Annual Report 2005-06

राष्ट्रीय कृषि आर्थिकी एवम् नीति अनुसंधान केन्द्र

NATIONAL CENTRE FOR AGRICULTURAL ECONOMICS AND POLICY RESEARCH

भाकृअनुप
ICAR

NCAP Annual Report 2005-06

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NCAP Annual Report 2005-06

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PREFACE

The National Centre for Agricultural Economics and Policy Research (NCAP) has completed 15 glorious years of its existence. In the past, the Centre has made significant contributions to policy research and facilitated strengthening of agricultural economics profession in the country. The strong foundation laid by my predecessors helped in evolving the tradition of creditable research, dissemination and advocacy of its research outputs and supportive role to other institutions related to the national agricultural research system. The Centre is committed to further build up strong research, capacity strengthening and policy advocacy programmes in partnership with national and international organizations.

This report provides the glimpses of some of the significant achievements of the Centre during the year 2005-06. Besides a wide range of research, capacity strengthening and policy dissemination activities, the most significant ones were: (i) ICAR National Professor award bestowed to our distinguished scientist Dr Ramesh Chand, and (ii) acquisition of long-awaited new office building. On the research front, most noteworthy achievements included impact assessment of agricultural research, contribution of livestock to poverty alleviation and environment management, measurement of economic losses in the dairy sector, estimation of feed consumption, role of information technology in knowledge dissemination, institutional innovations in the seed sector, estimation of supply response in oilseeds, system of rice intensification and its implications on smallholders, management of risk in the rainfed areas, projections of demand for urea by the year 2011, and doubling of agricultural growth to four per cent. Some new programmes on topical issues were also initiated that included insurance in rainfed agriculture, implications of value chains in improving marketing efficiency, causes of farmers' distress in the rainfed areas, and identification of problems and opportunities in northeast agriculture.

NCAP continued providing strong support to the national and international collaborating partners in undertaking research programmes of mutual interests. The Centre brought out a large number of publications during the year under report and organized few policy advocacy programmes to effectively disseminate its research outputs across a wide range of stakeholders.

By the time this report came out, unfortunately we lost our former director Dr Dayanatha Jha on 24th October 2006 after a brief illness. We pay our homage to Dr Jha and salute him for his incredible contributions in strengthening agricultural economics profession and building the Centre.

The Centre received unstinting support from the ICAR in pursuing its programs. Special thanks to Dr Mangala Rai, Director General, Indian Council of Agricultural Research, and Secretary, Department of Agricultural Research and Education, Government of India for his continuous encouragement and keen interest in the Centre's activities. Sincere thanks to Dr V. K. Taneja, Deputy Director General (Animal Sciences) and Dr J.P. Mishra, Assistant Director General (Economics, Statistics and Marketing) for their continuous support in fulfilling the Centre's mandate.

The credit of bringing out this report goes to Dr Ramesh Chand and Dr B. C. Barah, who provided guidance at every stage. Dr Sant Kumar did the splendid task of collating various activities and eloquently editing the report. Dr Suresh Pal and Dr Pratap Singh Birthal offered valuable comments during the preparation of this report. Mr. Ajay Tanwar assisted in patiently processing the manuscript. I gratefully acknowledge the invaluable contributions of all of them in bringing out this report.

I am sure that the report will provide useful information and contribute extensively to agricultural policy analysis.

November 2006

P. K. Joshi
Director

ACRONYMS AND ABBREVIATIONS

AAU	Assam Agricultural University
AgNSDP	Agricultural Net State Domestic Product
ANGRAU	Acharya NG Ranga Agricultural University
ARIS	Agricultural Research Information System
BAU	Business As Usual
CABA	CAB Abstracts
CGIAR	Consultative Group on International Agricultural Research
DSR	Dry Seeding Rice
DT	Decision Tree
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
FTE	Full Time Equivalent
GARCH	Generalized Auto Regressive Conditional Heteroscedasticity
GM	Genetically Modified
GoI	Government of India
HAU	Haryana Agricultural University
HRD	Human Resource Development
HYV	High Yielding Variety
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
ICT	Information and Communication Technology
IGKVV	Indira Gandhi Krishi Vishvavidyalaya
IPM	Integrated Pest Management
IPR	Intellectual Property Right
ISA	Indian Science Abstract
IT	Information Technology
ITC	Indian Tobacco Company
LDA	Linear Discriminant Analysis
LR	Logistic Regression
MAU	Marathwada Agricultural University

MC	Management Committee
MNCs	Multi-national Companies
MPUAT	Maharana Pratap University of Agriculture & Technology
NAARM	National Academy of Agricultural Research Management
NAIP	National Agriculture Innovation Project
NARS	National Agricultural Research System
NATP	National Agriculture Technology Project
NCAP	National Centre for Agricultural Economics and Policy Research
NDUAT	Narendra Deva University of Agriculture & Technology
NGO	Non-Governmental Organization
O&M	Organization and Management
OTA	Over Time Allowance
PME	Prioritization, Monitoring & Evaluation
PRI	Panchayti Raj Institution
RAC	Research Advisory Committee
R&D	Research and Development
RAU	Rajendra Agricultural University
RDT	Rough set based Decision Tree
RS	Rough Set
SAU	State Agricultural University
SCI	Science Citation Index
SHG	Self-help Group
SRI	System of Rice Intensification
TE	Triennium Ending
TFP	Total Factor Productivity
TMO	Technology Mission on Oilseeds
UAS-D	University of Agricultural Sciences-Dharwad
USAID	United States Agency for International Development
WTO	World Trade Organization

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EXECUTIVE SUMMARY

- The National Centre for Agricultural Economics and Policy Research has completed 15 years of its existence, having being established in 1991. It continued its pursuit for excellence in agricultural research and policy interface and achieved wider visibility in the current year. The Centre at present has 16 scientists (including one National Fellow) and 14 other staff in position. The budgetary outlay of the Centre for the year 2005-06 was Rs 390.59 lakh.

- A high level Research Advisory Committee provides guidance to the Centre in its research programmes, and a Management Committee oversees the overall research administration of the Centre. In addition, a number of internal committees facilitate the decentralized management of the Centre's activities. Research at the Centre is conducted under five broad themes, viz. technology policy, sustainable agricultural systems, markets and trade, institutional change, and agricultural growth and modelling. Each theme is headed by a senior professional. The salient research achievements during 2005-06 are summarized below:

- Impact of research in the NARS is assessed in terms of scientific outputs – publications and technologies – which are main outputs of agricultural research. The results revealed an increasing trend in the total number of publications during 1990s as compared to that in 1980s. However, a majority of these publications (about 80 per cent) have been published in non-SCI (Science Citation Index) journals with zero impact factor. Only a small proportion of these publications have the impact factor greater than zero but less than two. The tendency of agricultural scientists to publish in low-rating journals is a matter of concern. As regards technologies, a large number of crop varieties for different production environments along with improved production practices, resource conserving and environmentally-safe technologies have been developed. Such technologies have also been developed for livestock, poultry and fish, but because of capital intensiveness, their acceptance has been limited, causing a scale bias. A high pay-off to investment in agricultural research has been observed and it is a 'win-win' option to improve total factor productivity (TFP) and alleviate rural poverty. Moreover, deceleration in agricultural growth since the mid-1990s, has underscored the need for acceleration of technology flow to farmers, which emphasized higher investment in R&D.

- Declining production and productivity growth of rice, particularly from the mid-1990s has been a major concern. On account of limited possibility of horizontal expansion, increasing productivity is a critical challenge to the agricultural researchers and policymakers. Productivity can be increased by both technological means and/or manipulation of farmers' practices. A study on an innovative practice of rice production, called 'System of Rice Intensification' (SRI), is underway to understand the socio-economic dimensions of its adoption. A detailed survey of 300 farmers is being conducted in the southern states of Andhra Pradesh, Tamil Nadu and Karnataka, where most encouragingly, the governments have not only approved

and implemented the SRI but are also popularizing it among the farmers. The focus is on quantification of the gains due to yield increase, water conservation, enhanced biological dynamics in soil and plants, savings in seed, and social acceptance. The adoption of SRI internationally has shown a phenomenal speed, covering from a single country of Madagaskar in 1995 to nearly 24 countries around the world today. The advantages of SRI include capacity to generate additional rice yield of 1-2 t/ha as compared to the existing best practices; and orientation towards small farmer which potentially ensures household food-security and resource-conservation. Therefore, this practice is being looked at as a boon to rice-growing farmers, especially smallholders.

- The pattern of changes in rice production systems and their policy imperatives have been assessed. An inverted bowl-shaped growth curve has been observed in rice production during the past couple of decades. The down-syndrome if not reversed, is likely to threaten the food-security in the country. The inter-regional disparity in rice productivity could be more damaging as has been evidenced from findings at the disaggregated level. The gains due to modern rice technology have been discriminatory against the resource-poor areas dominated by small and marginal farmers. The inter-state variations in rice productivity have been quite pervasive, and show sharp differences between irrigated and rainfed systems. The empirical evidence has suggested that stagnation in rice production is due to decline in area and productivity in the core green revolution areas. Farmers are likely to adopt the technology/practice faster, if the productivity-enhancing and resource-conserving properties could be embedded on it. In this context, the rainfed areas have demonstrated high potentialities for development of rice production system. To exploit this potential in the vast rainfed areas of eastern India, a shift in policy paradigm has been suggested to build a stronger ground for increasing production. It has been observed that besides the yield increasing technology, issues of input-use efficiency, agricultural diversification and efficient implementation of developmental programmes need to be addressed to achieve higher agricultural growth.

- Oilseed is an important component of crop production in Indian agriculture. The continued decline in its production after mid-1990s and yield fluctuations has critical macro-economic implications in the country. The production behaviour of four major oilseeds, viz. groundnut, rapeseed/mustard, sunflower and soybean has been analyzed to understand the instability and supply response in production of oilseeds. The analysis has indicated lack of trend in yield instability, prices and gross returns, while covariate risk has increased. The econometric analysis has further indicated that expected price and price risk are important determinants of oilseeds production. Price risk has the direct influence on the production decision and acreage allocation by the farmers.

- Since early-1980s growth in crop production in the rainfed areas has mainly been due to yield growth. The patterns of growth and variability in yield in the rainfed regions are diverse and could be managed through better crop care. To manage the shortfall in yield

and income of this region both *ex-ante* and *ex-post* measures are essential. *Ex-post* measures include foodgrains distribution and employment generation; these should be strengthened and made pro-poor. Among other measures, crop insurance, institutional credit, and product diversification towards horticultural crops suited to the region could be developed and implemented.

- The role of livestock sector in agricultural growth and poverty reduction is well established. In India, small farmers control 70 to 90 per cent of the livestock population and have considerable potential to contribute to agricultural growth, leading to poverty reduction. Study has revealed that the states of West Bengal, Tamil Nadu, Kerala, Karnataka, Haryana, Punjab and Maharashtra have performed better in both livestock production and poverty reduction during 1983-84 to 1997-98 as compared to that by Assam, Madhya Pradesh, Rajasthan and Uttar Pradesh.

- Feed and fodder are important prerequisites of proper livestock development. An estimation of feed and fodder has been made by species, age, sex, and type of functions in 10 livestock regions of India during 2001-02. Livestock consumed 420 million tonnes of green roughages, 510 million tonnes of dry roughages, and 55 million tonnes of concentrates. About 12 per cent of foodgrains is also used as feed, although the National Commission on Agriculture has assumed that only 2 per cent 'coarse cereals' should be fed to animals.

- India's livestock population is one of the largest in the world. It has come under scrutiny and severe criticism for its contribution to greenhouse gas emission. However, another study undertaken during 2001-02, has revealed some positive contributions also of livestock to environment.

- Despite revolutionary progress in milk production in India, the productivity of milch animals is low and there is enormous loss of attainable output. The economic losses in dairy production have been estimated along with identification of constraints in a study undertaken during 2002-03 in 54 villages spread over 9 states, viz. Andhra Pradesh, Haryana, Karnataka, Jharkhand, Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh and West Bengal. The economic losses in dairy output have been found about 26 per cent of the total attainable output. By species, loss is maximum in the case of indigenous cows (38 per cent), followed by buffaloes and crossbred cows. Feed scarcity has been observed the most important constraint, followed by breeding problems and health and management aspects. Infertility has been found an important problem for indigenous cows, while long inter-calving period is the main problem for buffaloes. In addition, lack of green fodder has been observed as the most critical nutrition constraint, followed by mineral deficiency in dairy production. The major diseases include Mastitis, Foot and Mouth Disease, Brucellosis, and Theileriosis.

- The Indian seed system has undergone a tremendous change. New Seed Policy and economic reforms have provided enormous opportunities to the private seed sector. At present, this sector shares a large proportion of seeds of cotton, rice, maize, and vegetables. However,

their participation in crops of groundnut and potato has been very low. This has been because of requirement of high investment, low profit margin, and voluminous nature of these crops. The study has reported that a majority of the farmers get information about new crop varieties from the fellow farmers/farm-input dealers. This shows the functional inefficiency of public extension and seed system. This emphasizes the need for technological backstopping, developing partnership with private and civil societies. A need has been found for developing institutional capacity for enforcement of seed regulations and protection of intellectual property rights.

- The analysis of seed laws of 13 Asian countries in the wake of WTO regime has concluded that the seeds of notified varieties must be regulated and certified. The amendments in the seed laws provide incentives to the local seed companies and encourage participation of private sector in the seed market. It also guarantees better access to overseas markets.

- Information and communication technology (ICT) is one of the potential options to provide the needed information to farmers at the right time and affordable cost. A study of three ICT initiatives—*e-Choupal*, *I-Kisan* and *Helpline*—has revealed that by using these services, a farmer could save in his/her travelling time and in turn transaction cost, between 90 and 95 per cent, and could benefit by taking timely decision to sell his farm output and may fetch a better price. The lessons derived from this study of ICT-based initiatives could be helpful in upscaling and increasing the overall profitability.

- India has the rich tradition of having peoples' institutions in the rural areas. A strong institution is the root of rural prosperity. If adequately replicated, such institutions could be the potential agents of change in the rural life. Notwithstanding the importance of these institutions, farmers have been deprived of access to information, technology, etc. due to neglect of these institutions, leading to production risks. The need for an efficient rural institution has been argued because development without human face is believed to weaken the prospects of livelihood. Therefore, clarity is essential on the 'rules of the game' to sharpen our understanding about complexity of institutions, their strengths and weaknesses. This would facilitate in replicating the success story.

- Demand for urea by the year 2011 has been projected under different scenarios. Under the scenario, 'business as usual', the demand for urea has been projected to increase by 3.4 per cent per annum to reach 24.96 million tonnes as compared to 19.06 million tonnes during 2002-03. Under the scenario 'subsidies remain same', the demand for urea has been projected as 24.12 million tonnes with an increasing rate of about 3 per cent. Under third scenario, both 'expansion in irrigated area (1 per cent) and gross cropped area (0.25 per cent)', the demand for urea is expected to increase by about 4 per cent annually which corresponds to 26.30 million tonnes. One more scenario has been visualized to attain 4 per cent growth in agricultural output with full exploitation of irrigation potential and 2 per cent increase in HYVs. This scenario would require 4.6 per cent annual growth and the demand has been projected to be 27.45 million tonnes. Therefore, demand for urea by 2011 would vary

between 24.1 million tonnes at low growth output to 27.4 million tonnes at relatively high growth output.

- Crop and livestock sectors are the two major sub-sectors of agriculture. As the economy develops, the contribution of primary sector (particularly income from crop output) declines. The same has been the case in Indian agriculture since independence. Analysis has shown that during 1980s and 1990s, the share of crop sector in total agricultural output has declined, while that of livestock and fisheries has increased. This implies that agriculture is diversifying towards high-value livestock and fisheries commodities. Among the factors promoting agricultural growth, investment in R&D, trade and economic reforms have been identified as crucial.

- Increased growth performance in agriculture is essential for the growth of economy. The performance of agriculture sector in India since mid-1990s has sharply decelerated despite the country aiming at 4 per cent annual growth. To put agriculture on the targeted growth trajectory, the potential sources of growth have been studied. The analysis has shown high variability in crop-output growth, being lowest in Punjab (less than 1 per cent) and highest in Bihar (above 6 per cent). The growth in crop output has observed as 1-2 per cent in Haryana and Rajasthan, and more than 5 per cent in Maharashtra, Himachal Pradesh, and West Bengal. To achieve 4 per cent growth in crop output, India needs to increase fertilizer application by 4.35 per cent and irrigation by 1.95 per cent. Besides, a shift in area of about 0.5 per cent to other than foodgrains and growth in TFP of 0.72 per cent per annum are also required to achieve this target.

- The number of female students in agriculture education has been non-uniform across states in india. A study carried out in 10 SAUs has shown that proportion of female students varied from 49 per cent in Kerala to 5 per cent in Uttar Pradesh. It has been found that addressing the issues of transportation, accommodation and security would potentially increase the number of female students in agricultural education.

- Indian agriculture is stated to be increasingly vulnerable to abnormal situations, leading to high variability in production. Agricultural insurance is one of the instruments to protect farmers from such a vulnerability. Despite considerable efforts, the coverage under insurance schemes has been very small. A study on 'problems and prospects of agricultural insurance in India' is underway and is expected to suggest strategies to make agricultural insurance schemes more effective with wide coverage.

- To identify households vulnerable to food shortage, a dynamic rough set based decision tree (RDT) model has been developed and tested. The analysis carried out using linear discriminant analysis (LDA) technique as a benchmark for comparing accuracy of RDT model, has shown the RDT model to be better than LDA method.

- Under a study on fore-warning of crop diseases, the potential of three machine learning techniques, viz. decision tree (DT) induction, rough set (RS) and RS based DT induction (RDT) has been studied against the traditional logistic regression (LR) technique to test the accuracy of timely forecasting of incidence and crop loss from powdery mildew in mango. This is a devastating disease and causes yield losses between 22 and 90 per cent. The results of machine-learning techniques have been found better than those of LR technique.
- The Centre has been actively involved in the preparation of Project Implementation Plan for NAIP and provided lot of inputs at various stages of project preparation.

The NCAP website available at http://www.ncap.res.in has been redesigned and updated. The NCAP publications are now available in the PDF format and can be downloaded. The website for Networking of Social Scientists, http://www.agrieconet.nic.in is facilitating research, resource-sharing and optimization of response time for addressing methodology-related problems.

The ARIS facility at the Centre has been equipped with 128 kbps leased line from ERNET to provide the E-mail and Internet facilities to NCAP staff. The Centre has now its independent mail server which is being used to its potential.

As a part of dissemination of research output, the Centre and its staff has published one Policy Paper, three Policy Briefs and five books during the current year. The Centre's staff has been involved in a number of professional and policy interactions and projects and also organized several meetings at NCAP and outside. It has also collaborated with a number of national and international research organizations. These activities could facilitate achieving of greater impact and wider visibility by the Centre in the current year.

I. PROFILE OF NCAP

The National Centre for Agricultural Economics and Policy Research (NCAP) was established by the Indian Council of Agricultural Research (ICAR) in March 1991, to strengthen agricultural economics and policy research in the national agricultural research system (NARS), comprising ICAR and its affiliated institutions and state agricultural universities (SAUs). The Centre visualized the need for participation of ICAR in policy dialogues and decision-making in the NARS. The NCAP has served as 'eyes and ears' for the Council in monitoring and interpreting the research implications of changes in ground realities, macroeconomic environment and international developments.

Location

The Centre is located in the Pusa campus in New Delhi. The Indian Agricultural Research Institute, Indian Agricultural Statistics Research Institute, and a number of international research institutes under CGIAR system are in the close vicinity of the Centre. This offers locational advantage to the Centre in terms of opportunities for interdisciplinary and inter-institutional interaction and research as well as access to library, computational facilities and other infrastructure available at these institutes.

Mandate

The mandate of the Centre includes to: (1) conduct policy-oriented research on (i) technology generation, diffusion and impact assessment, (ii) sustainable agricultural production systems, (iii) interaction between technology and other policy instruments like incentives, investments, institutions, trade, etc. (iv) agricultural growth and modelling with focus on the role of technology; (2) strengthen agricultural economics and policy research and teaching capability in the state agricultural universities and institutes of ICAR; and (3) enhance participation of ICAR in agricultural policy debates and decisions.

Research Activities

Research activities of NCAP emphasize five major themes: technology policy, sustainable agricultural systems, markets and trade, institutional change and agricultural growth and modelling. The Centre's significant study areas include research investment, research resource allocation, WTO and trade in agriculture, private sector participation in agricultural extension, food policy, monitoring and evaluation of agricultural research and O&M reforms, impact assessment, institutional aspects, growth and investment, food systems, viz. livestock and fishery and horticulture.

As a part of policy advocacy, the Centre organizes workshops where issues of major policy interests are discussed by policymakers, academicians, etc. The Centre also organizes lectures of distinguished scholars and policymakers for a deeper understanding of the global developments and policy changes. Training and capacity building in frontier areas of agricultural economics research are the priorities of the Centre.

The Centre maintains close linkages with several national and international organizations involved in agricultural research, development and policy. Collaborative research projects, seminars, workshops, publications and participations in policymaking bodies are the usual modes of policy interface which helps improve the outreach of the Centre. The Centre regularly brings out publications like Policy Papers, Policy Briefs, Conference Proceedings, and PME Notes. These serve as the main agents for dissemination of its research findings. During the short span of 15 years of its existence, the Centre has established a track record of impressive research. The Centre endeavours in making a synergy between socioeconomic and biological sciences and provides economic inputs to specific areas of agricultural research.

Management

A high-powered Research Advisory Committee (RAC) comprising eminent professionals, mostly from outside the ICAR system, guides the Centre on its research policies. Prof Y.K. Alagh, the former Minister of State for Power and Science and Technology, Government of India, was the first Chairman of RAC. Prof. V. Rajagopalan, an eminent agricultural economist, was the Chairman of its recent RAC. The RAC provides guidance to the Centre in planning, research thrusts and strategies. Initiatives in human resource development, approaches towards improving policy dialogues and evaluation are some other areas in which Centre receives guidance from the RAC.

The functioning of the Centre is supervised by a Management Committee (MC) which is constituted and mandated by the ICAR. A number of internal committees, such as: Staff Research Council, Budget Committee, Academic Planning & Policy Committee, Scientists' Evaluation and Development Committee, Purchase Committee, PME/NATP Site Committee, Official Language Committee, Library Committee, Publications Committee, Consultancy Processing Cell, Grievance Cell, and Women Cell are operating at the Centre for decentralization of management. The Joint Staff Council of the Centre promotes healthy interaction and the congenial work environment.

Infrastructural Development

New Office Building

The Centre moved to its new building, which is adjacent to the old building, in February 2006. The Centre had the approval for construction of office building and staff quarters in the IX Plan. Approximately Rs 4.83 crore has been spent on the construction of this building. The construction of quarters will start as soon as the Master Plan of IARI is approved by the civic authorities. Efforts are being made to get this approval.

NCAP Website

The website of NCAP (http://www.ncap.res.in) provides latest information about the Centre particularly on its staff, infrastructure, research activities, research projects, publications and linkages.

The publications of NCAP, namely annual reports, policy papers, policy briefs, conference proceedings and PME notes, etc., are available on this website in downloadable PDF file. The website is being updated regularly.

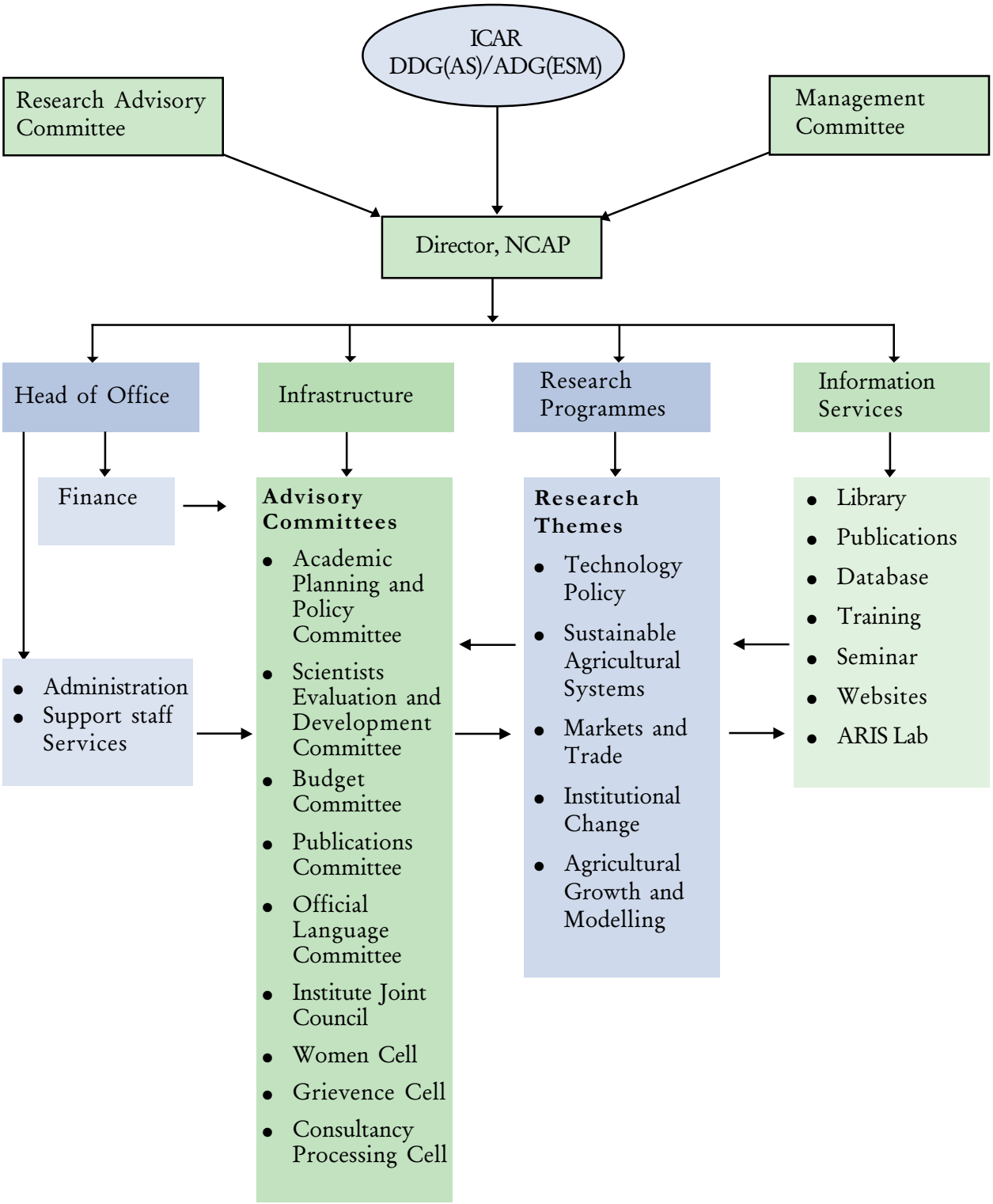
Website for Networking of Social Scientists

The website for Networking of Social Scientists (http://www.agrieconet.nic.in) facilitates exchange of information, resource sharing and optimization of the response time for addressing methodology-related problems. The website has been hosted through NIC web servers since December 2000. The site provides details about Department of Agricultural Economics in ICAR institutes and SAUs. It also provides access to research–oriented data of about 533 projects, 659 publications, 578 scientists, 646 courses and 1008 theses. The data has been classified under 12 theme areas for each category.

Agricultural Research Information System Lab

A new Agricultural Research Information System (ARIS) Lab of NCAP has been built due to the shifting of the NCAP office to the new building. The Local Area Network (LAN) has been developed to cater to the requirement of 100 users in the system. The LAN cabling has been done for 100 nodes using CAT 6. High Speed Nortel Switches have been incorporated to boost its performance. The ARIS is equipped with 128 kbps leased line from ERNET to provide the E-mail and Internet facilities to NCAP staff. The Centre has its independent mail server placed at its location to manage e-mail account of NCAP staff. The other essential components of the network include a gateway for Internet services, file server for file sharing, mail server for communication and database server for management of data, desktops and laptops. To manage security of the network, a centralized antivirus system was designed and implemented in the network with the help of an anti-virus server system. Any system that is on the network is examined for the latest version of the antivirus software to protect the individual machine as well as the network. Hardware firewalls have also been incorporated in the network as the first line of defence. The firewalls have been integrated with Intrusion Detection System (IDS) and Intrusion Prevention System (IPS). A firewall also provides the gateway level virus protection and web content filtering features.

Figure 1: Organogram of NCAP



Budget

The expenditure pattern of NCAP for the year 2005-2006 is presented in Table 1 and its staff position in Table 2.

Table 1: Expenditure during 2005-2006 **(in lakh Rs)**

Head of Account	Plan	Non-Plan	Total
Pay and allowances	—	77.71	77.71
Over time allowance (OTA)	—	0.25	0.25
Travelling expenses	3.99	1.30	5.29
Works	163.00	—	163.00
Other charges including equipments	57.55	45.42	102.97
Human resource development (HRD)	0.37	—	0.37
Total	**224.91**	**124.68**	**349.59**
Other projects	—	—	41.00
Grand Total	**224.91**	**124.68**	**390.59**

Staff Position

Table 2: Staff position (2005-06)

Designation	Number
Director (Acting)	1
National Fellow	1
Principal Scientist	5 *
Senior Scientist	6
Scientist (Sr. Scale)	5+
Assistant Administrative Officer	1
Assistant Finance and Accounts Officer	1
Assistant	1
Stenographer	1
Junior Stenographer	1
Upper Division Clerk	1
Lower Division Clerk	1
Technical Officer (T-6)	1
Technical Officer (T-5)	3
Driver (T-2)	1
Supporting Staff Gr. II	1
Supporting Staff Gr. I	1

* includes the Acting Director and the one on deputation;
+ includes one on study leave and one on deputation

II. RESEARCH ACHIEVEMENTS

TECHNOLOGY POLICY

The technology policy theme deals with agricultural research & development policies, decision support system for research priority and impact assessment, role of technology in meeting challenges of growth, poverty, sustainability, and globalization of agriculture-related research issues. The salient findings of the studies in this area are reported below:

Impact of Agricultural Research in India

Suresh Pal, Prasoon Mathur and A.K. Jha

The public agricultural research system in India comprising institutions of the Indian Council of Agricultural Research (ICAR) and the state agricultural universities (SAUs) has been evaluated and reviewed several times. This coupled with slowdown in the rate of agricultural growth after the mid-1990s has created an impression of decelerating research impacts. As the research system is not able to maintain the up-trend in the scientific productivity, newly emerging stresses are threatening the sustainability of our agricultural systems. How far this fear is true? This question has been examined by using some empirical evidences. Scientific publications and technologies being the two main outputs of agricultural research, have been used for this purpose. These research outputs also adequately capture other research contributions like development of research methodologies and intermediate products that facilitate technology development. The trends in these main outputs of the ICAR-SAU system are discussed below:

Scientific Publications

Scientific productivity is assessed by using the number of research publications in refereed journals covered by the abstracting and indexing services for agricultural and allied sciences, such as *Science Citation Index* (SCI), *CAB Abstracts* (CABA), and *Indian Science Abstracts* (ISA). The total number of research publications of the scientists of ICAR and the SAU system were culled from these three sources. A drastic decline has been observed in the number of SCI-indexed publications of these scientists in 1990s from those in 1980s. This decline was deeper for the SAUs than ICAR and it continued even in 2002. However, the ICAR institutions have shown a moderate recovery subsequently (Table 3). What is more worrisome is that even the institutes and universities with the best publication record could not achieve the 1980-level in 2002. This clearly showed a depletion of the upstream or strategic research in the ICAR and SAUs system. A sharp decline in the SCI-indexed articles authored by the agricultural scientists echoed the broad trend observed for the Indian science, in general. The total number of SCI-indexed research articles authored by Indian scientists in all the fields of science decreased from 14,983 in 1980 to 10,103 in 1990, but rose back to 14,028 in 2002. However, a part of the slow recovery of the articles on agricultural sciences during 1990s could be attributed to a shift towards their publication in the Indian journals, which have also increased in number over time. Some of these journals though rated high by the national

professional academies and assessment boards, are not covered by the SCI. On the whole, trends in the total number of publications on agricultural sciences are quite encouraging. The number of CAB-abstracted publications increased from 3,014 in 1980 to 6,058 in 1990 and further to 6,664 in 1998. A similar trend was observed for the ISA-covered publications. The increase in the number of publications during 1990s is considered important because it is believed that the number of agricultural scientists might have gone down during this period. The number of publications per scientist per year also increased from 0.48 in 1990 to 0.51 in 1998, registering an increase of about 6 per cent.

Table 3: Trends in annual research publications of ICAR-SAU system

Particulars	ICAR institutes	SAUs	Total (ICAR & SAU)	Articles per FTE[a] scientist
Number of articles indexed in SCI				
1980	696	758	1,454	0.14
1990	205	292	497	0.04
2002	299	231	530	0.05
Number of articles included in CABA				
1980	1,090	1,924	3,014	0.29
1990	1,645	4,413	6,058	0.48
1998	2,027	4,637	6,664	0.51
Number of articles covered in ISA				
1990	1,170	4,308	5,478	0.43
2002	1,250	4,786	6,036	0.53

[a] Full-time equivalent (e.g., a scientist spending 50% of his time on research was considered as 0.5 FTE).

The above data clearly showed an upward trend in scientific productivity of the ICAR-SAU system. However, there were some noteworthy patterns. Nearly 80 per cent of the papers were published in the non-SCI journals with zero impact factor and only a small proportion of the papers was published in the journals with impact factor greater than zero and up to two. About half of the SCI-indexed and more than 70 per cent of the total publications were authored by the scientists working in the SAUs, which was expected because of their scientific strength and dominance of student research. However, the tendency to publish in the low-rating journals is a matter of concern. The average impact factor was 1.1 for ICAR publications, which is close to 1.6 of CSIR publications in 2002. This underscores the need for improving the quality of publications vis-à-vis research in the country, particularly in agricultural sciences.

Technology Development

Development of usable technologies is another indicator of scientific productivity, but it is very difficult to compile time-series data on them. Therefore, the trends in rice varieties were considered to find the broad pattern of technological contributions. Rice being one of the important crops has been receiving greater attention of the research system, and most crop

management technologies evolve around improved rice varieties. An upward trend has been observed in the number of varieties developed by the Indian rice breeders. During 1970s, a total of 127 rice varieties were released; which rose to 223 in the 1980s—almost doubling the breeding productivity (Table 4). The number of officially-released varieties increased to 257 during the 1990s. Apart from the number of varieties, rice breeding has also witnessed some qualitative changes over time. The proportion of varieties with fine quality (long slender) grain increased from 29 per cent in 1970s to 36 per cent in 1990s. Also, there was a significant increase in the number of varieties developed for marginal production environments, as well as those tolerant to biotic stresses. This development has led to a substantial reduction in yield variability even in the rainfed areas of eastern India.

Table 4: Trends in rice variety development, 1971-2000

Particulars	1971-1980	1981-1990	1991-2000
Total number of varieties developed	127	223	257
Percentage of varieties with fine grain quality[a]	29.1	34.9	36.5
Percentage of varieties tolerant to diseases	50.4	67.2	51.0
Percentage of varieties tolerant to insect pests	10.2	25.1	20.2
Percentage of varieties developed for marginal areas[b]	41.7	50.6	46.0
Percentage of short to medium duration varieties[c]	74.8	53.8	52.5

Source: Based on DRR (Hyderabad) data
a) Long slender grain type.
b) Rainfed upland and lowland, deepwater, saline and alkaline ecosystems.
c) 50 per cent flowering in less than 100 days.

Development of hybrid rice in partnerships with the International Rice Research Institute, Manila (Philippines) and private seed companies has established a yield advantage of 15-20 per cent. Thus, maintaining high and stable yields with improved grain quality is a major contribution of Indian plant breeding programmes. Focus was also on breeding short-duration rice varieties, which constituted about half of the total varieties released during 1980s and 1990s, down from three quarters during 1970s, owing to trade-off between yield-enhancing and crop maturity - reducing traits. Similar trends were observed in research achievements in maize and wheat. The success in varietal development could attract the private sector to the seed industry. Research in horticulture, fishery, and medicinal & aromatic plants has been highly rewarding, resulting in productivity enhancement. Development in resource conservation technologies, including IPM in agriculture, and disease resistance in livestock was also achieved. But, the success was confined to dairy, commercial poultry and fish sectors only, and the subsistence livestock sector suffered because of limited commercialization of technologies which are often capital-intensive, causing a scale bias.

Socio-economic Impact

Economic Payoffs: Agricultural R&D has been assessed quantitatively through a number of studies conducted by both national and international organizations. These studies have revealed

that investment in the agricultural R&D is a 'win-win' option as it is the largest contributor to the total factor productivity (TFP), and reduces the rural poverty significantly. Although there were considerable variations, the average rate of return to investment in agricultural research was about 70 per cent with, a median value of more than 50 per cent. These rates were comparable with those obtained internationally, covering both developed and developing countries (Table 5). Furthermore, the marginal internal rate of return to research investment in India ranged from 57 to 59 per cent during the green revolution era. Returns realized for agricultural R&D were 35 per cent for private, and 45 per cent for public agricultural extension. The growth in TFP was estimated to be 1.4 per cent during 1980-2000, which is equal to the one observed for the crop sector during the initial phase of green revolution.

Table 5: Internal rates of return to agricultural research investment in India

(per cent)

Particulars	India (All studies)	Global estimates
Mean	71.8	79.6
Mode	50.0	26.0
Median	57.5	49.0
Minimum	6.0	-7.4
Maximum	218.2	910.0

On the other hand, a deceleration in the TFP growth for crops was observed in the Indo-Gangetic Plains during the mid-1990s. It was certainly an undesirable trend, but it would be premature to entertain the deceleration hypothesis based on the data for a few years. Whether this deceleration was because of slow improvement in the technical efficiency—an important factor for growth in TFP, or technological regression, needs to be ascertained. In fact, deceleration in the agricultural growth since the mid-1990s has underscored the need for acceleration of technology flow to farmers, requiring higher investment in agricultural R&D.

Benefits to Smallholders: Has agricultural research in India benefited smallholders and the dryland areas? Since the green revolution technologies were neutral to scale, the growth benefits were also shared by the small producers and the urban poor benefited through reduction in food prices. The high-yielding varieties also spread rapidly to the dry and semi-arid regions of the central and peninsular India and covered more than 74 per cent of the area under sorghum and pearlmillet, which was higher than that of paddy. Of late, there has been a rapid spread of modern varieties in the eastern India, contributing to most of the increase in the national foodgrain production during the 1990s. Earlier studies have shown that technological change was pervasive even in the rainfed areas, and crops like coarse grains, pulses, oilseeds, fibres, and vegetables had registered a positive growth in the TFP. However, the impact was limited in a few states, viz. Bihar, Madhya Pradesh and Karnataka, partly because of incremental nature of technological advancements (unlike oneshot jump in irrigated areas), which are often eroded by erratic weather conditions. Barring these few limitations, the research system could address the objective of

sustainable agricultural development in the country with social justice, and the economic policy environment helped in achieving this objective.

Delivering Seeds of 'Orphan Crops'

Suresh Pal, Harbir Singh and Prasoon Mathur

The ability of public sector to deliver seeds at the local level is a part of the debate on public-private sector interface in seed supply. To what extent decentralization should be undertaken for seed provision at the local level and what other forms of seed systems may be more effective in augmenting seed supply in the marginal areas? These issues were studied in the context of high-volume, low-value crops, often known as 'orphan crops'. Groundnut and potato crops are the perfect examples of 'orphan crops' as their seed rate is very high, seed cost forms nearly one-third of the total variable cost of cultivation and seed replacement rate is very low.

A number of actors were involved in breeding, multiplication and distribution of seeds of groundnut and potato, and there were inefficiencies in their delivery system. The farmers got little information about new varieties of these crops from the public extension or seed system. In the absence of an effective extension mechanism, a majority of the farmers (80 per cent or more) could know about a new variety from the fellow farmers. Since plant breeding was still in the public sector domain and there was no commercial interest at present in both these crops, there was a strong case to strengthen information flow though public extension machinery.

Farmers acquired 35 per cent fresh groundnut seed from the commercial sources, and 65 per cent through traditional sources, viz. own farm-saved seed and seed-exchange. However, in potato, the share of farm-saved seed was much higher (60 per cent) than the commercial seed. Since more than half of the seed was acquired off-farm, the formal seed system was suggested to meet this demand, which was quite high by any standard. Given the nature of seed business, there was not much incentive for the private sector in the provision of seed, and therefore there was a clear case of government intervention. The study has suggested that the government should look for linking marginal production regions with the national and global markets, and should develop value-chain, especially for premium market, which could eventually attract the corporate sector as well as the seed market. The public seed corporations should take lead in the direct seed supply to farmers with special emphasis on areas of seed multiplication and its quality. Coordination among public seed agencies could provide opportunities for cost reductions, augmenting supply in deficit regions, and offering greater choice to farmers.

Although the seed replacement rate was higher than other self-pollinated crops, formal seed system was meeting hardly one-third of the seed requirement. Concerted efforts were required to augment seed supply, improve seed quality and promote new varieties. Technological innovations should address (a) major production constraints, (b) problem of aflatoxin, and (c) multiplication rate and seed quality. It is highly unlikely that these crops would attract private investment in plant breeding, even under the IPR regime.

Economic Losses in Dairy Production in India

P. S. Birthal and A. K. Jha

India has made a revolutionary progress in milk production over the past three decades, but the productivity of dairy animals continues to be low due to a number of constraints related to breeding, animal health and nutrition. Apart from low productivity, these constraints contribute to large economic losses. To identify the constraints and quantify the economic losses from these constraints, a study was attempted at the national level, covering 54 villages, spread over 9 states of India, viz. Andhra Pradesh, Haryana, Karnataka, Jharkhand, Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh and West Bengal. A focused group discussion between multi-disciplinary team of scientists and dairy farmers constituted the base to generate the data used in this study.

Loss in yield due to different constraints was assessed for the average dairy herd based on dairy producers' perceptions using the following formula:

$$\theta = \varphi.\eta.\gamma.\delta$$

where, θ = average annual yield loss (litres/animal), φ = reduction in milk yield (annual) of the affected animal due to a constraint, η = probability of occurrence of the constraint, γ = propor of animals affected, and δ = periodicity of occurrence (days) in a year

Multiplication of the average annual yield loss (θ) by milch animal population provided an estimate of the total milk loss due to a particular constraint. The value of output los s was obtained by multiplying the physical output loss with the output price. Summation of losses due to different constraints yielded the total annual loss. Table 6 provides the estimated losses for broad groups of constraints.

Table 6: Economic losses in dairy production in India, 2002-03

(in billion Rs.)

Constraints	Cattle			Buffalo	Total
	Crossbred	Indigenous	Total cattle		
Breeding	4.4	33.1	37.6	22.5	60.1
Feed and nutrition	9.3	43.3	52.5	79.0	131.5
Health	8.5	19.4	27.8	20.8	48.6
Management	3.4	15.0	18.5	9.7	28.2
Total loss	25.6	110.8	136.4	132.0	268.4
Total loss as percentage of value of production	11.5	37.6	26.3	26.3	26.3

In 2002-03, the dairy output worth Rs 268.4 billion was lost due to different constraints, which was equivalent to 26.3 per cent of the attainable output (actual output + output lost). At the disaggregated level by species, indigenous cows suffered the most with a reduction of 37.6 per cent, followed by buffaloes and crossbred cows. It was obvious because the indigenous cows had

the lowest milk yield and thus were the least-cared, while the yield of crossbred cows was highest and they were looked-after well.

Feed scarcity was the most important constraint, accounting for nearly half of the total losses in dairy production. Breeding problems were the next, followed by health-and management-related problems. A similar pattern was observed at the species level, but with wide variations. In buffaloes, 61 per cent of the total loss was due to inadequate feeding and nutrition compared to 39 per cent in indigenous cows and 36 per cent in crossbred cows. In the crossbred cows, diseases caused as much loss in production as inadequate feed and nutrition. In the indigenous cows and buffaloes, breeding problems were next to feed scarcity in economic losses.

A disaggregated analysis of constraints was more revealing and useful in prioritizing research and development activities. Failure of artificial insemination and repeat breeding were the major breeding problems. Lack of availability of progeny bulls for breeding was also an important constraint. Infertility was a major breeding problem in indigenous cows, followed by lack of availability of progeny bulls. For buffaloes, the main breeding problems were long inter-calving period, lack of availability of progeny bulls and failure of artificial insemination. This suggested that R&D efforts should target production and provision of quality bulls and improve effectiveness of artificial insemination to improve yield of dairy animals.

Lack of availability of green fodder was the most critical nutritional constraint in realizing the production potential of crossbred cows, while mineral deficiency emerged as the most limiting factor in the case of buffaloes and indigenous cows. Inadequate concentrate feeding was the second most important nutritional constraint in improving the yields of buffaloes. It was also an important yield-limiting factor in the indigenous cows. This suggested the need to encourage farmers to grow food-feed crops and disseminate technologies and practices that alleviate feed scarcity and improve animal nutrition.

Amongst diseases, Foot and Mouth Disease (FMD) was the most important yield-reducing factor in indigenous as well as crossbred cows. Mastitis, Black Quarter, Brucellosis, Theileriosis were the important diseases in the crossbreds; and Brucellosis, Diarrhea, Pneumonia, Theileriosis and Ticks in the indigenous cows. Mastitis, FMD, Ticks, Brucellosis, liver-flukes and *Hemorrhagic septicemia* were the major diseases in buffaloes. By and large, the pattern of losses due to different diseases has suggested more focus on prevention and control of Mastitis, FMD, Brucellosis, Theileriosis and Ticks.

Estimation of Feed Consumption in India

P. S. Birthal, S. N. Mishra, A. K. Dixit and Gaurav Tripathi

Estimation of feed consumption and its environmental effects were studied by conducting a sample survey in 10-livestock regions of the country over a period of one-year during 2001-2002. The data were collected on the feed consumption level (per day per animal) by types and sources of feed for different categories of animals by species, age, sex and type of

function. The species covered were cattle, buffaloes, sheep, goat, horses/ponies and camel. The total feed consumption and environmental effects were estimated using 1997 livestock population.

Livestock consumed 420 million tonnes of green roughages, 510 million tonnes of dry roughages and 55 million tonnes of concentrates. While almost the entire dry roughages came from cultivated crops in the form of straw and stalk, half of the green roughages were the gathered grasses. Foodgrains fed to the animals (excluding bran) were estimated at about 23 million tonnes, which was about 12 per cent of the foodgrain output in that year. The estimated consumption of brans of cereals and pulses was 8 million tonnes and of oilcakes, including cottonseed was 22 million tonnes. In contrast, the National Commission on Agriculture of 1976 had estimated that only 2 per cent coarse cereals should be fed to animals.

Contribution of Livestock to Environment

India's livestock population is one of the largest in the world. It has come under scrutiny of environmental agencies for its contribution to greenhouse gas emission. The estimates of greenhouse gas emission for India are based on default rates provided by the Intergovernmental Panel on Climate Change. In this study, greenhouse gas emission was estimated using quantity and quality of different types of feeds. Since livestock in India is a part of mixed-farming systems, these make several positive contributions to environment.

Land saving due to recycling of agricultural by-products as feed was to the tune of 52 million hectares. It simply means that if the by-products (dry fodder and oilcakes and meal) were to be replaced by cultivated green fodder that much land would be required. Dung used as manure replaced as much as 3.3 million tonnes of chemical fertilizers and prevented emission of greenhouse gases. Animal energy used in agriculture saved as much as 25.5 million tonnes of diesel oil, which would otherwise cause carbon-di-oxide emission. On the negative side, India's livestock emits about 9.9 million tonnes of methane, which is due to enteric fermentation of feed.

Role of ICT-based Institutional Innovations in Reducing Transaction Cost of Farmers

P. Adhiguru

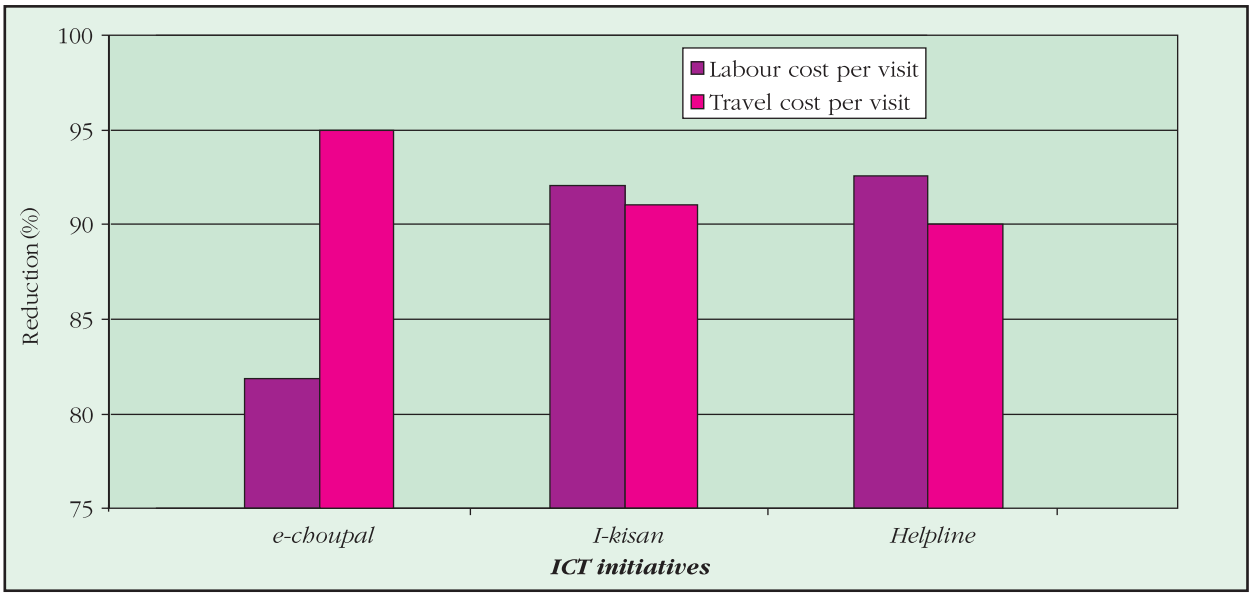
The new economic forces, including globalization of agriculture, are leading to the transition of subsistence farming to commercial farming. Agricultural diversification, value-addition, and recycling are the integrated farm approaches having the potential of risk-minimization capacity. The success of the approach depends on access of farmers to the latest technical knowledge. Acquiring of the relevant knowledge from the extension agents entails high cost and time, which influence the farmers' decision-making process. The Information and Communication Technology (ICT) is one of the potential options available to the farmers for accessing the required information.

ICT-based initiatives in agriculture are at the take-off stage in India. The study has examined the impact of some of such initiatives and it has been found that ICT has made a positive impact on

reducing the transaction cost in accessing information. Segregation of the exclusive impact of ICT is difficult but it has broadly indicated that ICT is one of the significant sources for accessing information.

Traditionally, for seeking information or any technical knowledge on crop cultivation, farmers visit nearby taluk headquarters and contact the officials in Department of Agriculture or get the suggestions from the private dealers while purchasing agro-inputs. Usually the private dealers do not spend enough time to disseminate such information without their marketing interest. Also, they do not have technical knowledge at the required level. In other words, it is product-oriented marketing rather than farmer/farm-oriented advice. As a result, farmers in general are rarely benefited. The ICT-initiatives have potential to change this scenario and offer savings in transaction costs of the farmers on accessing information. They can get it by visiting kiosks in their own village or a nearby village. The components of transaction cost incurred by the farmers covered 'distance travelled', cost equivalent of labour hours foregone, and cost on travelling per visit. The reduction in ftransaction cost of farmers who availed ICT-enabled services has been depicted in Figure 2. Three ICT-based initiatives, viz. *e-choupal* by ITC, *I-kisan* by Nagarjuana group and *Helpline* by C. S. Azad University of Agriculture & Technology, Kanpur have been studied. The *e-choupal* focuses on dissemination of information about price and the remaining two, on technologies. The study has shown that by availing ICT services, a farmer could save his travelling time and in turn the transaction costs by 90-95 per cent.

Figure 2: Reduction in transaction cost for accessing information through ICT-based initiatives



Apart from information on technologies or farm inputs, farmers were spending considerable time and money on seeking information about marketing of the produce and the prevailing price. In this context, *e-choupal (soy-choupal)* was found a good model of ICT as a mechanism to overcome these difficulties of the farmers. It adds value to the time of the farmers. As per ITC estimates, by using *soy-choupal*, the farmers could save, on an average, 68 per cent in the transaction costs due

to information which helped in decision-making and efficient marketing of farm produce (soybean). The study has suggested replication of such ICT-based initiatives for minimizing transaction costs and enhancing overall profitability.

Instability and Supply Response in Oilseeds Production in India

L. M. Pandey, Sant Kumar and Mruthyunjaya

Oilseeds constitute an important component of crop production in Indian agriculture. The continued shortfall in their production and yield fluctuations after mid-1990s have critical macro-economic implications in the country. Presently, India meets a large part of its domestic demand (about 40 per cent) of edible oils through import and this proportion may go up. A study of four major oilseeds, viz. groundnut, rapeseed/mustard, sunflower and soybean was attempted to examine 'instability and supply response in production of oilseeds' during the periods 1986-87 to 1993-94 (Period I) and 1994-95 to 2001-02 (Period II). The instability in yields and prices was examined employing coefficient of variation (CV) technique, while effects of price and price risk in oilseeds production were studied using GARCH model.

Instability in Yield and Prices of Oilseeds

The average yield levels of edible oilseeds have increased in most of the states over the years, while its variability has declined (Table 7). In most cases, their average prices and variabilities have also declined. The imports of cheaper edible oilseeds and oils during Period II might have helped in declining the prices of oilseeds in India.

Table 7: Instability in yields and prices of major oilseeds in selected states of India

State	Periods	Yield (kg/ha)		Price (Rs/q)	
		Mean	CV (%)	Mean	CV (%)
		Groundnut			
Andhra Pradesh	I	938	9.00	883	8.5
	II	909	24.8	805	23.0
Gujarat	I	705	71.4	1030	84.5
	II	935	49.8	964	50.2
		Rapeseed/Mustard			
Punjab	I	1010	7.6	1069	13.3
	II	1099	13.0	926	13.7
Rajasthan	I	832	10.4	948	16.5
	II	871	12.1	872	15.7
		Sunflower			
Karnataka	I	473	24.8	856	48.3
	II	518	19.2	904	25.1
Maharashtra	I	373	15.0	973	19.1
	II	390	9.6	898	15.7
		Soybean			
Madhya Pradesh	I	854	18.6	774	23.8
	II	977	12.8	660	25.4

Effects of Price and Price Risk on Oilseeds Production

The economic environment and incentives are changing rapidly and farmers are responsive to these changes in the oilseed sector. Analysis has shown a mixed response for instability in yields and prices, while covariate risks have increased. The findings of GARCH model have indicated that the expected prices and price risks were important determinants of oilseeds production. The prices had positive and price risks had negative effects on oilseeds production. The price elasticity of oilseeds production varied between 0.26 and 0.88, and price risk elasticity was negligible. These results imply economic significance of prices and price risks, which may play important role in policy decisions on improving oilseeds production in the country.

SUSTAINABLE AGRICULTURAL SYSTEMS

This research theme deals with studies on alternate development pathways in crops, cropping systems, agricultural typologies, nutrient management by ecosystems, sustainability status, trends and dimensions in natural resources management and other productivity enhancement practices. The highlights of studies done are presented below:

System of Rice Intensification – An Analysis

B. C. Barah

The productivity enhancement in rice is of paramount concern to the agricultural researchers and policymakers. The increase in productivity can be achieved by adoption of improved technology and recommended package of practices, along with better crop care. Such a strategy/technology adoption is essential to break the yield barriers in rice, which ensures resource conservation and leads to sustainable production. Studies on alternative practices of rice production such as dry seeding rice (DSR) under zero-tillage, wet direct seeding under puddle condition and system of rice intensification (SRI) are under way. The SRI has the dual relative advantage of productivity enhancement and resource conservation. This innovative practice of rice-growing with less input, reflects a synergy of specific practices. The adoption of SRI has shown a phenomenal speed – from a single country of Madagaskar in 1995 to nearly 24 countries of the world today. The SRI has the following basic tenets:

(i) Land preparation with local equipment, (ii) early transplantation of single seedlings of 8-12 days, with wider spacing before the appearance of third leaf, (iii) rather flooding continuously, keeping soil moist; and practising alternate wetting and drying, (iv) use of mechanical rotary weeder every 10-14 days, which controls weeds and provides enough soil aeration, (v) use of compost and organic manure as against inorganic fertilizers and other external inputs, and (vi) use of relatively lesser inputs. More specifically, it conserves water substantially.

Accumulated evidence show that by following the recommended practices, the SRI could provide additional rice yield of 1-2 t/ha as compared to best existing practices. Due to higher yields along with resource conservation, SRI had become the preferred practice of the farmers. Moreover, the small farmers' orientation of agriculture had made SRI socially more desirable. To reap the quantitative gains from SRI and growth prospects of rice production, there was a need to understand the synergy between agronomy and economics of SRI. The study is underway in three peninsular states, viz Andhra Pradesh, Tamil Nadu and Karnataka, where the respective governments accord high priority to popularize SRI among the farmers.

Source and Management of Risk in Rainfed Agriculture in India

Suresh Pal

This study has clearly shown that the growth in crop yield and production has accelerated in the rainfed areas since the early-1980s. Owing to differences in agro-climatic factors and technology adoption, the patterns of yield growth and variability were rather diverse. But growth with stability could be achieved under better crop management systems. Although the level of relative variability in the yield and production might not be high at the regional level, it could be high at the farm level in absolute terms, affecting the farmers and rural poor adversely. The effect of shortfall in yield would be far more serious in the year of drought or flood. Both *ex-ante* and *ex-post* measures to deal with drastic fall in crop production and income were found essential. *Ex-post* management measures like public distribution of foodgrains and employment generation programmes were already operating, *albeit* with varying degree of success. These should be strengthened and made more pro-poor. Crop insurance and institutional credit were other options to manage after-effects of risk, needing attention of policymakers to make them more effective. A long-term strategy to check sharp shortfall in the production should incorporate appropriate measures in the agricultural development. Product diversification towards horticultural crops in low-potential rainfed areas is often talked about to minimize risk and raise farm income. This option requires development of post-harvest and product-handing facilities in these regions. Also, incorporation of risk reduction as one of the research objectives for high risk agriculture, and strengthening of technology and input delivery systems should be accorded high priority to meet the diverse needs of farmers of these areas.

MARKETS AND TRADE

The theme includes research on marketing aspects and competitiveness of Indian agriculture in the post-WTO period, government intervention in food markets, demand and supply projections for agricultural commodities, problems and issues in marketing of perishable products, pricing policy, etc. Following are the highlights of research in the theme:

Demand for Urea Towards 2011

Ramesh Chand

In this study, the demand for urea by the year 2011 has been projected under different scenarios. The first was 'business as usual (BAU) scenario' which assumed that area under irrigation and HYV as well as real price of urea would change at the same rate as witnessed during the recent past, i.e. 1992-93 to 2001-02. In addition to these factors, one more factor was added to account for the increase in demand for urea due to change in the total cropped area. Demand for urea under BAU scenario was projected to increase annually at the rate of 3.29 per cent. When the residual effect of all other factors was added, the demand for urea was projected to increase by 3.42 per cent (Table 8). Total demand for urea in the year 2011 has been projected to be 24.96 million tonnes as against 19.06 million tonnes during triennium ending 2002-03. This scenario involves a decline in the real price of urea by 1.28 per cent per year, as witnessed during the reform period. This in turn implies either increase in nominal and real subsidies on urea or much faster increase in crop prices relative to the price of urea.

Due to serious resource constraint there is a strong likelihood that real subsidies on urea would not increase in the country. This could happen if urea prices were increased at the same rate as the increase in prices of crops. This scenario showed that the demand for urea would increase at a rate close to 3 per cent, which would generate the total demand for urea as 24.12 million tonnes.

The third scenario assumed the increase in urea price matching with the increase in crop price and 2.13 per cent annual growth in area under irrigation. This expansion of irrigation corresponds to the full exploitation of India's irrigation potential by the year 2020. This scenario also assumed that expansion of irrigation would increase crop intensity. Empirical evidence on this indicated that 1 per cent increase in irrigation would result in 0.25 per cent increase in gross cropped area. Under this scenario, demand for urea would grow by about 4.10 per cent per annum which corresponds to 26.30 million tonnes of urea by the year 2011.

One more scenario was visualized of attaining 4 per cent growth rate in output. This scenario assumed full exploitation of irrigation potential, expansion of HYVs by 2 per cent per annum and small increase in crop intensity due to increase in irrigation facility. Since growth rate in output is contributed by several factors, this scenario assumed 0.62 per cent growth in output due to TFP and 0.51 per cent growth in output due to diversification. On balancing, this scenario required 4.6 per cent annual growth in application of urea. This growth required a decline in the real price of urea by 2 per cent per year–which in turn requires growth in subsidies at a much higher rate than what was witnessed during the reforms period. Demand for urea under this scenario has been projected to be 27.45 million tonnes by 2011.

Table 8: Demand projections for urea under different scenarios

Variables	Elasticity	Scenarios: Growth rates (per cent)			
		BAU	BAU and freeze on subsidy	Freeze on subsidy, exploitation of irrigation	Attaining 4 per cent growth
1. Area under irrigation	0.843	1.27	1.27	2.13	2.13
2. Area under HYVs	0.797	2.05	2.05	2.05	2.05
3. Gross cropped area	1.000	0.15	0.15	0.55	0.55
4. Real price of urea	-0.344	-1.28	0	0	-2.00
Subsidy on urea		Increase in real term	Urea price increases at the same rate as of crop price		
Growth rate in demand for urea due to variables 1 to 4		3.29	2.85	3.97	4.53
Growth rate including residual		3.42	2.98	4.10	4.66
Projected demand for urea in 2010-11 ('000 tonnes)		24959	24122	26303	27452

Demand projections for urea based on positive approach were quite close to the projections based on normative approach. A synthesis of two approaches revealed that demand for urea towards 2011 would vary between 24.1 million tonnes at low output growth scenario to 27.6 million tonnes corresponding to a relatively high growth scenario.

The Seed Laws of Asian Countries under WTO and IPR Regime: A Paradigm Shift

M. B. Dastagiri

Seed laws of 13 Asian countries have been analyzed in the context of a paradigm shift in liberalization in seed policies. As per the seed law of India, registration is obligatory for seed sale. India's New Seed Bill 2004 has provided benefits to the private sector. In China, all the commercial seed production has to be registered and certified.

In Afghanistan, registration and certification are mandatory for all crops. Seeds from the informal sector are, however, exempt from it as long as they are not sold. In Bangladesh, seeds of the government-notified crops only are subject to regulation prior to liberalization. With the introduction of 'Seed Act Amendment 1997' and 'Seed Rules 1998', even the private sector can import and market any non-notified seeds. In Bhutan, the government regulates the seeds of notified kinds and varieties. The system is voluntary and there is no distinctiveness, uniformity and stability (DUS) criterion. In Indonesia, the government regulates seeds of plants. However, the farmers' varieties are not governed by these regulations because these are considered as 'natural varieties'.

In Iran, the government enacted the 'Plant Varieties Registration, Control & Certification of Seeds & Seedlings Act' in 2003; it deals with both plant varieties protection and seed certification. The 'non-improved' varieties (essentially the farmers' seed) also need registration but 'improved' seeds can be imported by the private sector.

In Kyrgystan, new seed laws are being drafted with the help of international organizations like USAID and FAO. In Nepal, the Seeds Act of 1988, and Seed Rules 1996, deal with the registration and release of 153 varieties of plants. In Pakistan, as per the Seeds Act of 1976, only the notified varieties of crops are to be registered and regulated. In Philippines, the High-Value Crops Development Act of 1995 encourages the farmers to cultivate non-traditional crops, for which several incentives are provided including low-cost credit, tax exemptions and market linkages. The recommended (similar to 'notified' in South Asian countries) varieties must be registered and certified. In Sri Lanka, the Seed Act 2003, requires anyone 'causing a seed to be placed in the market' has to be registered. If a farmer wishes to sell his seeds in the open market, he has to produce and sell certified seeds. In Thailand, the notified verities are regulated as per the 'Plant Act, 1992' through a licensing system and all other varieties are free from government control.

The seed laws of all the Asian countries require that the notified varieties must be regulated and certified. The seed laws and policies, in general, encourage the participation of private sector in the seed market. The study observed that the amendments in the seed laws offer several incentives to the local seed companies and provide a better market access to the foreign seed companies.

INSTITUTIONAL CHANGE

Studies on tenancy reforms, linkages in seed industry, institutional reforms in irrigation, public-private partnerships in research and extension, role of NGOs and self-help groups and institutional innovations in agriculture are the priority areas under the theme of institutional change.

Prosperous Institution and Prosperity of Farmers

B. C. Barah

India has a rich tradition of peoples' institutions in the rural areas. These institutions traditionally performed socially beneficial role and contributed towards sustainable livelihood. But, neglect of these institutions in recent past, non-availability to farmers the access to information, technology, and other infrastructure has increased the vulnerability of the rural areas to multiple risks and has alienated them from the development process. Under the circumstances, the economic growth without 'human face' has led to the paradox of 'growth without development'. Ironically, the influence of external forces has also weakened these institutions, causing distortions to development. It has been widely recognized that due to lack of effective institution for proper delivery, only a small fraction of a rupee invested in the rural areas

reaches the targeted poor. In order to fill the gap, newer and modern institutions including Panchayati Raj Institution (PRI) and the Self-help Group (SHG), have been experimented. The corporate and NGO interests are also emerging as reflected through the successes of various models of rural institutions. Notwithstanding these changes, their impact at the grassroot level was still meagre and was spreading sparsely. It indicated the need for appropriate rural institutions for sustainable livelihood prospects of the targeted population in rural areas. This study aims at gaining insights into the 'rules of the game' and would sharpen our understanding of the complexity of the rural institutions, their strengths and weaknesses and to draw policy lessons.

Agricultural Insurance in India: Problems and Prospects

S. S. Raju and Ramesh Chand

The need to protect farmers against high fluctuations in yields and prices in agriculture has been a continuing concern of agricultural policy. In India, agricultural insurance is one of the instruments for protecting farmers from wide agricultural variability. The coverage under various agricultural insurance schemes has been low in the past. This study aims at identifying the problems and prospects of agricultural insurance in India, and suggesting an effective agricultural insurance programme in India. Based on the literature reviewed, the following observations were made:

1. Penetration of agricultural insurance in India is very low. The annual crop insurance coverage of the farmers in India during 2004-05 was about 18 millions and the annual risk commitment (i.e. sum assured) was of about Rs 11267 crore.

2. Providing insurance tailored for the rural market and covering perils that do not have problems with risk independence, exposure or tariffs/ premium are worth considering.

3. Group insurance is rewarding in many ways. Delivery and servicing become easier and administrative costs can be kept low. If the group is sufficiently large and homogeneous, problems of anti-selection, and to some extent of moral hazard, can be mitigated. Unit area of insurance could be brought down to the village panchayat level.

4. A linkage and close working arrangement with the banking sector is significant for agricultural insurance. Marketing of insurance is much easier if it is linked to credit.

5. Insurance products for the rural areas should be simple so that they are easily understood and wherever possible, a package approach should be adopted so that the different covers do not have to be marketed separately.

6. Minimum indemnity limit has been suggested at 80 per cent in place of 60 per cent and threshold yield to be based on best 5 out of preceding 10 years.

7. Participation of private insurance companies needs to be encouraged

Policy and Institutional Perspectives on Seed System Development

Suresh Pal, Harbir Singh, and Prasoon Mathur

The Indian seed system has undergone tremendous change during the past two decades or so. The seed system, started with the public seed corporations in the 1960s, matured during the green revolution period. The new seed policy of 1988 and the economy-wide reforms of 1991 attracted the multinational companies (MNCs) in a major way.

The private seed sector has witnessed tremendous growth and now it supplies most of the hybrid seeds in the country, particularly in the major cotton-growing states. Even in the self-pollinated crops like paddy, the share of public sector is nominal and the private sector supplies 60-80 per cent of the commercial seeds in the states of Haryana and Andhra Pradesh. Low marginal cost and risks in producing paddy seeds and potential lucrative market for hybrid rice could explain greater participation of the private sector in paddy seed. In the case of inaccessible hilly areas also, the private sector supplies significant proportion of commercial maize and vegetable seeds. Only in the case of high-volume seed crops like potato and groundnut, there is less participation of the private sector.

The Indian seed industry is now heading towards the maturity phase with three major undergoing changes. First, private seed companies consider research and development (R&D) as an important mechanism to differentiate their product and enhance their marketing power. This tendency is likely to intensify further. The second major change is arising from the process of globalization and liberalization. The resource-rich MNCs with well-established R&D programmes are expanding their activities through mergers and acquisitions, while the national companies are finding it difficult to compete with them. Third, in view of multiple regulations governing the industry, protection of intellectual property rights (IPRs) has emerged an important factor to shape its growth and performance. India has put in place all necessary legislations to strengthen the IPR regime to comply with the WTO.

These developments are expected to further accelerate privatization of seed research in the country. In fact, private seed companies are finding it more attractive to develop and market proprietary material to capture a significant proportion of the seed market. Whatever may be the path, Indian farmers may have multiple choice and access to improved seed, which can have positive effect on crop productivity. The provision of compulsory licensing and presence of a strong public sector in developing varieties are useful options to control the monopolistic tendencies.

India has approved commercial cultivation of first GM crop (Bt cotton) and taken a number of other initiatives. Yet several issues related to the development of research capacity, bio-safety and IPR regulations, and management of public dialogue remain controversial. Forging public-private linkages seems to have potential and could enhance the overall impact.

Strategies to Encourage Rural Female Students in the Agricultural Education

D Rama Rao, N Sandhya Shenoy and Rasheed Sulaiman V.

In this study the share of rural female students in agricultural education was assessed and strategies were suggested to enhance their participation. The study was carried out in ten agricultural universities in India, viz. AAU in Gujarat, NDUAT in Uttar Pradesh, HAU in Haryana, MPUAT in Rajasthan, MAU in Maharashtra, RAU in Bihar, IGKVV in Raipur, UAS-D in Karnataka, ANGRAU in AP and OUAT in Orissa. Information related to female students' enrollment in agricultural education was collected from various student groups and professionals in agriculture. The proportion of girls in SAUs varied from 49 per cent in Kerala to 5 per cent in Uttar Pradesh. The study found that addressing of issues like transportation, accommodation and security would potentially encourage more rural females into agricultural education.

The policy recommendations were:

- NARS institutions need to undertake career counselling at the secondary level to motivate female students from rural schools to take up higher education in agriculture.
- ICAR to come forward with an action plan for implementation of the government policy of promoting agricultural education for women, making provisions of fellowships/ scholarships and other financial supports.
- ICAR may take lead towards proactive step in identifying and strengthening quality of vocational agricultural education, encouraging students for college education.
- Establishment of agricultural colleges and polytechnics in the rural areas and relaxation in qualifying marks or reservation for rural students, re-orienting the courses according to the present employment needs. Accommodation facilities for female students, specifically at polytechnics be made available.
- Campaign for creating awareness regarding the scope of agricultural education through different communication media. ICAR can organize this on the lines of national literacy campaign on Television and Radio.
- The country needs National Council for Agricultural Education to develop agricultural education for the new millennium. Develop national action plans and enhance investment in basic and higher education. Implement integrated strategies for gender in agricultural education.

AGRICULTURAL GROWTH AND MODELLING

This theme includes analysis of growth patterns, and structural changes in rural areas, including occupational structure, determinants of agricultural growth and potential of high-value agriculture along with sectoral, regional and commodity outlook, aspects of socio-economic dynamics, agricultural diversification, sustainability, and supply response in different sectors. Agricultural model building and sources of growth in agriculture are the other priority issues for research in this theme.

Exploring Possibilities of Achieving Four Per cent Growth Rate in Indian Agriculture

Ramesh Chand

In recent years, the performance of agriculture sector in India has decelerated sharply although the country aims at 4 per cent annual growth rate. To find the possibilities of putting agriculture on the targeted growth trajectory, the study has looked at sources and growth prospects at the state level. The exercise involved estimation of output elasticity with respect to fertilizer and irrigation, scope of irrigation expansion and increase in fertilizer-use, scope of diversification through high-value crops, improvement in TFP, and estimation of prospects of output growth through expansion of irrigation, increase in application of fertilizer, diversification and growth in TFP.

The state level analysis showed that feasible growth rate in Punjab was the lowest at less than 1 per cent. Bihar had the scope to raise crop output annually by 6.64 per cent in medium-

Table 9: Sources of output growth by 2011

(per cent)

States	Diversification	Irrigation	Fertilizer	TFP	Total
Andhra Pradesh	0.25	1.71	1.14	0.40	3.50
Assam	0.27	1.42	1.33	0.88	3.89
Bihar	0.18	3.36	0.85	2.24	6.64
Gujarat	0.78	0.65	1.79	0.47	3.69
Haryana	0.33	0.00	0.68	0.65	1.66
Himachal Pradesh	0.69	3.02	0.70	1.08	5.49
Jammu & Kashmir	0.90	2.88	2.03	0.42	6.23
Karnataka	0.19	1.75	1.16	0.86	3.96
Kerala	0.00	1.54	1.46	0.60	3.60
Madhya Pradesh	0.75	1.62	0.81	0.26	3.44
Maharashtra	0.99	1.95	1.35	0.88	5.18
Orissa	1.05	2.33	0.92	0.14	4.44
Punjab	0.17	0.00	0.40	0.36	0.94
Rajasthan	0.46	0.00	1.61	0.25	2.33
Tamil Nadu	0.40	0.82	1.60	0.35	3.17
Uttar Pradesh	0.37	1.49	1.45	0.60	3.90
West Bengal	0.78	1.22	2.34	1.16	5.49
All-India	0.49	1.43	1.32	0.72	3.96

term which was highest among all the states (Table 9). Growth prospects seemed to be low in Haryana and Rajasthan which were projected to achieve 1.66 and 2.33 per cent, respectively, in crop output. Maharashtra, Himachal Pradesh and West Bengal had potential of more than 5 per cent growth rate. Growth prospects were also high for Orissa. Output growth rate in the remaining states was projected to be between 3 and 4 per cent.

Table 10: State-wise growth under different factors needed to achieve 4 per cent output growth at the national level

(per cent)

States	Fertilizer	Irrigation	Area shift to other than foodgrains	TFP
Andhra Pradesh	3.15	2.39	0.555	0.40
Assam	6.94	3.00	0.166	0.88
Bihar	5.11	4.87	0.074	2.24
Gujarat	4.61	1.36	1.136	0.47
Haryana	2.42	0.00	0.500	0.65
Himachal Pradesh	1.75	3.13	0.146	1.08
Jammu & Kashmir	5.11	2.98	0.283	0.42
Karnataka	4.61	1.86	0.116	0.86
Kerala	4.61	1.98	0.000	0.60
Madhya Pradesh	4.40	3.88	0.854	0.26
Maharashtra	4.59	3.34	0.664	0.88
Orissa	6.89	4.93	0.884	0.14
Punjab	1.74	0.00	0.500	0.36
Rajasthan	4.44	0.00	0.640	0.25
Tamil Nadu	2.28	0.82	0.374	0.35
Uttar Pradesh	4.39	1.80	0.213	0.60
West Bengal	5.19	4.01	0.559	1.16
All-India	4.35	1.95	0.497	0.72

The actual growth rates required in fertilizer, irrigation, area under non-foodgrain crops and TFP to achieve 4 per cent growth rate in output are summarized in (Table 10). For this, India needs to increase fertilizer consumption by 4.35 per cent and area under irrigation by 1.95 per cent annually. Further, there was a need to shift about 0.5 per cent area from foodgrains to non-foodgrains every year. Growth in TFP in India has been projected to be 0.72 per cent per year at all-India level. It may be mentioned that TFP consists of contribution of several factors, the most important being technology and its dissemination. Improvement in infrastructure and farmer's knowledge and skills applied to farming are other contributions to TFP.

Promoting Growth in Livestock Sector for Poverty Alleviation

P. S. Birthal and V. K. Taneja

There is now an increasing consensus that in the developing countries growth in agriculture is more poverty-reducing than the growth in other economic sectors. In India, agriculture and allied activities, despite their falling shares in the gross domestic product, are central to livelihood of millions of rural people. Nearly 72 per cent of India's population lives in the rural areas,

and 75 per cent of it depends on agriculture and allied activities for livelihood. Further, of the 261 million poor in the country, 75 per cent are from rural areas. Accelerating agricultural growth is thus important to reducing rural poverty. The National Agricultural Policy targets a 4 per cent growth in the agricultural sector over the next two decades and envisages an important role for the livestock sector in achieving it.

Livestock accounts for over a quarter of the agricultural gross domestic product and has been growing faster than the agriculture sector as a whole (Table 11). Besides, distribution of livestock resources is more egalitarian than that of land. In 2002-03, the small farm households (< 2ha) that comprised 60 per cent of the rural households, controlled 76 per cent cattle, 72 per cent buffaloes, 80 per cent small ruminants, 83 per cent poultry, and 90 per cent pigs. Thus, faster growth in livestock sector has considerable potential to contribute to agricultural growth and thereby poverty reduction.

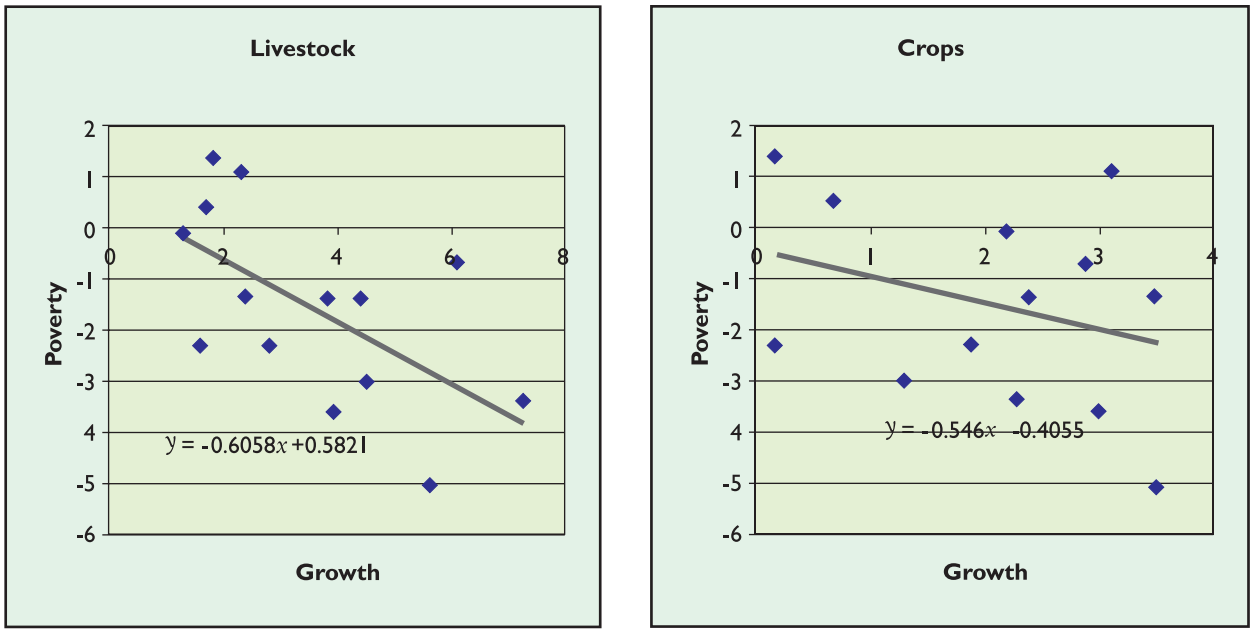
Table 11: Annual growth rate in the value of output of various agricultural activities, 1970-71 to 2002-03

(per cent)

Periods	Crops	Livestock	Fishery	Forestry
1970-71 to 1979-80	1.8	3.9	2.9	-0.6
1980-81 to 1989-90	2.5	5.0	5.7	-0.7
1990-91 to 2002-03	2.2	3.8	4.7	1.3

Figure 3 depicts growth in head count rural poverty ratio vis-à-vis growth in livestock and crop sub-sectors for major Indian states for the period 1983–84 to 1997–98. The fitted lines clearly show a faster reduction in rural poverty where growth in the livestock sector had been robust.

Figure 3: Relationship between growth and rural poverty in different states of India



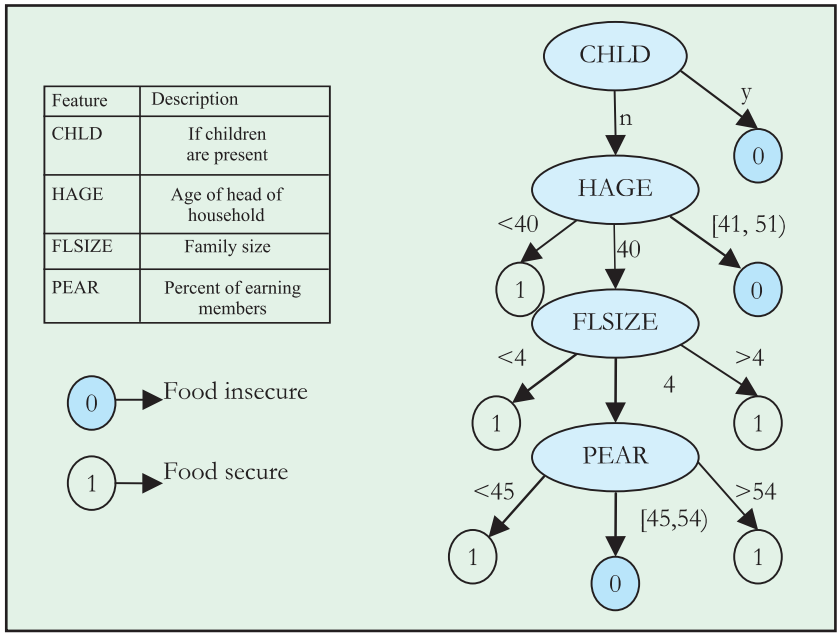
States like West Bengal, Tamil Nadu, Kerala, Karnataka, Haryana, Punjab and Maharashtra performed better in both livestock production and poverty reduction. Andhra Pradesh too witnessed high growth in livestock production but its impact on poverty reduction was not as high. It was because of industrialization of poultry production that accounted for nearly half of the livestock income in the state. On the other hand, Assam, Madhya Pradesh, Rajasthan and Uttar Pradesh experienced low growth in livestock production as well as poverty reduction.

Data Mining-based Initiatives in Agriculture – A Case of Identifying Vulnerable Households

Rajni Jain, Sonajharia Minz and P. Adhiguru

Dynamic Rough set-based Decision Tree (Dynamic RDT) induction model was developed to extract rules and patterns which can identify households vulnerable to food insecurity. For this, a dataset of 180 rural households in the Dharampuri district of Tamil Nadu in India was used.

Figure 4: Decision tree to identify vulnerable households



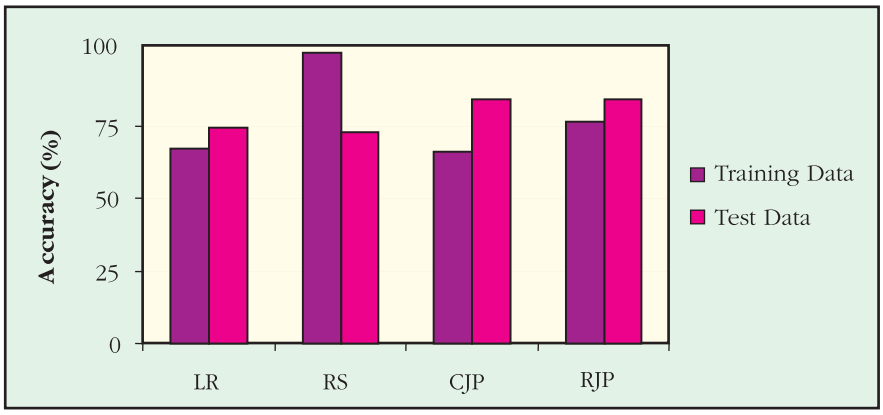
The estimated accuracy, obtained by using linear discriminant analysis (LDA), was used as a benchmark for comparing accuracy of the proposed model, called dynamic RDT. The LDA approach did not provide the rule-based model, hence the number of rules was not possible in this approach. The model required fewer features such as CHLD, HAGE, FLSIZE and PEAR to predict household as compared to that by the LDA. The Dynamic RDT model showed improved understandability (Figure 4). Several other data mining approaches were also experimented on the dataset. The estimated accuracy performance of the model was observed to be 73 per cent as compared to 71 per cent of the LDA.

Fore-warning of Crop Diseases Using Machine Learning Techniques

Rajni Jain, Sonajharia Minz and V. Ramasubramanian

With the advent of computers, the development of accurate forewarning systems for incidence of crop diseases is being increasingly emphasized. Timely forewarning of crop diseases will not only help in reducing yield losses but will also alert the stakeholders to take effective preventive measures. Traditionally, logistic regression (LR) and discriminant analysis methods have been in use in the forewarning systems. Recently, several machine learning techniques such as decision tree (DT) induction, Rough Sets (RS), soft computing techniques, neural networks, genetic algorithms, etc. are gaining popularity for predictive modelling. This study has examined the potential of three machine learning techniques, viz. RS, DT induction and RS- based DT induction (RDT) in comparison to standard LR method. RS offers mathematical tools to discover hidden patterns in data and therefore its application in forewarning models needs to be investigated. CJP algorithm was used to represent the DT induction while RJP algorithm represented the RDT.

Figure 5 : A comparison of algorithms for fore-warning of powdery mildew in mango



Powdery mildew of mango is a devastating disease and has assumed a serious threat to mango production in India, causing yield losses of 22.3 to 90.4 per cent. As a case study, prediction models for forewarning *Powdery mildew* disease of mango using variables such as temperature and humidity were developed. The results of machine learning techniques were better than those of LR technique (Figure 5). The results of a comparison of training data with test data supported the recommendation of RJP for prediction in crop diseases.

Rice in India and Policy Options

B. C. Barah

Rice is the staple food of nearly 65 per cent of the total population in India. The production of rough rice reached 135 million tonnes (89 million tonnes of clean rice) in the TE 2002, from 32.3 million tonnes (20 million tonnes clean rice) in 1952. However, this phenomenal pace in increase

in rice production and productivity has been uneven, and the disparity is highly pervasive in space and time. The yield curve has started showing a declining trend since mid-1990s which has continued thereafter in most of the rice-growing regions. The present study has traced the growth path of rice production along the time scale and has analysed the trends and growth at the disaggregated level. The production pattern has depicted a inverted-bowl shaped growth curve during the past couple of decades. Continuation of this pattern is a sustainability concern and is likely to threaten the food-security in the country. Clearly, the gain due to modern rice technology has been discriminatory against the resource-poor areas dominated by small and marginal farmers. This effect is quite pervasive, and the productivity varied from less than 2 t/ha in the rainfed areas to as high as 5.85 t/ha in the irrigated tracts of Punjab.

Notwithstanding the overall disparity and poor performance in several areas, rice production systems have experienced a considerable degree of dynamism in recent years. While characterizing the typology of the change, it has been argued that a likely shift in production base from well-endowed irrigated areas to less well-to-do rainfed areas in India is discernible. The recent changes in policy environment designed to divert prime rice-wheat areas in favour of crop diversification in agriculturally-developed states also justifies the shift. The accumulated evidence has suggested that the declining rice production in recent years and perceived ecological implications would push the core green revolution areas away from the mainstream of rice production.

Therefore, strategy for exploiting enormous untapped production potential in the rainfed areas has gained prominence. The widespread improvement in performance of rice productivity and production growth in the eastern Uttar Pradesh, West Bengal, Assam and other parts of the rainfed areas is a positive indication in this direction. The enhanced utilization of huge untapped potential in the eastern India could pave the path for next generation green revolution. For this to happen, a paradigm shift in policy and production environment has been suggested so as to build a stronger ground for increasing production in the rainfed areas.

The reform is also essential in agricultural R&D investment. A new look for regionally differentiated R&D policy of 'rice-plus' agriculture system (as against the rice-only system) has been advocated with special emphasis on resource-rich but poor-utilization areas. Development of modern varieties resilient to biotic and abiotic stresses should be supported by policy intervention to ensure its access to stakeholders for increasing production. The strategies recommended for the rainfed areas are: (i) the region with low yield and low yield gap requires '*Yield-increasing technology',* (ii) the strategy for the low yield and high gap areas is '*Appropriate technology, adaptive research and* '*reaching out to farmers',* and (iii) the high-yield and low-gap areas need '*Higher input efficiency and agricultural diversification'.*

Appropriate intervention on efficient implementation of the developmental programmes has been suggested to achieve growth rate of rice production at a level higher than that of population growth, otherwise the problem of food insecurity will loom large.

Agricultural Productivity and Growth in India

Anjani Kumar and K. Elumalai

This study has examined the issues related to growth performance of the agricultural sector in major states of India and has reviewed the sources and determinants of growth and importance of small farmers, and regional disparities in agricultural growth since the 1980s. Crop husbandry is the principal source of income-generating activity in agriculture, followed by livestock. The changes in the share of crop sector in total agricultural gross domestic product imply that agricultural diversification is gradually gaining momentum in favour of high-value livestock and fisheries commodities. This pattern was found identical across various states.

The growth in agricultural productivity in terms of Ag NSDP/ha has, by and large, declined during the 1990s as compared to that in 1980s. Except Andhra Pradesh, Gujarat, Jammu and Kashmir, Karnataka, Madhya Pradesh and Maharashtra, other states have shown deceleration in growth of agricultural productivity. This might have happened due to neglect of needed emphasis on infrastructural development and institutional changes. Further, the decline in public investment in agriculture during the 1990s affected the growth performance of agriculture. The growth in per capita AgNSDP in the rural areas also performed on similar lines. The livestock sector registered a favourable growth during the 1980s and 1990s in different states. Effective government interventions and the rising demand for livestock products in response to rising incomes might have helped in the progress of livestock sector. The fisheries sector plays an important role in generating income and employment for a large section of the rural poor in India. With the changing patterns of consumer demand and technological developments, the sector has assumed added importance and has been undergoing rapid transformation. The growth in the fisheries sector in India has been about 5 per cent per annum during 1984-2002.

However, the persistent problem of wide disparities across states/regions continues to be a serious challenge. The indicators of regional disparities for AgNSDP/ha and AgNSDP/rural person have exhibited a fluctuating trend. Regional disparities in the crop sector have shown a divergent tendency during the 1980s (though at a slower rate), which has further accentuated in the 1990s. A similar pattern has been observed among all crop groups, except fibres. However, rural income from the livestock sector seems to show a convergent tendency during the 1980s. But, this trend was reversed in the 1990s.

Both public and private sector investment in agricultural R&D system is seen as an important determinant of increased agricultural production. Policy directions are needed to unleash the potential of high-value agriculture, which also has high employment elasticity. Concerted efforts should be made to impart education and skill development so that small farm holders, who are the major producers of high-value food commodities, could be integrated with emerging markets. Further, trade and macro-economic policy reforms are needed to boost long-term investment in agricultural research and development to sustain and bring out technological changes in crop, livestock and other allied sectors.

National Agriculture Innovation Project (NAIP)

The Centre has been actively involved in the preparation of Project Implementation Plan for NAIP and has provided lot of inputs at various stages of project preparation.

III. POLICY INTERACTIONS

Dr Ramesh Chand was invited to the pre-budget consultation by the Ministry of Finance, Government of India.

Dr Ramesh Chand is a Member of the Working Group of Sub-Committee of the National Development Council on Agriculture and Related Issues of Region/ Crop Specific Productivity Analysis and Agro-Climatic Zones - Information on Field Level Demonstrations.

Dr Ramesh Chand is a Member of the Working Group on Rainfed Area of the 11th Five-Year Plan.

IV. LINKAGES AND COLLABORATIONS

Name of scientist	Project	Collaborator
P. S. Birthal and S. S. Raju	Macroeconomic Dimensions of Livestock Sector of Chhattisgarh	Centre for Advanced Research and Development (CARD), Bhopal
P. S. Birthal P. Adhiguru and A. K. Bawa	Agricultural Science and Technology Indicators: Survey for India	International Food Policy Research Institute (IFPRI) and ICAR
Ramesh Chand	Hunger and Food Security: New Challenges and New Opportunities	ICSSR-UNU-WIDER, Helsinki, Finland

V. AWARDS AND RECOGNITIONS

Dr Anjani Kumar received 'Lal Bahadaur Shashtri Young Scientist Award' of the ICAR for the Biennium 2003-04 for his outstanding contributions to social sciences (16th July 2005).

Dr Ramesh Chand is the Member of Editorial Board of the *Indian Journal of Agricultural Economics,* Mumbai.

Dr Ramesh Chand is the Member of Governing Council and Technical Committee of United Nations at Centre for Alleviation of Poverty and Sustainable Agriculture (CAPSA), Bogor, Indonesia.

Dr Ramesh Chand is the Member of Governing Body of SAARC Agriculture Information Centre (SAIC), Dhaka, Bangladesh.

Dr Suresh Pal is the Member of Steering Committee on Impact Assessment of Agro-Advisory Services, Department of Science and Technology, Government of India, New Delhi.

Dr Suresh Pal is the Member of High Power Committee of ICAR on Development and Strengthening of Agricultural Education for Overall Development of State Agricultural Universities.

Dr Suresh Pal is the Member of Drafting Committee of IPR Guidelines of ICAR, New Delhi.

Dr Suresh Pal is the Member of Team for Scenario Planning for Indian Agriculture, NAIP/World Bank.

Dr Suresh Pal was the Rapporteur for the technical session on 'Resource Use Efficiency Particularly in Irrigated Agriculture' at the annual conference of the Indian Society of Agricultural Economics, at PAU, Ludhiana, 24-26 November 2005.

VI. PUBLICATIONS

A. NCAP Publications

Policy Paper

B. C. Bhowmick, B. C. Barah, Sushil Pandey, and N. Barthakur. Performance and Prospects of Rice Production Systems and Technology in Assam. Policy Paper No. 22.

Policy Briefs

Andy Hall, Rajeswari Raina, Rasheed Sulaiman V., Norman Clark, Shambu Prasad and Guru Naik. Institutional Learning and Change: A Review of Concepts and Principles. Policy Brief No. 21.

Suresh Pal, Prasoon Mathur and A. K. Jha. Impact of Agricultural Research in India: Is It Decelerating? Policy Brief No. 22.

Ramesh Chand. Post-WTO Agriculture Trade and Agenda for Negotiations on Agriculture. Policy Brief No. 23.

B. Books

P. K. Joshi, Suresh Pal, P. S. Birthal and M. C. S. Bantilan
Impact of Agricultural Research: Post-Green Revolution Evidence from India
A joint publication of NCAP and ICRISAT, Patancheru

N. P. Louwaars, R. Tripp, D. Eaton, V. Henson-Apollonio, R. Hu, M. Mendoza, F. Muhhuku, S. Pal and J. Wekundah
Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries
Wageningen University and World Bank

Ramesh Chand
Free Trade Area in Asia
Academic Foundation, New Delhi

Ramesh Chand
India's Agricultural Challenges: Reflections on Policy, Technology and Other Issues Centre for Trade and Development, New Delhi

P. Parthasarathy Rao, P.S. Birthal and J. Ndjeunga
Crop-livestock Economies in the Semi-arid Tropics: Facts, Trends and Outlook.
ICRISAT, Patancheru

C. Book Review

Pal, Suresh. 2006. Globalization and the developing countries: Emerging strategies for rural development and poverty alleviation. *Indian Journal of Agricultural Economics, 61* (1): 147-149.

D. Research Papers

Angadi, U.B., S. S. Raju, S. Anandan and K.S. Ramachandra. 2005. Information system on availability and requirement of animal feed resources in the country. *Indian Journal of Animal Sciences, 75* (9): 1083-1086.

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I. Presentations in Conferences/Workshops/Symposia

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Mruthyunjaya, Sant Kumar, Rajashekharappa and L.M. Pandey. 2005. Technical efficiency in edible oilseed sector: Analysis and implications. Presented in the *Workshop of IGIDR-USDA/ERS Collaborative Project* on *Indian Agricultural Markets and Policy,* held at IGIDR, Mumbai, 16 April.

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Pal, Suresh. 2005. Wheat economy of India: Emerging scenario. Presented at *Annual Wheat Workers Workshop* at UAS, Dharwad, 27-30 August.

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Pandey, L. M., Sant Kumar and Mruthyunjaya. 2006. Instability, supply response and insurance in oilseeds production in India. Presented at the Annual Conference on *Management of Risk in Agriculture,* organized by Agricultural Economics Research Association (India), held at CSAUA&T, Kanpur, 6-7 January.

Pandey, Sushil, B. C. Barah and S. Pal. 2005. Recent patterns of rice productivity growth in eastern India: Implications for research and technology development. Presented at the *ICAR-IRRI Workplan 2003-08*, New Delhi, 22 June.

VII. ON-GOING RESEARCH PROJECTS

S. No.	Projects	PI/ CCPI
1.	Determinants of improved cultivation practices: Data mining approaches	Rajni Jain and Ramesh Chand
2.	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
3.	Innovation in rural institutions: A driver for agricultural prosperity	B. C. Barah
4.	Agricultural insurance in India: Problems and prospects	S. S. Raju and Ramesh Chand
5.	Rural distress and farmers' suicides in Andhra Pradesh	Aldas Janaiah and Ramesh Chand
6.	Impact assessment of fisheries research in India	Aldas Janaiah
7.	Returns to investment on livestock research and develop-ment: Implications for growth, equity and sustainability	P. S. Birthal
8.	Agricultural science and technology indicators: Survey for India	P. S. Birthal P. Adhiguru and A. K. Bawa
9.	Relooking of agricultural marketing institutions in the context of trade liberalization regime in India	M. B. Dastagiri
10.	Subsidies and investments in livestock sector	M. B. Dastagiri
11.	Strategies to encourage rural female students in the agricultural education	Rasheed Sulaiman V.
12.	Groundnut seed system in Andhra Pradesh	Suresh Pal Harbir Singh
13	Resource allocation for agricultural research: The case of wheat	Sant Kumar

VIII. CONSULTANCY PROJECTS

The consultancy and contract research activities are undertaken by the Centre to complement the emerging research thrusts, supplement its budgetary resources and contribute to resource generation. Consultancy proposals are examined by the Consultancy Processing Cell of the Centre and finalized as per guidelines of the ICAR.

Following individual consultancy services and contract research in collaborative mode were provided by the Centre during the year:

Consultancy/Contract Research

Name of scientists	Institution to which consultancy/ contract research was provided	Areas of consultancy/ contract research
P. S. Birthal and S. S. Raju	Centre for Advanced Research and and Development (CARD), Bhopal	Macro-economic dimensions of livestock sector of Chhattisgarh
P. S. Birthal	International Food Policy Research Institute, Washington DC	Contract farming in milk and poultry in India
Suresh Pal, Anjani Kumar and Harbir Singh	National Centre for Medium Range Weather Forecasting (NCMRWF) DST, Government of India, New Delhi	Impact assessment of weather forecasting
Rasheed Sulaiman V.	Write-arm, Bangalore	Technical backstopping for the workshop on learning from institutional change
B. C. Barah	NABARD, Mumbai	Dynamics of rice economy in India

IX. MANAGEMENT AND OTHER COMMITTEES

Members of Management Committee (MC)

Dr Ramesh Chand (Chairman)
Director (Acting)
NCAP, Pusa
New Delhi-110 012

Dr Mahesh Pathak
Honorary Director
Agro Economic Research Centre
Sardar Patel University
Vallabh Vidyanagar (Gujarat)

Dr B.C. Barah
Principal Scientist
NCAP, Pusa
New Delhi-110 012

Dr B. K. Sharma
Director
Department of Economics and Statistics
Government of India
Delhi State Old Secretariat, Delhi

Dr Suresh Pal
Principal Scientist
NCAP, Pusa
New Delhi-110 012

Dr S. L. Goswami
Joint Director
National Dairy Research Institute
Karnal-132 001 (Haryana)

Dr P.S. Birthal
National Fellow
NCAP, Pusa
New Delhi-110 012

Dr P.G. Chengappa
Director of Instruction (Agriculture)
University of Agricultural Sciences
Bangalore-560 065

Shri S.P. Ashra
Assistant Finance & Accounts Officer
NCAP, Pusa
New Delhi-110 012

Dr R.C. Sharma
Joint Director
Economic and Statistical Advisor to
Government of Haryana
30-Bays Building, Sector-17, Chandigarh

Shri S. K. Yadav
Special Invitee
NCAP, Pusa
New Delhi-110 012

Dr R.S. Deshpande
Professor and Head (ADRT Unit)
Institute for Social and Economic Change
Nagarbhavi Post, Bangalore-560 072

Ms Sanjeevani Prakash
Finance and Accounts Officer
NBPGR, Pusa, New Delhi-110 012

Meeting of Management Committee

A meeting of the Management Committee was held on 30 December 2005. The major observations of the Committee were:

The Committee appreciated the achievements made by the Centre in research in different theme areas. It approved the expenditure incurred by NCAP for 2003-04 and expenditure till September 2005. The Committee was happy to note that the construction of office building of NCAP was completed. The Committee again stressed for pursuing and expediting the construction of staff quarters on priority basis. The Management Committee suggested to organize winter/summer institute during 2006-07 on the theme of Agricultural Policy Issues, Tools and Methods. The Committee also suggested to prepare a compact module covering issues on 'agricultural development, research prioritization, science policy and changing phase of domestic and global agriculture' for senior level research managers of the NARS. This programme should be of three days. To meet the communication requirements, the Committee suggested to give priority to buy EPBAX system for the new office building of the Centre.

Meeting of Staff Research Council (SRC)

Seven meetings of the SRC were held during the year. The SRC is comprised of the Director, NCAP, the scientific staff of the Centre as well as Assistant Director General (Economics, Statistics and Marketing) of ICAR. The SRC discusses the progress of the on-going research activities and new research proposals. The Scientists and Research Associates of the Centre delivered seminars on new proposals and presented results of the ongoing studies during these meetings. Presentations to share the experiences and the outcome of the foreign deputations were also made at the SRC meetings.

Other Committees

A number of internal committees have been constituted for the decentralized management of the Centre. These committees and their terms of reference are as follows:

Academic Planning and Policy Committee

- To strengthen internal planning and policy direction functions.

Scientists Evaluation and Development Committee

- To encourage critical participation and strengthen socially-acceptable incentives and deterrent mechanism.

Budget Committee

- To plan, review and monitor the expenditure and income, including those for the sponsored projects of the Centre.
- To ensure compliance of proper procedures.

Purchase Committee

- To purchase materials and services according to the prescribed official procedures and in accordance with the Budget Committee guidelines/directions on utilization of funds.

Publications Committee

- To plan format and make recommendations regarding Centre's publications.
- To prepare guidelines and arrange internal and external reviewing of publications, and coordinate revisions.
- To help and advise younger faculty of the Centre on publication-related matters.
- To identify printers and suggest pricing, circulation norms, etc. for Centre's publications.

Consultancy Processing Cell

- To examine proposals related to Consultancy with reference to guidelines of the ICAR issued from time to time and recommend appropriate action.

Computer Committee

- To plan and monitor computer facilities at the ARIS cell and its maintenance.
- To facilitate and monitor IT facilities (LAN, e-mail, Internet) at the Centre.

Women Cell

- To recommend measures for the welfare of the women employees of the Centre.
- To make recommendations for expeditious relief and redressal of grievances including those related to sexual harassment.

Grievance Cell

- To examine the grievances received and to suggest the follow-up action accordingly.

Official Language Committee

- To monitor the progress of works done in official language from time to time and suggest relevant measures for improvement.
- To organise Raj Bhasha Month/Fortnight/Week/Day, as intimated by the Council from time-to-time.
- To report to the Council and other agencies on the progress from time to time.

PME/NATP Cell

- To plan, promote and monitor PME activities of the NATP.
- To report the progress to the NATP authorities/ Council about the progress from time to time.

X. PARTICIPATION IN SCIENTIFIC ACTIVITIES

Name	Topic and date(s)	Place
B. C. Barah	National Seminar on Peri-urban Agriculture Issues in Food Security 10-11 June 2005	Amity School of Rural Management, New Delhi
	ICAR-IRRI Workplan 2003-08 22 June 2005	NASC Complex, New Delhi
	Technical Seminar on Development of Producers Price Index (PPI)-Issues and Methodology 29-30 September 2005	PHDCC, New Delhi
	National Seminar on Rice & Rice-based System for Sustainable Production 18-19 October 2005	ICAR RC, Goa
	The WTO Regime: Understanding the Agreement on Agriculture 22-23 October 2005	VPKAS, Almora
	South Asia Conference on Trade and Development: Mainstreaming Development in Trade Negotiations–Run up to Hong Kong 27-28 October 2005	Centad, New Delhi
	Meeting of the Research Committee of Foundation for Public Economics and Policy Research 21 November 2005	IHC, New Delhi
	Workshop on Research Potential of Cost of Cultivation Data 22 November 2005	IEG, New Delhi
	Policy Retreat and Seminar on Agriculture, Food Security and Rural Development 28 November 2005	Hotel Hill View, Faridabad
	Rice Economy and Trade Perspectives in India 11 December 2005	IARI, New Delhi

P. S. Birthal	International Conference on Public-Private Partnerships for Harnessing the Potential of Rainfed Agriculture 19-20 October 2005	FICCI House, New Delhi
	Policy Retreat and Seminar on Agricultural Food Security and Rural Development 27-28 November 2005	Hotel Hill View, Faridabad
	ICAR-ILRI International Workshop on Smallholder Livestock Production in India: Opportunities and Challenges 31 January–1 February 2006	NASC Complex, New Delhi
Ramesh Chand	International Conference on Social Science Perspective in Agricultural Research and Development 15-18 February 2006	IARI, New Delhi
	ICAR-Industry Meet on Agricultural Transformation through Public-Private Partnership–An Interface 19-20 January 2006	NASC Complex, New Delhi
	Brainstorming on WTO and Indian Agriculture: Implications for Policy and R&D 23 December 2005	NAAS, New Delhi
	ICAR-ILRI International Workshop on Smallholder Livestock Production in India: Opportunities and Challenges 31 January-1 February 2006	NASC Complex, New Delhi
	CESS Silver Jubilee Seminar on Perspectives of Equitable Development: International Experience and What Can India Learn 7-9 January 2006	CESS, Hyderabad
	Workshop on Economic Integration in Asia and India: What is the Best Way of Regional Cooperation? 9 December 2005	Institute of Developing Economies, Japan

	Workshop on Liberalizing Agricultural Markets: Gains for India 10 February 2006	NCAER, New Delhi
	International Conference on Public-Private Partnerships for Harnessing the Potential of Rainfed Agriculture 19-20 October 2005	FICCI House, New Delhi
	UNU-WIDER Project Meeting on Hunger and Food Security: New Challenges and New Opportunities 12-14 October 2005	World Institute for Development Economics Research, Helsinki, Finland
	Workshop on Research Potential of Cost of Cultivation Data 22 November 2005	IEG, New Delhi
	Technical Discussion on Addressing Vulnerability to Climate Change through an Assessment of Adaptation Issues and Options 26 October 2005	World Bank, New Delhi
M. B. Dastagiri	International Conference on Public-Private Partnerships for Harnessing the Potential of Rainfed Agriculture 19-20 October 2005	FICCI House, New Delhi
	Indo-EU Seminar on Protection and Promotion of Geographical Indications of Goods 23-24 November 2005	Hotel Taj, New Delhi
	Hongkong Ministerial Meeting: Outlook for India 25 November 2005	ASSOCHAM House, New Delhi
	WTO and Indian Agriculture: Implications for Policy and R&D 23 December 2005	NAAS, New Delhi

Rajni Jain	International Conference on Public-Private Partnerships for Harnessing the Potential of Rainfed Agriculture 19-20 October 2005	FICCI House, New Delhi
	Consultation on Ten Years after Beijing: Gender Science and Technology 18-19 November 2005	NASC Complex, New Delhi
	Second Indian International Conference on Artificial Intelligence (IICAI-05) 20-22 December 2005	National Insurance Academy, Pune
	ICAR-ILRI International Workshop on Smallholder Livestock Production in India: Opportunities and Challenges 31 January–1 February 2006	NASC Complex, New Delhi
	International Conference on Social Science Perspectives in Agricultural Research and Development 15-18 February 2006	IARI, New Delhi
Aldas Janaiah	National Seminar on Farmers' Suicides 10-11 June 2005	Council for Social Development-SRC, Hyderabad
	National Seminar on Capacity Building of Agri-business in India 22-23 June 2005	ANGRAU, Hyderabad
	National Consultation on Food Security for the Poor 27-29 June 2005	NIRD, Hyderabad
	Foundation Day Seminar on Rural Development and Social Change 8-10 November 2005	NIRD, Hyderabad
	National Workshop on Farmers' Suicide: Dynamics and Strategies of Prevention 28-29 November 2005	NIRD, Hyderabad

	Silver Jubilee Seminar on Development Perspectives: International Experiences and Lessons India Can Learn 7-9 January 2006	CESS, Hyderabad
	National Workshop on WTO and Agrarian Issues 13-14 February 2006	NIRD, Hyderabad
	National Workshop on Indian Cotton Farming at the Cross Roads: Strategies and Ways Forward 27-28 February 2006	Centre for Good Governance, Hyderabad
Sant Kumar	Happy Scientist: Happy Nation – How Can We Make Our Scientist Rich? 11 July 2005	ASSOCHAM House, New Delhi
	International Conference on Public-Private Partnerships for Harnessing the Potential of Rainfed Agriculture. 19–20 October 2005	FICCI House, New Delhi
	A Policy Retreat and Seminar on Agriculture, Food Security and Rural Development 28 November 2005	Hotel Hill View, Faridabad
	Brainstorming Workshop on WTO and Indian Agriculture Policy and R&D Implications 23 December 2005	NASC Complex, New Delhi
Suresh Pal	Workshop on NRM in Unfavourable Rice Environments 8-9 March 2006	IRRI, Dhaka (Bangladesh)
	Workshop on Genomics-based Germplasm Research 24-28 April 2005	Chinese Academy of Agricultural Sciences, Beijing (China)
	Annual Conference of Indian Society of Agricultural Economics 24-26 November 2005	PAU, Ludhiana

	Workshop on Scenario Planning for Indian Agriculture 5-7 July 2005	ICAR, New Delhi
	Public-Private Partnership in Agricultural Research 19-20 January 2006	ICAR, New Delhi
S. S. Raju	Policy Retreat and Seminar on Agricultural Food Security and Rural Development 27-28 November 2005	Hotel Hill View, Faridabad
	ICAR-ILRI International Workshop on Smallholder Livestock Production in India: Opportunities and Challenges 31 January-1 February 2006	NASC Complex, New Delhi
Rasheed Sulaiman V.	Workshop on Learning from Institutional Change 7-10 November 2005	NASC Complex, New Delhi
	Capacity Development Workshop on Applying Innovation Systems Concepts to Agricultural Research 22-24 November 2005	CRISP, Hyderabad
	Workshop on Learning with Financial Organizations for Enabling Rural Innovation 9-10 December 2005	NEDFI, Guwahati
Harbir Singh	Seminar on Peri-Urban Agriculture: Rural-Urban Synergy in Enhancing Food Security 9-10 June 2005	Amity School of Rural Management, New Delhi
	Pre-Hong Kong Ministerial Consultation: Agriculture Negotiations 19-20 July 2005	The Hotel Taj Mahal, New Delhi
	ICAR-IPA National Conference on IPR and Management of Agricultural Research 27-29 August 2005	NASC Complex, New Delhi

	ICAR-CITA Capacity Building Progarmme for Indian Agriculture Research, Extension and Development (RED) Organizations in Globalized Agricultural Economy 15-16 September 2005	IARI, New Delhi
	International Conference on Public-Private Partnership for Harnessing the Potential of Rainfed Agriculture 19-20 October 2005	FICCI House, New Delhi

XI. VISITS ABROAD

Name of Scientist	Purpose	Place	Duration
Ramesh Chand	Workshop on Indian Agriculture and Agricultural Policies, organized by Australian Bureau of Agriculture and Resource Economics	Canberra, Australia	1-3 July 2005
	Hunger and Food Security: New Challenges and New Opportunities, sponsored by ICSSR-UNU-WIDER	Helsinki, Finland	12-14 October 2005
	Programme Committee Meeting of the SAARC, preceding SAARC Summit	Dhaka, Bangladesh	8-9 November 2005
	Workshop on Economic Integration in Asia and India: What is the Best Way of Regional Cooperation?	Japan External Trade Organization (JETRO), Japan	8-9 December 2005
	Technical Committee Meeting and Governing Council Meeting of UN CAPSA	Bogor, Indonesia	24-27 January 2006
Aldas Janaiah	Training on Quantitative Methods for Policy Analysis: Multi-market Modelling	Colombo, Sri Lanka	25-29 July 2005
Suresh Pal	Workshop on Natural Resource Management in Unfavourable Environments	Dhaka, Bangladesh	8-9 March 2006
Rasheed Sulaiman V.	First Meeting of the Sub-global Authors of the East & South Asia and Pacific Region for the International Assessment of Agricultural Science and Technology for Development (IAASTD)	World Fish Centre, Penang, Malaysia	28 November to 1 December 2005

XII. POLICY ADVOCACY ACTIVITIES

International Workshop on Smallholder Livestock Production in India: Opportunities and Challenges

31 January-1 February 2006

Indian agriculture is dominated by smallholders. Over 31 per cent rural households are landless, and another 59 per cent operate on landholdings of 2.0 ha or less. For such households livestock is emerging as an important source of livelihood. Nevertheless, they face numerous constraints in production and marketing of livestock products. A two-day workshop entitled 'Smallholder livestock production in India: Opportunities and challenges' was organized in collaboration with the International Livestock Research Institute, Nairobi, Kenya, to identify technical, institutional and policy issues and to enable the smallholders to take advantage of the emerging opportunities. The following recommendations emerged from this Workshop:

(i) Improve smallholders competitiveness through markets, institutions and trade

- Identify factors for market failures (credit, insurance, inputs, technology and information) that prevent smallholders to participate in livestock production and marketing.
- Map supply chains for live animals and their products and sub-products and strengthen those chains that benefit most to the producers through public policy.
- Assess future demand for animal food products in terms of their quantitative and qualitative requirements, prices and other attributes.
- Evaluate and document benefits and costs of alternative institutional models such as contract farming, cooperatives and producers' organizations.

(ii) Strengthen the role of livestock in poverty alleviation, food security and environmental protection

- Understand and quantify the contribution of livestock to poverty reduction.
- Identify policy, institutional and technology options to make livestock growth more pro-poor.
- Risk mitigation, market access, credit, insurance, vulnerability and knowledge management to minimize smallholders' vulnerability to risks.
- Integrate smallholders in the process of industrialization of livestock.
- Equity and environmental impact of industrialization.
- Public policy support for participation of smallholders.

(iii) Increase livestock productivity

- Optimize livestock numbers in different production systems, commensurate with the available feed resources.
- Increase area under feed and forage crops to improve their availability.
- Accelerate adoption of improved technologies, nutrient supplementation, improved species of animals, etc.
- Check quantitative and qualitative deterioration of common grazing lands.
- Improve animal breeding and health care services.
- Empower livestock producers with information and knowledge.

Second Meeting of SAARC Technical Committee on Agriculture and Rural Development

27-28 June 2005

The Centre organized the second meeting of SAARC Technical Committee on Agriculture and Rural Development during 27-28 June 2005 in New Delhi. Dr Mangala Rai, Secretary, Department of Agricultural Research and Education, & Director General, Indian Council of Agricultural Research (ICAR), inaugurated and addressed the meeting. The meeting was attended by Director SAARC, delegation of all SAARC countries namely Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka including Director, SAIC.

Dr Mangala Rai, in his address suggested that South Asian countries should prepare *SAARC Agriculture Vision 2020* to provide perspective plan for future development of agriculture in the region by harnessing regional complementarities and facing common challenges. A large number of issues were deliberated in the meeting including Creation of SAARC Food Reserve, Water Resource Management for Agriculture, Exchange of Rural Development Volunteers in SAARC Countries, and collaboration with FAD/DIE on Trans-boundary Animal Diseases and Integrated Pest Management.

Policy Retreat and Seminar on Agriculture, Food Security and Rural Development

28 November 2005

As a part of technical assistance from Asian Development Bank, a project on '*Policy Research Networking to Strengthen Policy Reforms*' was launched in 2004. This involved preparation of series of papers by eminent scholars on various aspects of policy issues related to Indian Agriculture. The papers were commissioned by two hubs, namely, NCAP, New Delhi and Institute for Social and Economic Change, Bangalore. The papers covered a wide range of issues like sustainable water-use, rural employment and development, land policy, food security, research and extension, disaster management, capital formation, marketing and diversification.

A policy retreat and seminar was organized at Suraj Kund, Faridabad (Haryana) to share and discuss the findings of the papers prepared under the project. The retreat was attended by paper writers, academicians, policymakers, representatives of various ministries, international organizations and economic journalists.

XIII. LECTURES DELIVERED BY NCAP SCIENTISTS

Speaker	Title and Date	Venue
B. C. Barah	Stepping towards Adopting Agricultural Producer's Price Index in India: Problems and Prospects 7 December 2005	IARI, New Delhi
	Changing Pattern of Rice Productivity Growth in India: Implication for Research and Policy 15 December 2005	IARI, New Delhi
P. S. Birthal	Supply Chain Management in Agriculture 17 January 2006	IIM, Lucknow
Ramesh Chand	Agriculture Subsidies in the WTO: Are Developed Countries' Subsidies Hurting Indian Agriculture? 22 July 2005	Centad, New Delhi.
	Trends in Farm Income in India–Past, Present and Future 1-3 September 2005	FAI, New Delhi.
	Post-WTO Agriculture Trade, Food Security and Agenda for Agriculture Negotiations 17 September 2005	CUTS Centre for International Trade and Economics and Environment, New Delhi.
M. B. Dastagiri	New Seed Bill and IPR (Our preparedness and capacity building) 24-26 February 2006	ANGARU, Hyderabad
Rajni Jain	Computerization of Hindi: New Initiatives 17 December 2005	NCAP, New Delhi
Suresh Pal	Monitoring and Evaluation of Agricultural R&D 7 March 2006	IARI, New Delhi
	IPR and Indian Seed Industry 13 March 2006	IARI, New Delhi
Harbir Singh	TRIPS Provisions Relating to Agricultural Trade 16 December 2005	IARI, New Delhi
	TRIPS and Agriculture: Reflections on Policy Issues 10 March 2006	IARI, New Delhi

XIV. DISTINGUISHED VISITORS

Dr Wais Kabir, Director, SAIC, BARC Complex, Farmgate, New Airport Road, Dhaka – 1215, Bangladesh

Dr J.W. Taco Bottema, Director, CAPSA, Bogor 16111, Indonesia

Dr Luke Davies, First Secretary, Australian High Commission, 1/50 G, Shantipath, Chanakyapuri, New Delhi 110 021

Dr Chi Fulin, President, China Institute for Reform and Development, 57#Renmin Road, Haikou, Hainan, P.R.China

Dr Jamie M. Zimmerman, Associate Director, Globalization Studies, Washington Centre, The University of North Corlina at Chapel Hill, 1300 Pennsylvania Avenue, NW North Tower, Suite – 370, Washington, DC – 20004, USA

Dr Hiranya Mukhopadhyay, Economist, India Resident Mission, Asian Development Bank, 4 San Martin Marg, Chanakyapuri, New Delhi – 110 021

Dr Maurice R. Landes, Senior Economist, USDA / ERS/MTED, 1800 M Street, NW Washington, DC 20036, USA

XV. PERSONNEL

Scientific

Name	Designation	Area of Specialization
Ramesh Chand	Director (Acting)	Market and Trade, Agricultural Growth and Modelling
P. K. Joshi	Principal Scientist (on deputation to IFPRI)	Technology Policy, Sustainable Agricultural Systems
S. Selvarajan	Principal Scientist	Sustainable Agricultural Systems, Institutional Change
B. C. Barah	Principal Scientist	Agricultural Growth and Modelling, Sustainable Agricultural Systems
Suresh Pal	Principal Scientist	Technology Policy, Institutional Change
P. S. Birthal	National Fellow	Technology Policy Agricultural Growth and Modelling
Rasheed Sulaiman V.	Senior Scientist (Till 29 March 2006)	Institutional Change, Technology Policy
Aldas Janaiah	Senior Scientist	Technology Policy, Agricultural Growth and Modelling
M. B. Dastagiri	Senior Scientist	Market and Trade, Institutional Change
P. Adhiguru	Senior Scientist	Technology Policy, Institutional Change
S. S. Raju	Senior Scientist (Since 14.10.2005)	Market and Trade Technology Policy
Rajni Jain	Senior Scientist	Technology Policy
Anjani Kumar	Scientist (Sr. Scale) (on deputation to ILRI)	Technology Policy, Market and Trade
Sant Kumar	Scientist (Sr. Scale)	Technology Policy
Harbir Singh	Scientist (Sr. Scale)	Technology Policy, Institutional Change
P. A. Lakshmi Prasanna	Scientist (Sr. Scale) (on study leave)	Institutional Change

Technical

Name	Designation
Prem Narayan	Technical Officer (T-6)
Khyali Ram Chaudhary	Technical Officer (T-5)
Mangal Singh Chauhan	Technical Officer (T-5)
Sonia Chauhan	Technical Officer (T-5)
Satender Singh Kataria	Technical Assistant (T-2)

Administrative

Name	Designation
Narander Kumar	Assistant Administrative Officer (till 9th July 2005)
M. S. Vashist	Assistant Administrative Officer (12th August 2005 to 23rd February 2006)
Vinod Kumar	Assistant Administrative Officer (since 27th February 2006)
S. P. Ashra	Assistant Finance & Accounts Officer
M. S. Vashist	Assistant (till 11th August 2005)
S. K. Yadav	Assistant (since 17th August 2005)
S. K. Yadav	Upper Division Clerk (till 16th August 2005)
Inderjeet Sachdeva	Upper Division Clerk (since 17th August 2005)
Inderjeet Sachdeva	Lower Division Clerk (till 16th August 2005)
Sanjay Kumar	Lower Division Clerk
Umeeta Ahuja	Stenographer
Seema Khatter	Junior Stenographer
Mahesh Kumar	S.S.Gr II
Mahesh Pal	S.S.Gr I

XVI. TRAININGS ATTENDED

Scientist

Name of Scientists	Topic	Duration	Place
Rajni Jain	Development of Portals using LAMP Technology	1–21 February 2006	IASRI, New Delhi
Sant Kumar	Conceptual and Methodological Issues in the New Regime of International Agricultural Trade	29 November to 19 December 2005	IARI, New Delhi
Harbir Singh	Intellectual Property Rights and World Trade Organization Related Issues	5–9 December 2005	ASCI, Hyderabad
	Statistical Techniques for Agricultural Research with Emphasis on Use of Softwares	21 December 2005 to 10 January 2006	IASRI, New Delhi

Administrative

Name of official	Topic	Duration	Place
M. S. Vashisht	Improving Administrative Efficiency and Financial Management	2-9 December 2005	NAARM, Hyderabad
S. P. Ashra	Pension and Retirement: Benefits under New Pension Scheme	2-9 December 2005	NAARM, Hyderabad
Inderjeet Sachdeva	Finance Act 2005, Salient Aspects with Special Reference to TDS Audit Complexities and Company Taxation	20 August 2005	Institute of Socio-Economic Research and Action, Hari Nagar, New Delhi

XVII. OTHER INFORMATION

Promotion of Official Language

To promote and popularize the use of Hindi among the staff of the Centre, a Committee on Official Language (Hindi) is in place. It monitors the progress of works done in Hindi and suggests measures for improvement. It coordinates and helps in executing the Council orders from time to time and reports the progress.

The Official Language Committee of NCAP organized a series of events to celebrate 'Hindi Chetna Month' to create awareness among the staff about the use of Hindi. Essay writing, poem recitation, debate, knowledge of administrative words, etc. were some of them. The participation in these events was overwhelming. Dr C. D. Mayee, Chairman, Agricultural Scientists Recruitment Board, Prof. Dayanatha Jha, former National Professor, NCAP and Dr V. K. Gupta, Joint Director, IASRI, were chief guests at these events. Dr S. D. Sharma, Director of IASRI, and Dr B. C. Barah, Dr Suresh Pal, and Dr P. S. Birthal (all from NCAP) served as judges for the events. The prizes were distributed to the winners. The details of events and prize winners were as follows:

S. No.	Events	Prize winners
1.	Essay writing	A. K. Jha Sonia Chauhan Dheeraj Kumar Singh
2.	Poem recitation	A. K. Jha Dheeraj Kumar Singh Sonia Chauhan
3.	Debate	Sushil Kumar Yadav Gaurav Tripathi Sonia Chauhan
4.	Dictation	Khyali Ram Chaudhary A. K. Jha Sushil Kumar Yadav

The Committee also organized a workshop on 'Rajbhasha Implementation and Policy' on 17th December 2005 to promote the use of Hindi. Sri H. C. Joshi, Director (Hindi), ICAR Headquarters, Dr Ramesh Chand, Director (Acting) of NCAP, Dr Rajni Jain, Scientist, and Sri Prem Narayan, Technical Officer, from the Centre emphasized on the use of Hindi in day-to-day office activities.

Participation in ICAR Sports Meet

NCAP team comprising S. K. Yadav, Rajni Jain, Umeeta Ahuja, Sonia Chauhan, M. S. Chauhan, Prem Narayan, Khyali Ram Chaudhary, Sanjay Kumar, Seema Khattar, Inderjeet Sachdeva, Mahesh Kumar Khokhra, Mahesh Pal and Satender Singh Kataria participated in ICAR Zonal Tournament at Indian Agricultural Research Institute, Pusa, New Delhi, during 10-14 January 2006. Shri Inderjeet Sachdeva won the Third Prize in the 200-metre race.

विशिष्ट सारांश

राष्ट्रीय कृषि आर्थिकी एवम् नीति अनुसंधान केन्द्र की स्थापना वर्ष 1991 में भारतीय कृषि अनुसंधान परिषद् द्वारा की गई। इस केन्द्र की स्थापना का उद्देश्य राष्ट्रीय स्तर पर कृषि संबंधी नीति–संवादों एवं निर्णयों में परिषद् की सहभागिता को बढ़ाना है। विगत 15 वर्षो के अस्तित्व में केन्द्र ने कृषि शोध एवं नीतिगत विषयों में अपनी महत्ता दर्शायी है। वर्ष 2005-06 की अवधि में केन्द्र में 16 वैज्ञानिक (एक राष्ट्रीय अध्येता सहित) तथा 14 अन्य कर्मचारी कार्यरत थे, तथा इसका कुल बजट रूपये 390.59 लाख था।

केन्द्र के शोध-कार्यक्रमों को एक उच्च स्तरीय अनुसंधान सलाहकार समिति निर्देशित करती है तथा प्रबंध समिति शोध प्रशासन के विषय में सलाह देती है। इसके अतिरिक्त कई आंतरिक समितियां केन्द्र के विकेन्द्रीकृत प्रशासन प्रबंधन में सहयोग करती हैं। केन्द्र में शोध कार्य पाँच प्रमुख क्षेत्रों–तकनीकी नीति, कृषि में स्थायित्व, विपणन एवं व्यापार, संस्थागत बदलाव तथा कृषि वृद्धि एवं माडलीकरण में किये जाते हैं। प्रत्येक क्षेत्र में शोधकार्य वरिष्ठ कृषि अर्थशास्त्रियों की देख-रेख में किये जाते हैं। वर्ष 2005-06 की अवधि में किये गये शोध-कार्यों एवं गतिविधियों की प्रगति का संक्षिप्त विवरण निम्नवत है:

कृषि शोध के प्रभाव का विश्लेशण प्रकाशनों एवं तकनीकों को ध्यान में रखकर किया गया। विश्लेषण दर्शाता है कि 1990 के दशक में कुल प्रकाशनों (आई.सी.ए.आर एवं कृषि विश्वविद्यालयों) की प्रवृत्ति में वृद्धि 1980 के दशक की तुलना में अधिक थी। लेकिन इनमें से बहुतायत प्रकाशनों (80 प्रतिशत) के नॉन एस. सी. आई. (non-SCI) पत्रिकाओं में छपने के कारण उनका कारक प्रभाव नगण्य था। शेष प्रकाशनों का कारक प्रभाव शून्य से दो के बीच था। Non -SCI पत्रिकाओं में प्रकाशन की बढ़ती प्रवृति एक चिंता का विषय है। तकनीकी विकास का विश्लेषण दर्शाता है कि फसलों की विभिन्न उत्पादन स्थितियों के अनुसार किस्मों, उन्नत विधियों तथा कम साधन चाहने वाली एवं वातावरणीय दृष्टि के अनुकूल तकनीकों का विकास किया गया है। कृषि के उपक्षेत्रों-पशुपालन, कुक्कुट एवं मत्स्य पालन आदि क्षेत्रों के लिए भी तकनीकों का विकास किया गया है, लेकिन इनमें अधिक पूँजी की आवश्यकता के कारण इनके वाणिज्यिक प्रभाव में अपेक्षाकृत कम वृद्धि हुई है। कृषि में निवेश संबंधी अध्ययन बताते हैं कि कृषि के विकास के लिए निवेश एक प्रभावी विकल्प है। इससे कुल कारकों की उत्पादकता में वृद्धि होती है जोकि गरीबी (ग्रामीण क्षेत्रों) को दूर करने में महत्वपूर्ण है। तथापि, 1990 के दशक के उत्तरार्ध के वर्षों में कृषि वृद्धि दर में आयी गिरावट, उन्नत कृषि तकनीकों को किसानों तक पहुँचाने तथा कृषि शोध एवं विकास मे अधिक निवेश की आवश्यकता पर बल देते हैं।

भारतवर्ष में चावल एक बहुत ही महत्वपूर्ण खाद्य पदार्थ है। विगत वर्षों में तकनीकी विकास के बावजूद, 'कुल कारकों की उत्पादकता' वृद्धि दर में कमी तथा उत्पादकता स्तर में ठहराव आ गया है। जोकि कृषि वैज्ञानिकों एवं नीति निर्माताओं के लिए महत्वपूर्ण चुनौती है। चावल की उत्पादकता स्तर में वृद्धि दो प्रमुख तरीकों–तकनीकी साधनों एवं किसानों की उत्पादन विधियों में बदलाव लाकर किया जा सकता है। इस संबंध में चावल उत्पादन की नवीन तकनीकी 'सघन चावल प्रणाली' के सामाजिक-आर्थिक पहलुओं तथा इसके अपनाये जाने के विभिन्न आयामों का अध्ययन किया जा रहा है। तथ्यों से पता चला है कि इस नवीन तकनीकी को अपनाकर उत्पादकता स्तर में 1 से 2 टन प्रति हेक्टेयर की अतिरिक्त वृद्धि प्राप्त की जा सकती है। इस तकनीकी के अपनाने से सिंचाई के पानी की बचत, भूमि एवं पौधों की जैविक क्रियाओं में वृद्धि तथा बीज की बचत होती है। अध्ययन के सन्दर्भ में एक प्रक्षेत्र सर्वेक्षण दक्षिण भारत के राज्यों–आंध्रप्रदेश, कर्नाटक एवं तमिलनाडु में किया जा रहा है। छोटे किसानों के लिए इस लाभकारी तकनीक से पारिवारिक खाद्य-सुरक्षा में वृद्धि तथा उत्पादन कारकों के प्रयोग में कमी की संभावना है जो कि समय की माँग है। भविष्य में यह तकनीक चावल उत्पादकों के लिए वरदान साबित हो सकती है।

भारत की 65 प्रतिशत जनता का मुख्य भोजन चावल है। विगत पचास वर्षों में चावल के उत्पादन स्तर में चार गुने से अधिक की बढ़ोत्तरी के बावजूद, इसके उपज स्तर में क्षेत्रवार काफी विषमता है। इसके अतिरिक्त 1990 के दशक के उत्तरार्ध के वर्षों में प्रमुख उत्पादन क्षेत्रों में इसकी उत्पादकता में ठहराव आया है जोकि इसके सतत् वृद्धि में व्यवधान डाल रहा है। अध्ययन से स्पष्ट है कि विगत दो दशकों में चावल उत्पादन में वृद्धि दर की स्थिति में उल्टापन शुरू हो गया है। उत्पादन वृद्धि की ऐसी प्रवृत्ति खाद्य–सुरक्षा की दृष्टि से खतरनाक है। चावल के उपज स्तर में क्षेत्रवार विषमता के कारण इसकी प्रति हेक्टेयर उपज 2.1 टन बारानी क्षेत्रों में तथा 5.8 टन पंजाब के सिंचित क्षेत्रों में है। यह विषमता, चावल उत्पादकों को अपेक्षित तकनीक नहीं मिलने की तरफ इशारा करती है। अध्ययन से स्पष्ट है कि हाल के वर्षो मे आई गिरावट तथा परिस्थितिकीय प्रभाव के कारण प्रमुख चावल उत्पादन क्षेत्र में कमी आ सकती है जोकि खाद्य–सुरक्षा के लिए खतरनाक है। पूर्वी भारत के बारानी क्षेत्रों में चावल उत्पादन की अपार संभावनाओं का समुचित दोहन करने के लिए नीतियों एवं उत्पादन परिस्थितियों में आवश्यक बदलाव तथा मजबूत आधार तैयार करने की जरूरत है। इसके अतिरिक्त अधिक उपज देने वाली तकनीकों, उत्पादन कारकों की क्षमता बढ़ाने, कृषि में विविधीकरण तथा विकास योजनाओं के समुचित कार्यान्वयन की जरूरतें, आदि मुद्दे चावल उत्पादन में महत्वपूर्ण हैं।

भारतीय कृषि में तिलहन उत्पादन का महत्वपूर्ण स्थान हैं। देश में 1990 के दशक के उत्तरार्ध के वर्षों में तिलहन उत्पादन में लगातार गिरावट तथा उत्पादकता स्तर में उतार-चढ़ाव देश की अर्थव्यवस्था पर व्यापक प्रभाव डाल रहा हैं। अंतर्राष्ट्रीय बाजारों में खाद्य–तेलों के मूल्यों तथा उपज में अस्थिरता की प्रवृत्ति, इनके उत्पादन एवं उपभोग की स्थिति को काफी प्रभावित करते हैं। एक अध्ययन में चार प्रमुख खाद्य तिलहनों–मूँगफली, सरसों/तोरिया, सूरजमुखी एवं सोयाबीन के उत्पादन एवं आपूर्ति संबंधो में अस्थिरता के कारणों का विश्लेषण किया गया। विश्लेषण दर्शाता है कि तिलहनों की उत्पादकता, मूल्य एवं इनसे प्राप्त कुल आय की अस्थिरिता का प्रभाव मिला-जुला रहा, जबकि सहचरों (covariance) के जोखिम में वृद्वि हुई है। अर्थमिति विश्लेषण संकेत देता है कि संभावित मूल्य एवं मूल्य जोखिम, तिलहनों के उत्पादन में मुख्य कारक हैं। तिलहन उत्पादक, मूल्य जोखिम एवं संभावित मूल्य को ध्यान में रखकर तिलहनों के उत्पादन की मात्रा एवं दिशा तय करते हैं।

1980 के दशक से वारानी क्षेत्रों में कृषि उत्पादन में क्रमिक वृद्धि प्रमुख रूप से उपज में वृद्धि के कारण हुई है। वारानी क्षेत्रों में उपज में काफी विषमताएँ हैं, जिसे फसलों की उचित देखभाल से कम किया जा सकता है। उपज एवं आय मे आई कमी को अनेक उपायों (पूर्व एवं बाद) को ध्यान में रखकर दूर किया जा सकता है। उपायों में प्रमूख रुप से खाद्यान्न वितरण तथा रोजगार सृजन कार्यक्रमों, जो कि गरीबों के लिए लाभदायक हों चलाये जाने चाहिए। दूसरे अन्य उपाय जैसे कि फसल बीमा, संस्थागत ऋण, और कृषि उत्पादन का बागवानी फसलों की तरफ झुकाव, जो कि क्षेत्र विशेष के लिए उपयुक्त हों, विकसित एवं कार्यान्वित किये जाने चाहिए।

कृषि-वृद्धि एवं गरीबी निवारण में पशुपालन क्षेत्र का महत्वपूर्ण योगदान है, जोकि भारत तथा विकासशील देशों के लिए काफी सटीक बैठता है। भारत में छोटे किसान कुल पशुपालन के 70 से 90 प्रतिशत हिस्से पर काबिज हैं। अध्ययन से स्पष्ट है कि पश्चिम बंगाल, तमिलनाडु, केरल, कर्नाटक, हरियाणा, पंजाब तथा महाराष्ट्र प्रान्तों में पशुपालन क्षेत्र में बेहतर सुधार से 1983–84 से 1997–98 की अवधि में गरीबी स्तर (ग्रामीण क्षेत्रों) में कमी हुई है जबकि इसके विपरीत असम, मध्य प्रदेश, राजस्थान तथा उत्तर प्रदेश आदि प्रान्तों में पशुपालन क्षेत्र में आवश्यक सुधार न होने से गरीबी स्तर में अपेक्षित कमी नहीं हुई है।

पशुओं के समुचित विकास के लिए चारे एवं संकेन्द्रित पशुआहार अहम् हैं। इनकी जरूरतों का अध्ययन पशु प्रजातियों, उम्र, लिंग, एवं कार्य के प्रकार के आधार पर देश के 10 प्रमुख क्षेत्रों (पशुपालन की दृष्टि से महत्वपूर्ण) में वर्ष 2001-02 में किया गया। अध्ययन में 420 मिलियन टन हरे चारे, 510 मिलियन टन सूखे चारे तथा 55 मिलियन टन अनाज के उपभोग का आकलन किया गया। पशुओं को खिलाये गये अनाज की मात्रा, अध्ययन वर्ष में कुल उत्पादित अनाज का 12 प्रतिशत (23 मिलियन टन) थी। इसके विपरीत, 'राष्ट्रीय कृषि आयोग' (1976) ने मोटे अनाजों के कुल उत्पादन का केवल 2 प्रतिशत का अनुमान पशुओं को खिलाने में व्यक्त किया था।

आकड़ों के हिसाब से भारतीय पशुओं की संख्या का विश्व में पहला स्थान है। इनके द्वारा ग्रीन हाउस गैसों के उत्सर्जन का वातावरण पर पड़ने वाले प्रभाव की आलोचना की जा रही है। वर्ष 2001–02 अवधि में पशुपालन की दृष्टि से महत्वपूर्ण 10 प्रमुख क्षेत्रों के अध्ययन से स्पष्ट हुआ है कि पशुओं का वातावरणीय प्रभाव सकारात्मक है एवं इनके पालन से अनेक लाभ हैं।

दुग्ध उत्पादन में क्रान्तिकारी वृद्वि के बावजूद, दुधारू पशुओं की उत्पादकता कम है, क्योंकि इनके पालन में बहुत सी समस्याएं हैं जोकि अधिक आर्थिक नुकसान पहुचाती हैं। दुग्ध उत्पादन में आर्थिक नुकसान का आँकलन तथा समस्याओं की पहचान के लिए देश के 9 प्रान्तों (पशुपालन दृष्टि से महत्वपूर्ण) — आंध्रप्रदेश, हरियाणा, कर्नाटक, झारखण्ड, महाराष्ट्र, मध्य प्रदेश, राजस्थान, उत्तर प्रदेश तथा पश्चिम बंगाल के 54 गावों में वर्ष 2002–03 में एक अध्ययन किया गया। अध्ययन दर्शाता है कि दुग्ध उत्पादन से आर्थिक नुकसान, कुल संभावित उत्पादन का 26 प्रतिशत है। नस्लों के आधार पर सबसे अधिक नुकसान (38 प्रतिशत) देशी गायों, उसके बाद भैंसों एवं संकर गायों में मिला। समस्याओं के संबंध में विश्लेषण दर्शाता है कि किसानों ने दुग्ध उत्पादन में संकेन्द्रित पशुआहारों की कमी को सबसे महत्वपूर्ण समस्या बताया। समस्याओं के क्रम में प्रजनन तथा स्वास्थ्य एवं प्रबंध संबंधी समस्याएं बतायी। देशी गायों में प्रजनन की समस्या (अनउर्वरता) तथा भैंसों में ब्यॉत की लम्बी अवधि जैसी समस्याएं प्रमुख रूप से पहचान में आईं। पोषण संबंधी समस्याओं में प्रमुख रूप से हरे चारे तथा खनिज लवणों की कमी पायी गयी। बीमारियों एवं कीटों में प्रमुख रूप से मैसटाईटिस, खुरपका–मुँहपका, ब्रूसेलोसिस, थेलरोसिस, तथा टिक्स, आदि प्रमुख थे।

भारतीय बीजतंत्र में काफी बदलाव आया है। 1960 के दशक में 'राष्ट्रीय बीज निगम' की स्थापना, सन् 1988 में 'नई बीज नीति', तथा 1991 से अर्थव्यवस्था में व्यापक सुधार आदि उपायों ने भारतीय बीजतंत्र की कायापलट कर दी है। नयी बीज नीति तथा आर्थिक सुधारों ने निजी क्षेत्रों की कम्पनियों को कई नये अवसर प्रदान किये हैं। निजी क्षेत्र, विशेष रूप से कपास, चावल, मक्का, सब्जियों, आदि के बीजों के व्यापार में काफी अहम भूमिका निभा रहा है, जबकि आलू एवं मूंगफली जैसी फसलों के बीजों में इसकी हिस्सेदारी बहुत कम (20-35 प्रतिशत) है। ऐसा इन फसलों के बीज पैदा करने में अधिक निवेश की जरूरतों, कम लाभ तथा इन बीजों के भारी स्वभाव के कारण है। विश्लेषण दर्शाता है कि किसान इन फसलों की उन्नत किस्मों के बारे में जानकारी अपने नजदीकी किसान मित्रों तथा निजी क्षेत्र के कृषि व्यापारियों से प्राप्त करते हैं। यह स्थिति प्रसार-तंत्र एवं बीजतंत्र की कार्यक्षमता पर सवालिया निशान खड़ा करता है। साथ ही यह जरूरी तकनीकों को किसानों तक पहुँचाने, तथा निजी एवं नागरिक समितियों के साथ सहभागिता विकसित करने की जरूरत पर बल देता है। इसके अतिरिक्त, बीज के प्रावधानों, बौद्धिक संपदा सुरक्षा अधिकार, संस्थागत क्षमता के विकास तथा अनुभवों से सीख लेकर इसमें यथोचित बदलाव की आवश्यकता है।

एशिया के 13 देशों के कृषि बीजों के प्रावधान का विश्लेषण विश्व व्यापार संगठन एवं जारी आर्थिक सुधारों के सन्दर्भ में किया गया। विश्लेषण दर्शाता हैं कि संस्तुत किस्मों के बीजों का प्रमाणीकरण एवं निर्धारण इनके विक्रय के लिए अत्यन्त

जरूरी है। निजी क्षेत्रों की कम्पनियों को बीजों के व्यापार में प्रोत्साहित किया जाना चाहिए। कृषि बीजों के अप्रभावी प्रावधानों में सुधार लाने से स्थानीय बीज कम्पनियों की अंतर्राष्ट्रीय बाजार में पहुंच बढ़ी है।

'सूचना संचार तकनीकी' किसानों को सही समय एवं उचित कीमत पर सूचना उपलब्ध कराने का एक संभावित विकल्प है। किसानों द्वारा प्रयोग में लाई जा रही तीन सूचना तकनीकों---ई-चौपाल, आई-किसान तथा हेल्पलाइन---के अध्ययन का विश्लेषण दर्शाता है कि इनके प्रयोग से खेती संबंधी जानकारी प्राप्त करने में लगने वाले समय की बचत के साथ इनकी प्राप्ति लागत में 90 से 95 प्रतिशत की कमी आती है तथा उत्पादों के सही समय पर निस्तारण संबंधी निर्णय लेने और आकर्षक मूल्य की प्राप्ति में मदद मिलती है। अध्ययन से स्पष्ट है कि संचार तकनीकों के प्रयोग से किसानों को सर्वाधिक लाभ उठाये जाने के लिए प्रेरित किया जाए।

भारतवर्ष के ग्रामीण क्षेत्रों में लोक-कल्याणकारी संस्थाओं के विकास की परपंरा रही है। इनकी पर्याप्त संख्या ग्रामीण जीवन में महत्वपूर्ण बदलाव ला सकती है। इन संस्थाओं के प्रति समुचित ध्यान नहीं दिये जाने से किसानों को खेती संबंधी अपेक्षित सूचनाओं, एवं तकनीकों से वंचित रहना पड़ रहा है, जिससे ग्रामीण क्षेत्रों में अनेक प्रकार के जोखिम पैदा हो रहे हैं और विकास प्रक्रिया बाधित हो रही है। ग्रामीण संस्थाओं के एक अध्ययन में पता चला है कि मूल्यरहित विकास की गति ने इन संस्थाओ को कमजोर किया है। वर्तमान में विकास संस्थाओं जैसे पंचायतीराज, स्वयं-सेवी संस्थाएँ तथा गैर-सरकारी संस्थान आदि अपेक्षित विकास एवं प्रभाव छोड़ने में विफल रहे हैं। इसलिए इन ग्रामीण संस्थाओं के नियम एवं कायक्रमों की जानकारी करनी जरूरी हैं जो कि इनकी रीढ़ है, साथ ही में इनकी कार्यविधि में आवश्यकतानुरूप बदलाव भी जरूरी हैं।

एक अध्ययन में वर्ष 2011 में यूरिया की माँग का विश्लेषण विभिन्न स्थितियों के संदर्भ में किया गया। स्थिति के समान रहने पर, यूरिया की माँग में प्रतिवर्ष 3.4 प्रतिशत की वृद्धि दर का अनुमान है। जोकि लगभग 25 मिलियन टन के करीब पहुँचता है, जबकि वर्ष 2002-03 में यूरिया की माँग लगभग 19 मिलियन टन थी। 'आर्थिक सहायता' समान रहने की स्थिति में, यूरिया की माँग का अनुमान लगभग 24 मिलयन टन व्यक्त किया गया है जोकि लगभग 3 प्रतिशत की वृद्धि दर से बढ़ने का संकेत देता है। सिंचाई क्षेत्र में वृद्धि (एक प्रतिशत) तथा कुल कृषित क्षेत्र में वृद्धि (0.25 प्रतिशत) की स्थितियों में यूरिया की माँग में 4 प्रतिशत के प्रतिवर्ष वृद्धि दर का अनुमान है जोकि करीब 26 मिलियन टन बैठता है। 'राष्ट्रीय कृषि नीति प्रारूप' में इंगित 4 प्रतिशत की वृद्धि दर हासिल करने के लिए सिंचाई क्षमता में वृद्धि तथा अधिक उपज देने वाली उन्नत किस्मों के बीजों में 2 प्रतिशत की दर से वृद्धि आवश्यक है। उपरोक्त स्थितिं में यूरिया की दर में 4.6 प्रतिशत वृद्धि की संभावना है जिससे यूरिया की कुल माँग 27.4 मिलियन टन होगी। विश्लेषण नतीजों के आधार पर कहा जा सकता है कि वर्ष 2011 के अन्त तक कृषि उत्पादन में कम वृद्धि दर की स्थिति में 24.1 मिलियन टन तथा अधिक वृद्धि दर की स्थिति में 27.4 मिलियन टन यूरिया की जरूरत होगी।

देश की अर्थव्यवस्था में अपेक्षित वृद्धि के लिए कृषिक्षेत्र में वृद्धि आवश्यक होती है। भारत में कृषिक्षेत्र की वृद्धि दर में 1990 के दशक के उत्तरार्ध के वर्षों में तेजी से कमी आई है, जबकि 'कृषि नीति प्रारूप' में इस क्षेत्र में 4 प्रतिशत वृद्धि का लक्ष्य रखा गया है। कृषि में प्रतिवर्ष 4 प्रतिशत की अपेक्षित वृद्धि हासिल करने के लिए इसके विभिन्न स्रोतों तथा वृद्धि की संभावना का अध्ययन किया गया। अध्ययन से प्राप्त परिणाम से पता चलता है कि कृषि में वृद्धि दर पंजाब में एक प्रतिशत से कम तथा बिहार में 6 प्रतिशत से अधिक की संभावना है। हरियाणा एवं राजस्थान प्रान्तों में कृषि वृद्धि दर कम रहने (1.7 से 2.3 प्रतिशत) तथा महाराष्ट्र, हिमाचल प्रदेश और पश्चिम बंगाल में 5 प्रतिशत से अधिक वृद्धि दर का

अनुमान है। कृषि में अपेक्षित 4 प्रतिशत की वृद्धि दर प्राप्ति के लिए उर्वरकों के प्रयोग में 4.3 प्रतिशत तथा सिंचाई सुविधा में 1.9 प्रतिशत की वृद्धि करनी आवश्यक है। इसके अतिरिक्त खाद्यान्न फसलों के क्षेत्र में 0.5 प्रतिशत की कमी तथा 'कुल कारकों की उत्पादकता' में 0.7 प्रतिशत वृद्धि, कृषि में अपेक्षित लक्ष्य पाने के लिए जरूरी हैं।

'कृषि शिक्षा में महिलाओं की स्थिति' में प्रदेशवार काफी विषमता है। इस संदर्भ में एक अध्ययन देश के 10 कृषि विश्वविद्यालयों में किया गया। अध्ययन से पता चला है कि कृषि शिक्षा में केरल प्रान्त में 49 प्रतिशत तथा उत्तर प्रदेश में केवल 5 प्रतिशत महिला विद्यार्थी हैं। अध्ययन दर्शाता है कि कृषि शिक्षा में महिलाओं की स्थिति सुदृढ़ करने के लिए यातायात के साधन, आवास सुविधा तथा सुरक्षा संबंधी महत्वपूर्ण विषयों पर ध्यान दिया जाना चाहिए।

भारतीय कृषि बहुत सारी अनअपेक्षित स्थितियों एवं उतार-चढ़ाव से रूबरू होती है। अनअपेक्षित स्थितियों से उबरने में कृषि बीमा एक प्रमुख माध्यम है। अथक प्रयासों के बावजूद, कृषि बीमा संबंधी योजनाओं का विस्तार अपेक्षा से कम है। एक जारी शोध अध्ययन 'भारत में कृषि-बीमा में समस्याएं एवं समाधान' में इसके और अधिक प्रभावी बनाने तथा क्षेत्र में विस्तार आदि नीतियों के प्रति अपेक्षित सुझाव की आशा है।

डायनैमिक आरडीटी मॉडल का विकास एवं परीक्षण, खाद्य-सुरक्षा से प्रभावित परिवारों की पहचान के लिए किया गया। इस संदर्भ मे एलडीए तकनीक के प्रयोग से प्राप्त परिणाम को आधार मानकर आरडीटी मॉडल से प्राप्त परिवार की तुलना करने पर पता चला कि प्रस्तावित मॉडल से प्राप्त परिणाम काफी सटीक थे।

फसलों की बीमारियों के पूर्वानुमान से उपज नुकसान में कमी के साथ किसानों तथा संबंधित संस्थाओं को बचाव के कदम उठानें के लिए सतर्क किया जा सकता है। तीन मशीन लर्निंग तकनीकों जैसे डी टी इन्डक्शन, रफसेट तथा आरडीटी से प्राप्त परिणामों का तुलनात्मक अध्ययन एलआर तकनीक से प्राप्त परिणाम से किया गया। इनका प्रयोग आम की बीमारी 'चूर्णिल आसिता' से होने वाले नुकसान के आँकलन हेतु किया गया। इस भयानक बीमारी से आम की उपज में 20 से 90 प्रतिशत की कमी आती है। मशीन लर्निंग तकनीकों से प्राप्त परिणाम, एलआर तकनीक से प्राप्त परिणाम की अपेक्षा अच्छे थे।

फसलोत्पादन एवं पशुपालन कृषि के दो प्रमुख उपक्षेत्र हैं। देश के सकल घरेलू उत्पाद में फसलोत्पादन से प्राप्त आय का हिस्सा दिनोंदिन घट रहा है, जबकि पशुपालन एवं मत्स्य पालन की हिस्सेदारी बढ़ रही हैं। कृषि में यह प्रवृत्ति इसके अधिक मूल्यवाली कृषि फसलों /उद्यमों की तरफ बढ़ने का इशारा करती है। अध्ययन विश्लेषण बताता है कि कृषि से प्राप्त आय में 1980 के दशक की अपेक्षा 1990 के दशक में देश स्तर पर कमी आई है। राज्यवार ऐसी ही प्रवृत्ति, केवल आंध्रप्रदेश को छोड़कर, मिलती है। जबकि पशुपालन एवं मत्स्य पालन क्षेत्रों में 1980 तथा 1990 के दशको में वृद्धि दर अच्छी रही है; ऐसी ही स्थिति फसल, पशुपालन एवं मत्स्य पालन क्षेत्रों में 'कुल कारको की उत्पादकता' में हुई वृद्धि में मिलती है। इसके अतिरिक्त सरकारी निवेश में 1980 के दशक से निरंतर कमी तथा निजी निवेश में वृद्धि की स्थिति मिली है, फिर भी निजी क्षेत्र के निवेश में हो रही वृद्धि सरकारी निवेश में आ रही कमी को दूर करने में समुचित रूप से सहायक नहीं है। व्यापार एवं वृहद आर्थिक सुधार, कृषि शोध एवं विकास में दीर्घकालिक निवेश तथा कृषि के उपक्षेत्रों में तकनीकी बदलाव, कृषि क्षेत्र के समुचित विकास की आवश्यकता का बयान करते हैं।

केन्द्र की वेबसाइट (http://www.ncap.res.in) को अद्यतन एवं पुनर्व्यवस्थित कर दिया गया है। केन्द्र के प्रकाशन अब पी डी एफ प्रारूपों में उपलब्ध हैं जिन्हे प्रिंट कर प्राप्त किया जा सकता है। इस केन्द्र द्वारा विकसित एवं संचालित वेबसाइट, 'कृषि अर्थशास्त्रियों के सूचना तंत्र' (http://www.agrieconet.nic.in) द्वारा शोध से संबंधित सूचनाओं का

विनिमय, शोध संसाधनों का बटवारा एवं शोध पद्वति से संबंधित समस्याओं के समाधान किया जाता है। केन्द्र में स्थापित कृषि शोध एवं सूचना प्रणाली, केन्द्र की ईमेल एवं इंटरनेट जरूरतों के साथ-साथ शोध विश्लेषण एवं सूचना प्रबंधन में भी सहयोग प्रदान कर रहा है।

केन्द्र ने वर्ष 2005-06 के दौरान एक नीति पत्र (Policy Paper), तीन नीति सार (Policy Brief) तथा पाँच पुस्तकों का प्रकाशन किया है। केन्द्र के वैज्ञानिकों ने अनेक व्यावसायिक, पारस्परिक तथा नीति परामर्श परियोजनाओं मे भाग लिया तथा केन्द्र में एवं केन्द्र के बाहर अनेक बैठकों का आयोजन किया। केन्द्र ने विभिन्न राष्ट्रीय एवं अंतराष्ट्रीय शोध संस्थाओं से अपने संबंधों को सुदृढ़ किया है। उपरोक्त प्रयासों से केन्द्र ने वर्ष 2005-2006 के दौरान अपनी उपस्थिति को काफी प्रभावशाली ढंग से व्यक्त किया है।

OBITUARY

Prof. Dayanatha Jha passed away on 24th October 2006 after a brief illness at his residence. His passing away, the agricultural economics community has lost its mentor, his friends have lost a guide and companion, and the society has lost a philosopher and great thinker.

He was born on 10th March 1940 in Kishanganj (Bihar) in a reputed Maithili familiy. He graduated in 1960 from Bihar University and obtained his Master's degree in Agricultural Economics in 1963 from Ranchi University. After serving the Government of Bihar and the Bihar University for a short period, Prof. Jha joined the Indian Agricultural Research Institute (IARI), New Delhi, to pursue his Doctoral degree which he completed in 1969. His doctoral dissertation on sugarcane acreage response model is regarded a pioneering work in the field. His sportsmanship, team spirit and leadership qualities were acclaimed since his student days.

Prof. Jha started his carrier as Assistant Professor at the Division of Agricultural Economics, IARI in 1968. He became Senior Economist (Scientist S-3) in 1975 and Professor of Agricultural Economics in 1980. He was a Visiting Scientist at the International Crops Research Institute for Semi-Arid Tropics (Patancheru) during 1978-80. He joined International Food Policy Research Institute (Washington, DC, USA) in 1982 and worked there as Senior Research Fellow for a decade. In 1992, on his return to India in response the initiative of the then Honourable Prime Minister to bring back Indian scholars working abroad, he joined as Principal Scientist at the National Centre for Agricultural Economics Policy Research (NCAP). In 1995, he became the Director of NCAP and served in this capacity until his superannuation on 31st March 2000. In recognition to his outstanding professional and institutional contributions, he was awarded ICAR National Professorship in July 2000.

Prof. Jha was a man of great vision and professional wisdom. His contributions in the area of agricultural research policy and technological change are recognized internationally. His work on research investment and its impact on agricultural productivity and growth, and resource allocation is a seminal contribution. His-in-depth understanding of micro-dimension of technological change such as fertilizer response in dryland areas, pest and irrigation management, small farm considerations, and supply response is widely acclaimed. It was due to Prof. Jha's vision and leadership that NCAP became a centre of excellence and an institution of international repute. Indian agricultural economics profession rose to a new height and gained unprecedented visibility.

Prof. Jha bestowed with several awards and recognitions. The Indian Society of Agricultural Economics honoured him by electing as its President in 2000. In 1998, he became the second agricultural economist to be a Fellow of the National Academy of Agricultural Sciences. He was President of the Agricultural Economics Research Association (India) from 1996 to 1999 and during this period the Association became a matured professional body. He served as Member of

Editorial Board of the Indian Journal of Agricultural Economics and Editor of the Agricultural Economics Research Review for a long time. He was also associated with a number of national and international academic organizations, professional bodies and government committees in various capacities.

Prof. Jha had uncommon professional and personal qualities which any academician would like to emulate. Advancement of the agricultural economics profession and institutional development were very close to his heart and he tirelessly pursued these objectives through team work. His acumenship, exceptional communication skills, and humane approach attracted many friends and admirers irrespective of their age and position. His colleagues and student cherished his scintillating thoughts even beyond classroom and office boundaries. His deeds and teachings will always enlighten and inspire us to achieve 'the best'. We pray to the Almighty for the peace of the departed soul!

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