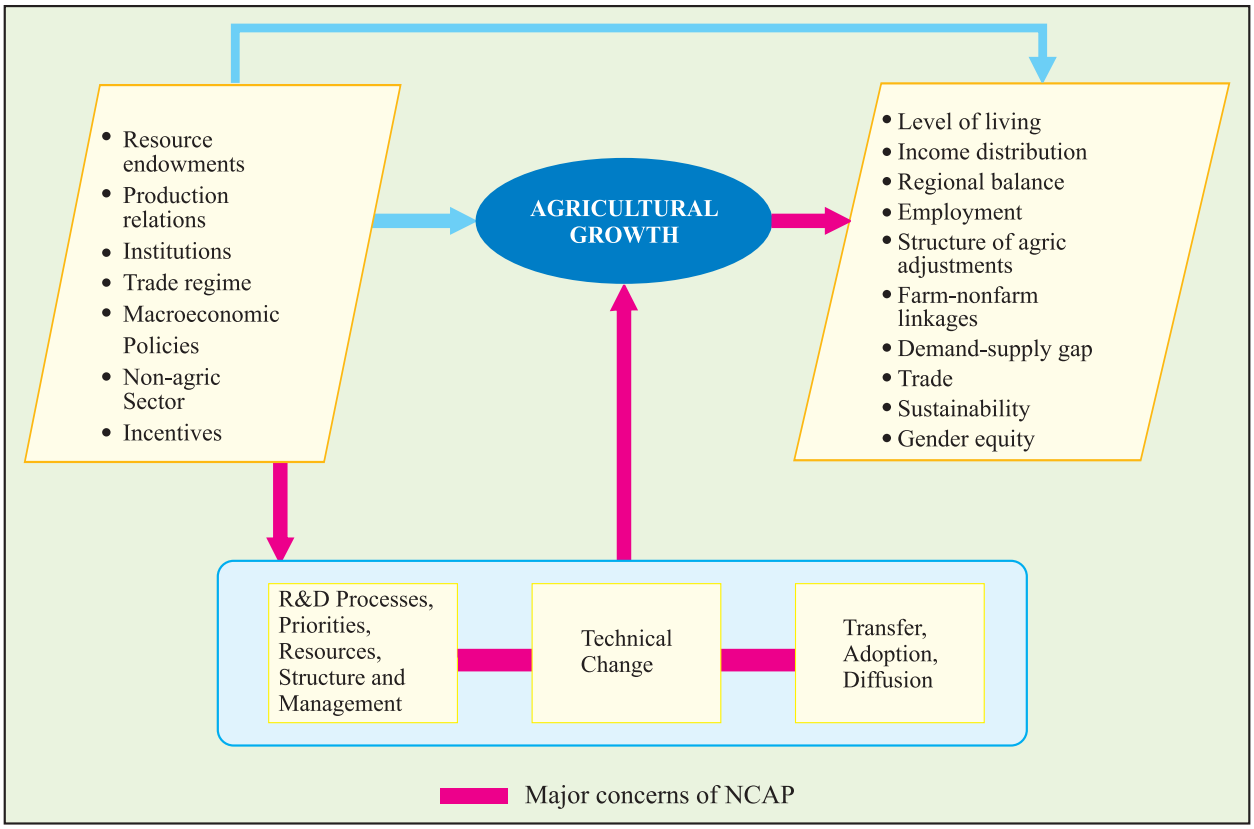
Emphasis on liberalization and trade reforms has opened up new opportunities and challenges. Value-addition and processing, international trade, non-farm sector growth, technical change-all offer opportunities for the agricultural sector, and economists are trained to decipher these market signals. A reorientation of research agenda along these lines on the part of agricultural economists in the NARS will greatly contribute to the overall efficiency of the system. This will require appropriate support and dynamic leadership. NCAP is uniquely placed to play the leadership role. Through its linkages with the agricultural universities and ICAR institutes, it can articulate more effectively the relevant blending of micro and macro perspectives in policy analysis.

The Centre's location in Delhi, where a number of leading institutions in economics research exist, also provides a great advantage. Interactions with these institutions, and policy wings of the government (Ministries, Planning Commission, Commission on Agricultural Costs and Prices, and alike bodies) will enrich Centre's work and its policy influence. Close interaction with economists in other ICAR institutes, like IARI, IASRI, NDRI, IVRI, CMFRI, etc. will lend mutual strength.

Threats

Economic and policy issues have become critical in agriculture after a gap of two decades. Achieving high and inclusive agricultural growth will rely on how conducive is policy environment. Lack of appropriate policy analysis will constrain agricultural growth. Economic reforms, particularly in liberalisation and trade areas, have altered the economic environment drastically. This calls for detailed research on marketing and incentive structure, technology transfer, traditional and innovative institutions, comparative advantage, efficiency, equity, etc. It will require high priority to agricultural economics discipline and the corresponding commitment of senior research managers. Lack of support will leave these gaps uncovered. The existing human resource capabilities in this area are poor and must be addressed on a priority basis.

Figure 8: Conceptualizing socio-economic research at NCAP



7. PERSPECTIVES

The vision of NCAP generates a comprehensive research agenda in agricultural sciences, socio-economic and institution-building processes. The main themes for socio-economic and policy research can be summarized as follows:

7.1 Analysis of Demand Patterns

The past work on demand for agricultural commodities has important gaps in terms of commodity coverage. Vegetables and fruits, livestock and dairy products, fish, processed food, and animal feed have received relatively less attention. These, as indicated above, will be the major growth areas in the future. For other commodities, including cereals, pulses and oilseeds, more empirical analysis is needed on changing demand levels and patterns in domestic and world markets and their implications on R&D. A greater emphasis will have to be laid on poverty and nutrition-related studies and demand patterns by income groups, socially-excluded communities and rural-urban consumers. Studies on market structure, conduct and performance, market failures and appropriate interventions would be important. The other significant areas for research are: world food demand scenario and potential demand for Indian agricultural products, identification of potential importing countries for Indian agri-commodities, and their requirements and strategies for creating demand in the global market.

7.2 Supply-side Constraints

Important research areas on the supply side include supply response studies for the commodity groups identified above and their implications for food and nutritional security. Limits on natural resources (land and water); efficiency of production; land, labour and capital markets, sustainability of natural resources; marketing; agri-processing; bio-technology, renewable energy sources; appropriate mechanisation; infrastructural needs, modern inputs, etc. are some other areas for future research. Human resource needs, technology generation and transfer, intellectual property regimes and R&D policies would need attention. Constraints to adoption of promising technologies is also an important research area under network mode.

7.3 Institutional Reforms

Greater commercialization of the agriculture sector and closer linkages with agri-business would demand innovative institutional and organizational arrangements. Institutions relating to land, farm inputs, credit and insurance would need a fresh look. Since agriculture is a state subject, effective implementation of national policies remain uncertain. Therefore, studies to analyze the areas of agreement and disagreement and their effects on effective implementation of national policies should receive attention. Studies on collective action in accessing knowledge, technology and markets will also be needed. Empirical assessment is needed on entry of industrial houses on agri-business, agri-retailing and contract farming, and their implications on smallholders. The role of the state in changing scenario will have to be carefully analyzed both in the context of eliminating restrictive policies and its catalytic and facilitating functions.

7.4 Dynamics of Agricultural Growth

Studies on patterns and determinants of agricultural growth, understanding the interactions between incentives, infrastructure, institutions, trade, and technology will be important areas for research, as will be the inter-regional and inter-class distributional, employment and wage-related consequences. Comparative studies on agricultural growth, particularly with reference to newly industrialized and rapidly growing economies of Asia, as well as between states will provide valuable guidance.

7.5 International Trade

Studies on impact of domestic and trade policies in agricultural commodities will be an important research area. Other significant research themes in this area include shifts in comparative advantage across exporting countries, analysis of world price movements and trends, monitoring restrictive trade practices and their impact, including welfare effects, constraints in the export sector, changing role of existing institutions like STC, FCI, NAFED, APEDA, etc. These will be necessary for effective participation in the world trade as well as to remain relevant to deal with large and expanding domestic market.

7.6 Long-term Issues

Two research themes have great importance in inter-generational transition. First is related with the economic studies on environment and sustainability of production growth and livelihoods. This

In the backdrop of mandate, achievements, impacts, and scenario analysis, NCAP proposes its vision, mission, goals, objectives, and strategies as follows:

Vision : Leveraging Innovations for Attaining Efficient, Inclusive and Eco-friendly Agricultural Growth through Agricultural Economics and Policy Research

Mission : To strengthen agricultural economics research for providing economically- viable, socially acceptable and environmentally-feasible policy options for science-led agricultural growth.

Goals : To articulate the relevance of agricultural economics and policy research for improving better policy options and enhancing their uptake by various stakeholders

Objectives : To evaluate policy options for efficient, sustainable and equitable agricultural growth and rural development

To serve as a Centre of excellence in agricultural economics and policy research and capacity strengthening

Strategies : Design and implement agricultural policy research, capacity strengthening and policy interfacing with focus on

a) Technology Policy
b) Markets and Trade
c) Sustainable Agriculture Systems
d) Institutional Change, and
e) Agricultural Growth and Modelling

will include natural resources, energy management, common property resources, climate change and carbon trading. The second theme relates to agricultural adjustment. The growth process involves social costs in terms of unemployment, changes in occupational structure, gender equity and greater immiserization of the rural poor. These changes need to be analyzed and longitudinal studies need to be organized in different regions of the country.

8. ISSUES

The ultimate goals of the Centre are to strengthen agricultural economics and policy research capabilities within the NARS and to improve policy interaction. The former is crucial for improving the efficiency of the system, and the latter helps in better policy formulation. There are two basic issues to strengthen agricultural economics research on which the Centre will focus are: human resource development and promoting policy-oriented research. Policy research of the Centre will draw strength from the micro-level studies as well as through professional links with leading policy research institutions within and outside the country. In terms of agricultural research policy, the Centre will provide input on socio-economic dimensions so that technology policy decisions are improved, leading to system-wide impact (Box 2).

The Centre will remain a small unit in the foreseeable future in terms of manpower. Yet, its mandate is comprehensive. The research tasks outlined above, are daunting. Also, unlike other research

Box 2: NCAP's Strategy to Implement the Perspective Plan

A. Undertaking empirical policy research
- Policy studies on contemporary agricultural R&D issues in network mode

B. Strengthening agricultural economics and policy research
- Capacity development by
  - Facilitation, networking and dissemination of information
- Training
  - R&D policy and technology management
  - Environmental economics
  - Agricultural development and trade policy
- Collaborative research
  - Promoting network research
- Promote learning from experience

C. Enhancing ICAR participation in policy decisions
- Publication of policy briefs in English and Hindi
- Developing institutional linkages
- Organizing policy dialogues
- Develop and strengthen 'Policy Research and Advocacy Network'

areas, policy research must have a quick response time to be effective. A well thought out strategy is, therefore, necessary. First, research programmes of the Centre must be prioritized with utmost care to maximize impact. Support to the Centre will depend on its ability to contribute to topical policy debates as well as the choice and quality of its research. Second, most of the research programmes will be collaborative in nature, involving economists from ICAR institutes, SAUs and other institutions. This will enable the Centre to draw upon a larger pool of scientific talent and will also contribute to human resource development. Third, the Centre will need to develop first-rate capacity to compile, process, analyze, interpret and disseminate data and research information. Partnerships with IASRI, CSO and Ministry of Agriculture will effectively facilitate this task. As a unique entity, NCAP will need to adopt a gearing strategy, emphasizing on development of faculty and infrastructure, linkages with agricultural economics research groups at ICAR institutes, SAUs and other social science research units outside NARS, and development of networks and collaborative activities.

9. PROGRAMMES AND PROJECTS

9.1 Prioritization

The large, but not exhaustive, research agenda outlined earlier has to be tackled by the ICAR-SAU social science group and other institutions involved in agricultural economics research. We shall begin with identifying areas where ICAR-SAU system has some comparative advantage. A broad

classification of such themes and major programmes within each area are presented below. These have been identified after considerable discussion and debate.

Technology Policy

Efficiency in management of the agricultural technology sector is the prime task of the ICAR-SAU system. Agricultural Economists can immensely contribute to this area by undertaking research on identification of research needs, planning, prioritization and resource allocation, technology forecasting and other agricultural research policy issues. Understanding technology transfer and constraints inhibiting this process is critical. Both national and international issues are relevant in this context. An other important research area relates to efficiency of modern inputs (water, agricultural chemicals, plant varieties, hybrids, etc.) used in agriculture and animal production systems. Adoption lags, technical inefficiencies, effects of input and output price policies, and socio-economic constraints in technology dissemination need to be researched. Monitoring and evaluation of the impact of technological change in terms of growth, equity, sustainability and trade would be essential. Finally, new emerging issues like evaluation of economic reforms, IPR, and issues related to biotechnology and biodiversity deserve high priority. Yield-gap analysis across crops and regions will also be important research areas for accelerating agriculture growth.

Agricultural Systems' Sustainability

The ICAR-SAU system is an important source of information with regard to the health of our natural resources, specific agents causing degradation, and technological options available to counter it. The social science group within the system must address the economic and social dimensions of this problem. It is a frontier area and NCAP must play a catalytic and leadership role in developing capacity in this field. Specifically, impact assessment, trade-offs between productivity growth and sustainability, environment-adjusted costing of technologies and projects are important research areas. Bio-mass and waste management, and sustainability implications of trade liberalization are other important sustainability-related concerns. A lot of research work is being done outside the NARS, and NCAP would play a key role in integrating such work in ICAR-SAU research agenda. Climate change and carbon-trading are new emerging issues which need to be viewed from policy angle.

Markets and Trade

While market studies have a very broad relevance, those by the ICAR-SAU system need to concentrate on the growth-related areas such as high-value products, commodities with export potential, and factor-product market constraints. There is a poor understanding of supply, demand, prices and market conditions, especially for commodities which were traditionally minor but will now become important. Because of its better understanding of the underlying production and technology conditions, the ICAR-SAU group is specially suited for such research work. Similarly, the impact of price policy on these parameters on the one hand, and the effects of quality enhancement, processing and grading on prices and incomes on the other, constitute important research areas. Domestic market reforms, supply chain development, land and labour markets and impact of WTO on agriculture are areas that deserve immediate attention. Market intelligence and its analysis as needed by a variety of users, has become important. NCAP can provide a framework of information/ data collection, analysis and dissemination to the nodal department.

Institutional Change

The paradigm that governed institutional development and agricultural transformation has undergone a sea change in recent years. Private initiatives and private sector participation have become the key words. Serious empirical studies on this theme, particularly relating to agriculture and implications on smallholders, are important. On the other hand, new demand patterns and supply constraints have emerged in several such areas as investments, financing, marketing and trade, agro-processing, etc. where public intervention is needed. Several innovations have pubic goods attributes, these are not amenable to private initiatives and require group action. Even in the public sector, the interface between policies, economics, politics, sociology and technology is changing and has posed new challenges to institutional and organizational development, such as better management and governance of public systems, management of CPR, ICT-technologies, role of panchayats, etc. Agri-retail chains and contract farming need deeper insights in the context of improving production and marketing efficiency, and benefit-sharing by producers and consumers. There is a need to document, understand and analyze these phenomena so that a more relevant paradigm is evolved.

Agricultural Growth and Modelling

Agricultural growth pathway is defined by the interaction of technologies, policies, incentives structures, investments, and resource endowments. Understanding these forces, their patterns and determinants, is essential for agricultural planning. Agricultural development needs to be studied in a longer-term perspective emphasizing farm and non-farm linkages, structural changes in agriculture and other adjustment processes characterizing agricultural transformation. Longitudinal, meso and farm level studies in all the major agro-ecological zones of the country are needed to keep track of these developments and interpret their implications for agricultural research, technology generation and policy formulation. This tradition has, unfortunately, gone out of vogue and the Centre could revive such basic research by helping ICAR and SAUs to initiate this activity on a sustained basis. Rural non-farm sector, modelling for regional growth alternatives, employment and poverty alleviation strategies, investment and policy options for agricultural diversification are some specific researchable issues. Risk assessment is another area for investigation that needs special attention in the changing climate and market forces.

The next step is prioritization. This has been attempted in Table 18 with reference to a more specific research agenda, derived from the above. A qualitative, scoring approach has been followed to rank different research themes. Three criteria have been used for priority determination. First was the relevance of the programme to the objective of growth (efficiency and exports), poverty alleviation (equity and employment) and sustainability of natural resources (soil and water). The second was 'visibility', the Centre can get by addressing a research programme. Finally, in view of the fact that a number of research institutions are involved in research on these and related themes, institutional criterion of comparative advantage of ICAR-SAU system was also included. All proposed research programmes have been evaluated against each of these three criteria in terms of expected contributions on a subjective scale (low, medium and high).

Some of the major research thrusts of the Centre are enlisted in Table 18. Under each thrust area, NCAP plans to develop contents of the programme and specific projects with focus and clarity on expected outputs. Two important points need to be mentioned. First, even though some programmes

shown in Table 18 have received low scores in the present evaluation, the Centre must keep itself abreast with and remain involved in research on these areas as well. This will be necessary to provide feedback to the national research system on implications of policy changes for research. Second, some resources will have to be allocated to such activities as well.

Table 18: Prioritization of research programmes

Research Programmes	Relative Priority	Core/ Collaborative	Time Frame
1. Science and Technology Policy			
▪ Policy research on IPRs and biotechnology	H	Core	Long-term
▪ Technology systems, diversification (horticulture, livestock, fishery, agro-forestry), including seed systems	H	Core	Short-term
▪ Technology forecasting	M	Core	Long-term
▪ Valuation of genetic resources and technologies	H	Core	Long-term
▪ Technology and resource-use efficiency in system perspective	M	Collaborative	Short-term
▪ Methodology for priority setting and impact assessment for livelihood improvement and prosperity	L	Core	Short-term
2. Sustainable Agricultural Systems			
▪ Externalities of natural resources and environmental degradation	H	Core	Long-term
▪ Indicators for sustainable production systems	M	Collaborative	Short-term
▪ Accounting, evaluation and management of natural resources	H	Core	Long-term
▪ Biomass, rural energy and waste management	M	Collaborative	Short-term
▪ Climate change and carbon trading	M	Core	Long-term
▪ Sustainability implications of trade liberalization	H	Core	Long-term
▪ Studies on fragile and disadvantageous agro-ecosystems and weaker sections	M	Collaborative	Short-term
3. Markets and Trade			
▪ International trade, competitiveness, regional trade agreement, impact of WTO and food security	H	Core	Long-term
▪ Domestic market reforms, including food-security issues	H	Core	Short-term
▪ Supply chain development, including food-safety issues	M	Collaborative	Short-term
▪ Land, water and labour markets	M	Core	Short-term
▪ Demand-supply projections	L	Collaborative	Short-term
▪ High-value and plantation crops	H	Collaborative	Short-term
4. Institutional Change			
▪ Changing roles of state and private sector (markets) in agriculture	M	Core	Long-term
▪ Linking markets with the farmers	H	Core	Long-term
▪ Governance and public sector reforms	M	Core	Long-term
▪ Agriculture development institutions, including collective actions	H	Collaborative	Short-term
▪ Rural financial and insurance institutions, including LDBs	H	Core	Short-term
▪ Panchayati Raj and other civil society institutions	L	Collaborative	Long-term

5. Agricultural Growth and Modelling			
▪ Investment, agricultural growth and diversification	H	Core	Long-term
▪ Modelling agriculture for	H	Core	Long-term
- Regional growth alternatives			
- Linkages with rest of the economy			
▪ Risk assessment in agriculture	H	Core	Short-term
▪ Rural non-farm sector	M	Collaborative	Short-term
▪ Agricultural growth, employment and rural poverty (especially in NE region, hill agriculture and rainfed areas)	H	Core	Short-term
▪ Commodity outlooks	M	Core	Short-term

Notes: H= High, M= Medium and L= Low

As indicated in Table 18, for some programmes, NCAP will extend support to SAUs and ICAR institutions in terms of providing professional interaction opportunities during different phases of research, and also more tangible support for data collection, analysis, information access and dissemination and reporting. While NCAP will gain by gleaning policy-related insights from such studies, the institution concerned will be benefited in terms of HRD and better research outputs. In other areas, NCAP will develop collaborative research programmes with relevant institutions, coordinated and fully- funded from its own resources. A small number of in-house research programmes in areas where NCAP has a comparative advantage, because of its national mandate, will form the third category. Finally, outstanding researchers need to pursue few research themes in which they are personally interested, regardless of institutional priorities. This flexibility and leeway would be provided.

9.2 Sequencing and Time-scale

The Centre has developed its research infrastructure during the Tenth Five-Year Plan. The research portfolio in Table 18 is based on the projected resource availability in the Eleventh Plan and beyond. This implies that it will not be possible to initiate research on all the themes in the short-term.

The last column of Table 18 provides an idea as to how, in the light of current and expected resource scenario, the Centre will address the above research agenda.

The Next Five Years

Developing quick and quality policy outputs emanating from strong empirical analysis are the primary value-added functions for the sustained growth of any organization. It is in this direction that the programme for the next five years will emphasize on developing linkages and networking with national and international research institutes, and strengthening policy interfacing with policymakers. The research programme will be further strengthened by undertaking more vigorous empirical analysis and using advanced policy modelling. Table 19 shows the on-going projects and Tables 20-22 indicate proposed research and other activities of NCAP for the Eleventh Five-Year Plan. The proposed research projects and other activities are a bit tentative because several vacant faculty positions are expected to be filled-in during this period.

Table 19: List of on-going projects at NCAP

Sl No.	Projects	PI/ Co-PI
Technology Policy		
1.	Determinants of improved cultivation practices: Data mining approaches	Rajni Jain and Ramesh Chand
2.	Impact assessment of fisheries research in India	B Ganesh Kumar
3.	Agricultural bio-technology : Commercialization and impact	Suresh Pal
4.	Temporal and spatial changes in agricultural productivity in India	Sant Kumar
Sustainable Agriculture Systems		
5.	Impact assessment of watershed programme	Harbir Singh
6.	Socio-economic and ecological concerns for productivity enhancing and resource conservation practices in rice: A case of SRI in the peninsular India	B C Barah
Markets and Trade		
7.	Relooking of agricultural marketing institutions in the context of trade liberalization regime in India	M B Dastagiri
8.	Subsidies and investments in livestock sector	M B Dastagiri
Institutional Change		
9.	Agricultural insurance in India: Problems and prospects	S S Raju and Ramesh Chand
10.	Geometry of information flow in agriculture	P Adhiguru and P S. Birthal
11.	The upcoming of supermarkets in India: Implications on small holders	P S Birthal
12.	Institutional innovations in value chain of potato	Harbir Singh
Agricultural Growth and Modelling		
13.	Agricultural growth and development in the North-East region	B C Barah and P S Birthal
14.	Rural distress and farmers' suicides in Andhra Pradesh	Aldas Janaiah
National Professor Project		
15.	Impact of agricultural policy, technology, institutions and trade on agricultural growth and rural poverty	Ramesh Chand
National Fellow Project		
16.	Returns to investment on livestock research and development: Implications for growth, equity and sustainability	P S Birthal

In HRD and policy interaction area, the Centre will organize seminars, workshops and training programmes on a regular basis to offer opportunities to the NARS economists to interact with policy analysts and mainstream economists. The visiting scientists, policy research fellowships,

Table 20: Proposed policy research projects and other activities at NCAP during XI Plan

Research	Target year
1. Technology Policy	
▪ Visioning and scenario planning	2010
▪ Impact of agricultural research	2007-2012
▪ Interaction of crop-livestock in the marginal environment	2008
▪ Emerging challenges and opportunities for agricultural diversification	2010
▪ Agriculture bio-technology	2012
▪ Trends in agricultural productivity and growth	2010
▪ Technology forecasting	2011
▪ Evaluation of alternative extension arrangements including ICT in India	2012
2. Sustainable Agriculture System	
▪ Watershed development: Upscaling and exit policies	2008
▪ Land use planning	2008
▪ Climate change and its impact on agriculture	2010
▪ Natural resource management: Collective action and benefit-sharing	2012
▪ Sustainability of agriculture systems	2012
3. Markets and Trade	
▪ Export competitiveness of livestock products	2008
▪ Marketing infrastructure and integration across commodities and locations	2007
▪ Impacts of trade liberalization and domestic policies	2011
▪ Market intelligence	2011
▪ Access of smallholders to agriculture markets	2010
4. Institutional Change	
▪ Future of smallholders	2010
▪ Transformation of food retailing system	2010
▪ Managing agricultural risks	2010
▪ Improving agricultural competitiveness through ICT	2011
▪ Institutional reforms in common property resource management	2007
▪ Group dynamics in agricultural credit management and insurance	2010
5. Agriculture Growth and Modelling	
▪ Growth opportunities in rice fallow system	2010
▪ Income diversification and inequality	2010
▪ Acceleration of agriculture growth	2011
▪ Agriculture distress in India	2008
▪ Accelerating agriculture development in the north-east region	2012

Table 21: Social science capacity strengthening

Programme	Target period	Targeted output
Training on policy modeling and research	2007-2012 (need-based)	Core research capacity in NARS for policy research, covering technology, trade, sustainability, growth and institution-related emerging areas
Social science networking system	2007-2012	Networking of social scientists for improving agricultural economics research capacity in SAUs and ICAR institutes Organization of e-seminars, e-debates and e-trainings
Collaborative research	2007-2012	Development of collaborative research programmes through networks and organizing workshops and seminars

Table 22: Strengthening policy interfacing at NCAP

Programme	Target year
Participation in policy debates	Every year
Policy dissemination (publication of Policy Briefs)	Every year
Interfacing with policymakers	Periodical
Organizing policy dialogues	Need based

MOUs with selected SAUs and international institutions in policy modelling and other exchange programmes will help upgrade the NARS capacity in policy analysis.

10. LINKAGES : COORDINATION AND MANAGEMENT

Development of linkages is crucial for fulfilling the mandate of the Centre. Discipline upgradation, research, and policy outreach require inter and intra-institutional linkages. These are:

- Linkages with SAUs and ICAR Institutes;
- Linkages with other policy research institutions such as Agro-Economic Research Centres, ICSSR Institutes, universities, and similar bodies;
- Linkages with international agricultural research centres (IARCs) and other development research centres and institutes abroad;
- Linkages with agro-biological sciences;
- Linkages with policymaking government units in the Ministries of Agriculture including DARE, Rural Development, Commerce, Finance, Planning Commission, etc.;
- Linkages with NGOs, corporate leaders, management institutes and donors.

The Council has taken a conscientious decision to constitute a common RAC for NCAP and IASRI. This implies a close collaboration of research activities of both the institutes. The collaborations in some of the research programmes, such as INARIS, Water-Food Security Scenario 2025, Household Food & Nutritional Security (HFNS) Project and Priority Setting, Monitoring & Evaluation (PME) under NATP have been quite successful. These will be strengthened further. Some of the potential areas for collaboration for mutual benefits include forecasting of important events and eventualities for insurance management, estimation of biodiversity loss, use of long-term trials for policy analysis, data warehousing and mining, market intelligence and technology forecasting.

Concerted efforts will be required to foster and sustain these linkages over the next few years on a priority basis. Seminars, workshops, training programmes, collaborative research, consultancies, wide dissemination of policy-related research findings and views, and greater personal interactions will be the mechanisms for achieving this end. Multi-disciplinary research will be a major strategy, so as to fully exploit the Centre's comparative advantage. Formal mechanisms like induction of distinguished policy advisors from outside the NARS in Centre's management committees and collaborations with institutions other than NARS will also be developed.

A major part of the research agenda outlined above consists of multi-locational coordinated projects. Mechanisms for such partnerships are well-established for agro-biological research where ICAR has been managing coordinated research projects for nearly 30 years. Even in the field of agricultural economics, multi-locational research on a number of nationally important topics have been conducted by ICAR with some modifications to take care of the distinctive features of social science research, such as different-resource use, input-use patterns, budgetary and staffing norms, non-experimental methodology for research, etc. Similarly, a well-thought out Memorandum of Understanding (MOU) between participating institutions incorporating mutual responsibilities, funding, staffing pattern, credit sharing, time frame, etc. will be developed. NCAP will coordinate and monitor these projects on the basis of these MOUs.

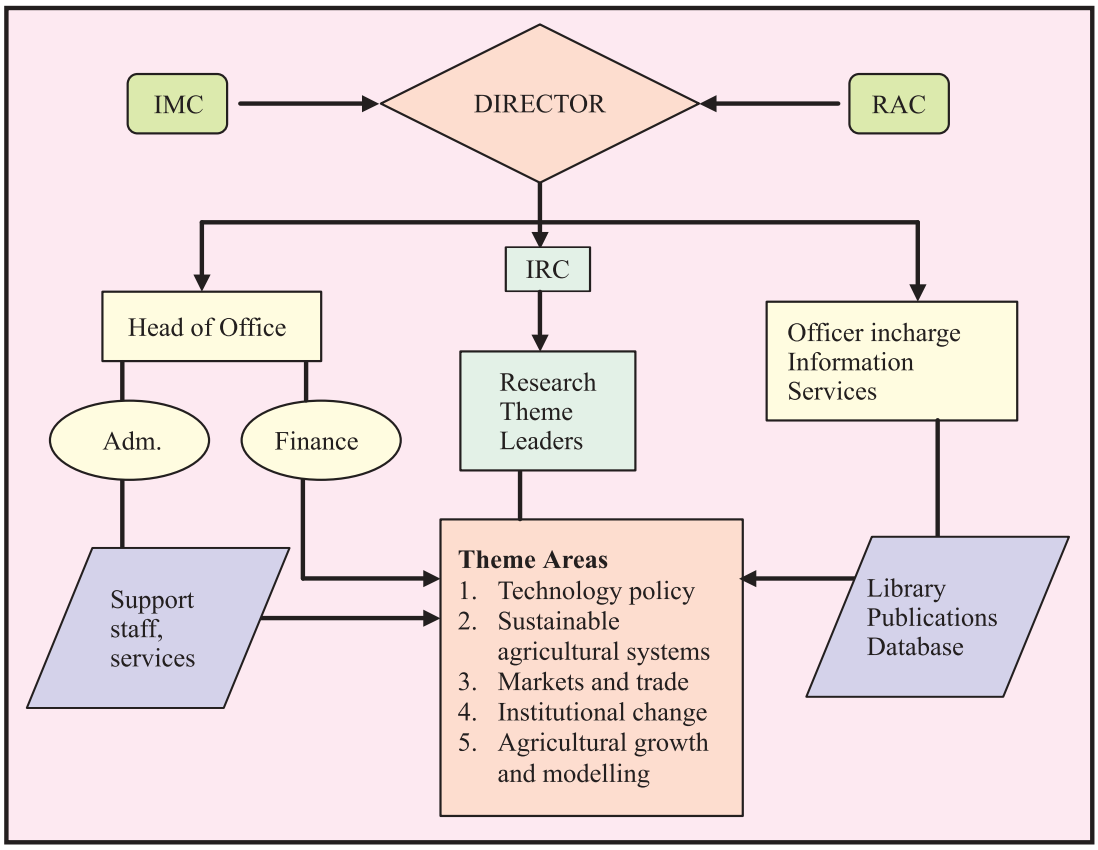
The Centre will also need closer co-ordination with the collaborating institutions, policymaking bodies and relevant government departments at the centre and state levels.

10.1 Management

The Centre will be guided in its policies by a high-powered Research Advisory Committee (RAC) comprising eminent professionals outside the ICAR system. Planning, research thrusts and strategies, initiatives in human resource development and approaches to improve policy dialogues and evaluation at the Centre will be guided by the RAC. Its meetings will be held as frequently as necessary, but at least once every year. Routine management of the Centre will be guided and supervised by the Institute Management Committee (IMC) as constituted and mandated by the Council. Normally, the IMC will meet every quarter.

Figure. 9 depicts the organogram of the Centre. It can be seen that the structure below the Director is activity-based.

Figure 9: Organisational chart of NCAP



11. CRITICAL INPUTS : HRD ACTIVITIES

One of the mandates of the Centre relates to capacity development. Four major activities are planned in this regard. First, the Centre will develop a documentation and dissemination unit, which will serve the needs of agricultural economists working in the ICAR-SAU system. It will primarily provide materials (reports, reprints, etc.) not generally available in the local libraries. This unit will also be responsible for the production of research reports, manuals, and other training/research publications and their dissemination. Edited volumes on selected themes, suitable for research or teaching purposes, will also be brought out.

Second, NCAP will play an expert advisory role in curricula development for graduate and post-graduate trainings in agricultural economics in SAUs and deemed universities, particularly in areas such as trade and management of natural resources. More directly, it will be associated with post-graduate teaching and research programmes at IARI which has been designated by ICAR as the Centre for Advanced Studies in Agricultural Economics.

Third, the Centre will offer training programmes solely or jointly with other institutions in India and abroad. These programmes, meant mainly for professionals in the ICAR /SAU system, will be targeted to those topics in agricultural economics and policy research which are reckoned as weak. Doctoral and post-doctoral programmes integrated with research activities will also help in capacity building in this area.

The above three programmes would contribute directly to human resources development. These would mostly benefit young professionals. The Centre, in association with the IARI Advanced Centre in Agricultural Economics, will strive to create a nucleus of excellence in agricultural economics training in the country. For more senior staff, NCAP will pursue two indirect strategies. First, it will submit research projects outside ICAR system to generate resources and get additional manpower. Secondly, collaborative research in networks mode will be an important research strategy for the Centre. This is a mechanism for skill upgradation and has considerable multiplier effects.

One of the recommendations of the first QRT for Centre was to establish a separate theme area of 'policy modelling' in the Centre. This theme area is merged with the related theme of agricultural growth and the revised theme area is now called as "agricultural growth and modelling". The modeling would integrate agriculture with environmental issues and develop analytical framework to measure the likely impact of policy instruments like tariffs, subsidies, price support, public investment and exogenous variables like fluctuations in international prices, exchange rate, interest rate, etc. on output, per capita income, poverty and employment. To execute such studies, NCAP will identify 4-5 SAUs for working in partnership mode. Further, to strengthen the policy research capacity in the NARS, policy research fellowship programme is proposed. Every year, 5-6 fellowships for Ph.D. students are proposed.

Equally important will be capacity development and training of Centre's own professional and other staff. It is well recognized that areas such as environmental economics, international trade, institutional economics, policy modelling, GIS analysis, IPR, etc. are generally weak in the national system. Even in the conventional agricultural economics, the frontiers are expanding and gaps are becoming apparent. A strong training programme for Centre's staff in eminent national and foreign institutions will be developed. HRD initiatives will also cover supporting and other staff.

12. RESOURCE REQUIREMENTS

Manpower, infrastructure and budgetary support are the critical inputs required to strengthen the Centre in next five years. Details regarding each of these are provided below.

12.1 Manpower

To undertake the above-mentioned research agenda and organize capacity strengthening programme and policy debates, a core scientific staff of 30 (9 Principal Scientists, 10 Senior Scientists and 11 Scientists) is proposed. The disciplines and specialization of staff will be governed by the thrust and specialized areas (e.g. sustainability, information systems, IPR, etc.).

An extremely important complement of the scientific capability of the Centre is the Visiting Scientists Programme. This is an important mechanism for taking advantage of the existing, high quality human capital in different institutions at a relatively low cost. Persons, from India and abroad, with experience and established scientific reputation in the priority areas of NCAP will be invited for a period ranging from 3 to 12 months. They will be required to develop issues/ policy papers on important themes of topical debate. This will allow the Centre to contribute to

policy debate even in areas where it does not have in-house expertise. These persons would require adequate incentives. A total of 30-40 man-months per year will have to be provided. Eminent economists from abroad will also be invited under this programme in various foreign assistance projects.

In addition, the Centre should have 5 positions of post-doctoral fellows who should be provided berths for 2-3 years to work on priority research areas under the guidance of a senior scientist of the Centre. These programmes have been found highly productive internationally. To strengthen policy research capacity in the Council, 5 to 6 policy research fellowships per year for Ph. D. students of NARS are proposed.

The scientists of the Centre must be adequately supported by technical, secretarial, and other supporting staff. There should be 10 technical assistants including those to man the documentation/ library and editorial and publications, 2 drivers, 10 administrative staff, and 2 supporting staff. Thus, the Centre will need a total of 30 scientists (including Director) and about 25 administrative, technical and supporting staff as regular employees. The possibility of using contract employees will help in reducing the numbers of some support staff.

There must be adequate budgetary provision to cover salaries, research costs, infrastructural development and construction of staff residences. Computer costs, travel, documentation, seminars and conferences, publications, etc. claim a much larger share of operating expenses in agricultural economics as compared to other disciplines. Therefore, norms based on agro-biological research institutions should not be applied in the case of NCAP.

12.2 Infrastructure

The Centre shifted to its new buildings in February 2006, and furnishing of the building is in progress. The building has been constructed on a plot measuring 4,338 square metres. The building has adequate office space, keeping in view the future expansion of the Centre's activities and staff. During the entire reporting period, the Centre was housed in an old and small complex of IASRI in the same campus. With the increase in staff strength, there was space constraint, impeding functional efficiency. Therefore, construction of the office building was taken and pursued on high priority basis. As regards staff quarters, it is proposed to construct 20 quarters for NCAP staff, along with those of National Bureau of Soil Survey and Land Use Planning (Delhi Centre) in the IARI campus.

The Centre has no guest house and has been advised to use guest house and other facilities like conference hall, of IASRI and IARI, besides those at NASC complex. Given the pressure on guest house and other facilities of these sister institutes, the Centre faces problems in scheduling of important activities like training programmes, workshops, conferences, etc. Lack of residential facilities for supporting staff on the campus has also constrained maintenance of essential services, which are outsourced. The experience is that sharing of facilities also require participation in their management and maintenance, so that the tendency to "preserve" or allow "controlled access" is minimized.

Dr Mangala Rai, Secretary, DARE and Director General, ICAR welcoming Shri Rajnath Singh, Former Union Minister of Agriculture at the foundation stone laying ceremony of NCAP building

Shri Sharad Pawar, Union Minister of Agriculture, Food and Consumer Affairs at Indo-US AKI Workshop

12.3 Library and Information Services

NCAP has a small library-cum-documentation centre, where selected reference books, research publications, including NCAP publications, and few journals are procured. This limited though essential collection is because of the existence of IARI and IASRI libraries on the campus; the Centre's collection is planned to complement these libraries. In addition, the Centre's staff makes use of other important libraries in Delhi and has established some linkages.

Given the nature of research work and locational advantage, the Centre accords high priority to the development of a rich database on various socio-economic aspects of agriculture and rural development. These data are frequently used by the researchers. The Centre currently maintains 1,261 database publications. In addition, there are 64 CD ROM databases mainly from NSSO. As regards other publications, the NCAP library has in total more than three thousand reference books in various areas, and it subscribes to 20 national and 9 international journals/periodicals regularly.

Communication and ARIS

The Centre has dependable internet and email services. All the scientific, technical and administrative staff are connected through email and internet services. All the computers of the Centre are inter-connected through LAN and windows NT file servers. Structured cabling has been done with CAT 6 cable, 4 manageable 24 port Nortel switches. Security of the network has been strengthened by means of firewall and centralized anti-virus server. In total, there are 35 email IDs and 70 internet nodes operational.

The ARIS at the Centre is equipped with 512 KBPS Leased Line from ERNET to cater to the email and internet requirements of researchers and administration. To utilize the full potential of ERNET, the Centre has got its independent mail server configured. To handle this additional facility effectively, the Centre has designed complete security planning that addresses security at all layers to help in creating a more reliable and safe network. The essential components of the network include a gateway for the internet service, file server for file-sharing, email server for communication and database server for management of data, desktops and laptops. To build a complete computer-security, many systems have been added to face multiple threats of various types.

13. OUTPUTS

With the development of NCAP as a credible centre for policy research, ICAR has an in-house unit capable of having effective interface with policymaking. It has capacity to analyse and interpret policy implications of its technology generation activities. An institutional base has been created for prioritization of agricultural research, as dictated by national concerns. The Centre with its credibility as a policy research group, will provide an effective mechanism for policy dialogue between ICAR and policymaking bodies. It has also fostered strong linkages with SAUs, other ICAR institutes, and national and international centres of agricultural research. The human resource development programme of the Centre will contribute significantly to improve the quality and relevance of agricultural economics and policy research in the ICAR-SAU system.

13.1 Review and Evaluation

The Centre jointly with IASRI has a high-powered, external Research Advisory Committee (RAC). The RAC scrutinizes research proposals, conducts annual review of research and other activities and provides guidance on policy and research programmes. A five-yearly external review and evaluation mechanism already exists in the Council. These mechanisms will ensure that the Centre's activities are in accordance with its mandate, inefficiencies are weeded out, and the Centre continues to grow in stature. The Centre will continue the existing mechanism of Annual Report to project its yearly achievements. The time-bound reporting will be strictly enforced with respect to research programmes of the Centre.

13.2 Resource Mobilization

Strong support from public funds will be necessary for the growth of the Centre. Subsequently, as credibility and staff strength improve, the Centre plan to augment its resources through consultancy, contract research, etc. Strong Industry-Centre linkage will be necessary to facilitate this process.

13.3 Policy Interaction

Strengthening policy research and communication capabilities through research and training activities, as outlined above, would improve the existing situation. Publications of the Centre will also contribute to this. In addition, the Centre will organise seminars/conferences on important themes and make explicit attempt to convey policy messages arising out of ICAR's research contributions. These ideas would be discussed in small professional meetings and the consensus recommendations would be disseminated to policymakers and policy analysts in the government and non-governmental instituions.

The feedback role is equally important to the national agricultural research system. Macroeconomic policy changes in agriculture and other sectors that affect the research system in terms of throwing up new challenges are important. The Centre would play a significant role in the analysis and interpretation of such policy changes and would spell out the implications to research planners. This will contribute directly to improving the planning process. Working papers, discussions, seminars, etc. will be the mechanisms used for this purpose. All these will improve policy back-up in ICAR and raise the stature of the discipline of agricultural economics.

EPILOGUE

Institutions sustain themselves through flexibility and decentralization. This pre-supposes continued financial support for core activities, and autonomy. The ICAR is committed to these principles. Given these, the Centre's contribution will be determined by its ability to create and nurture leadership around competent professionals, uncompromising quality standards, effective decentralization, and establishing healthy conventions to create productive and efficient work culture. This commitment has to be shared by the entire staff, and reiterated as the Centre grows. Plans and perspectives are important, but it is this commitment that makes any organization more stronger. We dedicate ourselves to this Vision.