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RESEARCH PAPER

Agricultural research and education: new ideology and innovations

Mruthyunjaya[1]

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Abstract
India has one of the largest agricultural research and education systems in the world. Thanks to the foresight and vision of our planners and policy makers that they have given priority to it by substantial funding support. It has significantly contributed to increasing agricultural production through several breakthroughs in technologies beginning with the green revolution. But there has been criticism in recent years about its inability to give major breakthroughs in the yields of staple cereals (rice & wheat), pulses and oilseeds as well as reorient itself to the fast-changing agriculture development context. In other words, it is criticized to be inefficient, if not fully irrelevant. This is attributed to some structural faults like the drifting of research, extension and education from one another, institutional proliferation, design rigidities like too much focus on production, the dominance of genetic enhancement in neglect of alternative options, centralization, HRD failures (quantity and quality), bureaucratization, poor and ineffective M & E system, poor sustainability of efforts after the existence of every mega external project assistance, distance/disconnect from clients and no/less dialogue with policy makers, stakeholders and the public at large. To overcome some of these structural faults, the system is pursuing new ideologies and innovations through fresh initiatives to put research into more use for promoting livelihood security and commerce in agriculture, strengthen basic and strategic research in frontier areas of agricultural sciences, and accessing scientific advances and knowledge explosion taking place in developed countries. The lecture commemorating the contributions and human qualities of Prof. L.S. Venkataraman provides details of three such fresh initiatives, namely the national agricultural innovation project, National fund for basic and strategic research in frontier areas of agricultural sciences, and Indo-US Knowledge initiatives in agriculture.

Keywords Agricultural research · Innovation · Education system · New ideology

L.S. Venkataramanan Memorial Lecture; This lecture was delivered by Dr Mruthyunjaya at the Institute for Social and Economic Change, Bangalore (ISEC) as the LSV Memorial Lecture on August 25, 2007. The article was submitted to ISEC for possible publication and circulation. This lecture is presented here in its original version.

✉ Mruthyunjaya
mruthyunjaya1947@gmail.com

[1] Formerly National Agricultural Innovation Project (NAIP), Indian Council of Agricultural Research, New Delhi, India

A tribute

I feel too small (pigmy) and humble to speak on this solemn occasion to commemorate Prof. L.S. Venkataraman (LSV), a towering personality with sharp intellect and outstanding personal qualities. I have met him, and was inspired by him. He was in fact, inspiring anybody by discovering the unknown abilities and providing tips to channelize them for achievements. I have read some of his contributions and listened about him from teachers and friends who were close to him. He enriched our profession enormously. Much before he could achieve his mission to make it the best, he was snatched away by almighty like Adi Shankara and Ms. Kalpana Chawala. It is an irreparable loss. My ramblings[1] *(Todalanudi)* today on a subject of his interest and contributions is my token tribute and humble homage to Prof. LSV on this occasion.

Indian agricultural research and education system: in retrospect

Today's lecture reflects my understanding of the Agricultural Research and Education System as it has evolved over the years and how it is re-orienting to remain efficient and relevant by pursuing new ideology and innovation. In this context, I would like to draw your attention to one of the earlier Prof. LSV Memorial Lectures by late Dr. D. Jha in 2003 on "Crisis in Agricultural R&D in India: The Road Ahead". He had begun the lecture with a provocative proposition, "Even if we get all the financial support we seek, we shall not be able to reach the goal of creating a globally competitive R&D infrastructure." He argued in the lecture why he had this view and outlined what to do (road map) if we have to become globally competitive. His diagnosis listed 10 structural faults in the agricultural R&D system, viz., drifting of research, extension and education from one another, institutional proliferation, design rigidities like too much focus on production, the dominance of genetic enhancement in neglect of alternative options, centralization, HRD failures – quantity & quality, bureaucratization, poor and ineffective M&E system, poor sustainability of efforts after the exit of every mega external project assistance, distance /disconnect from clients and no dialogue with policy makers, stakeholders and public at large. To overcome these faults, Dr. Jha suggested redesigning the system with new ideology, institutions and efforts. Specifically, he suggested, investing heavily in sustainable science based growth through basic science and strategic research capabilities combined with creating first rate scientists, modern laboratories, a stimulating, flexible but accountable environment, establishing a national innovation system, bringing professionalism in the management of the sector not only in operational fields but also in finance, administration and other supporting arms, more and certainty of funds for agricultural R&D combined with implementation of O&M reforms like project based budgeting, analytical PME system, exploring support from marketing boards, commodity boards and other client driven institutions to inject relevance and accountability and a bigger, upgraded, constructive, continuous and genuine political and social participation in the R&D apparatus for creating more effective social voice. Finally, he suggested that to build a constructive, effective socio-political constituency, strengthening the social science component in the agricultural R&D system is a necessity.

[1] Views are entirely personal and nothing to do with the employer (ICAR).

The agenda elaborated by Dr. Jha is very comprehensive and long term in nature and it may be difficult to consider and pursue all of them at once immediately. However, without any further loss of time, efforts on important ones must begin. In this context, I will report to you new ideologies, institutions and efforts referred to by Dr. Jha with respect to three initiatives taken in the last 26 years by ICAR, the apex R&D organization in India. The three initiatives reflect three new ideologies, viz.; (i) research must be put to use to promote livelihood security and commerce (ii) agricultural R&D system must strengthen basic and strategic research and (iii) scientific advances and knowledge explosion taking place in the developed countries must be accessed to strengthen research capacity and competent humanware. The initiatives put in place to implement these ideologies, respectively, are (i) National Agricultural Innovation Project (NAIP), (ii) National Fund for Basic and Strategic Research (NFBSR) and (iii) Indo-US Agricultural Knowledge Initiative (AKI). I will provide, some details of these initiatives and efforts/progress made so far under each one of them in subsequent sections.

New ideology and innovation

Backdrop

Economic growth with social justice is our national goal. While pursuing this goal, the focus is laid on job-led, pro-poor, eco-friendly growth combined with enhanced food and nutritional security, profitability, income, and competitiveness. For India, like many other developing countries, agriculture will continue to be significant for the overall growth of the economy. After about 40 years of green and other technology revolutions, agriculture is again in the news for its deplorable performance.

After a period of significant growth rate in agricultural GDP of about 3.70% in the beginning of 1990s, the growth rate has plummeted to 1.75% per annum since 1996–97 against the target growth rate of 4% per annum. General public are recalling the difficult days of huge import of foodgrains during mid sixties and the associated social, economic and political implications/anxieties for a big and agriculturally important country like India. Many people, if not all, though acknowledge contributions of modern technology combined with critical input (fertilizer and irrigation) supply and price support system (MSP for rice & wheat) which enabled India to attain foodgrains self sufficiency till recently, but are skeptical now about the capacity of the R&D system and the relevance of the policies pursued in the changed context to overcome the persisting crisis and emerging complex challenges in agriculture. Observations and feelings like technology fatigue, substantial yield gaps, etc., are frequently made pointing towards less than desired performance of the R&D system. It is also pointed out that the R&D system is not adequately responding to market signals. In this context, a review of efforts made to re-orient the R&D system and policies assumes special significance.

India since independence has continuously invested in agricultural research and education. As a result, we have one of the largest agricultural research systems in the world. Investment intensity rose from 0.2% of ag GDP during the early 1960s to about 0.5% in the 1990s (NCAP 1997, Jha and Pal 2003, NCAP 2003). This, however, remains way below the globally funded levels (NCAP 2006). For example, public expenditure on agricultural R&D as percentage of ag GDP is around 3% in USA, Japan &UK, 4% in Australia as compared to only 0.5% in India. Further, scientists per million of population

are 158 in India as compared to about 5000 in Japan, 4000 in USA 2700 in UK, 3300 in Australia and 460 even in China. Expenditure per scientist (thousand USD) is about 18 in India as compared to about 200 in USA and Japan, 164 in UK and 100 in Australia. Not only research intensity is low but also India accounts for about 2.3% of global area and 4.2% of global water but supports about 17% of global population.

The marginal contributions of the research system towards attaining not only national food self-sufficiency but also exports up to mid 1990s is well recognized. It is stated, "It was remarkable that poor society like ours was able to create a public research and education system which not only became a model for the developing world, but, in less than a generation, paid itself many times over" (NCAP 2006). In this success, the role of externally assisted projects like National Agricultural Research Project (NARP), National Agricultural Extension Project (NAEP), Agricultural Human Resource Development Project (AHRD) and National Agricultural Technology Project (NATP) is significant. Externally aided projects provide unique opportunities to try new methods, procedures and models for addressing issues which are generally not possible under regular schemes/projects on account of relatively rigid and inflexible administrative/financial rules and norms.

The recently concluded (June, 2005) NATP has contributed to considerable improvement in the productivity of NARS scientists. Substantial and innovative production system research on the farmer's field has made a greater impact on productivity enhancement, cost effectivity, profitability, employment and income of farmers. Yet another significant achievement of NATP has been the establishment of the new district based Agricultural Technology Management Agency (ATMA) model for technology dissemination with the full participation of farmers in 28 districts of the country. The model is now being replicated in 252 districts in the country.

Yet another follow-up of this ATMA model is that a Multi-State Agricultural Competitiveness Project' has been jointly proposed by the World Bank and the Government of India. Five States, namely, Maharashtra, Rajasthan, Orissa, Andhra Pradesh and Tamil Nadu are expected to participate in the first phase of the Project. The Project would aim to achieve:

- Development of more competitive marketing system; and improved market access for farmers, through enhanced knowledge and more effective producer organizations.
- Increase efficiency; and reduce costs in the marketing chain- to the benefit of both producers and consumers.
- Increased SME investment in agriculture; and more effective use of public funds allocated to extension/applied research and investment schemes.

Within each State Project, Project activities would be grouped into three main components as follows:

1. Expanding market infrastructure and opportunities by increasing market and associated infrastructure and making market management more responsive to farmers' needs and promoting private sector investment in agribusiness
2. Increasing farmer access to market opportunities by improving the relevance of market information and regulatory framework and improving supply chain management
3. Facilitating intensification and diversification of production by making extension and adaptive research more relevant and accessible to farmers, encouraging the development

and introduction of more effective agricultural production system and reducing the risk associated with change, especially for small operators.

The draft preliminarily project reports are being prepared by the States. The project, if gets approved and implemented, will further strengthen the much-needed research –extension -farmer-market linkages.

National agricultural innovation project (NAIP)

The concept

After successful completion of NATP, National Agricultural Innovation Project (NAIP) is designed as the next step towards attaining excellence in science, using science for enhancing rural livelihood security and making agriculture as a profitable commercial venture through integration of technology orientation with agricultural economy orientation.The new orientation integrating technology and agricultural economy warrants a new process and pace of knowledge generation and application going beyond the conventional investments such as research and extension. The new process of knowledge generation and application is termed as 'National Agricultural Innovation System'.

In the 1980s, the concept of the "National Agricultural Research System (NARS)" was developed. During this period research supply was strengthened by providing infrastructure, capacity development and policy support at the national level (NCAP 1997). No doubt such strengthening has helped to increase the accumulation/supply of new knowledge and new technologies but not adequately contributed to use/adoption of new technologies. Further during mid to late 1990s, the instability and inefficiency was also evident in many research organizations. All these led to an emphasis on development of pluralistic agricultural knowledge and information systems with greater client participation and even some funding. Even this change was found inadequate in the context of knowledge production and use to match rapid changes in agriculture.

I would like to draw your attention to one of our usual traits (overreacting, overdoing, adhocism, narrow vision/foresight) to respond to crisis situations with agriculture R&D system as an example. We opened institutions (ICAR Institutes, SAUs) without analysis of their need, logic and sustainability. They are now considered as not only unsustainable in terms of availability of qualified human ware as well as funding support but also ineffective to address holistic, end-to-end, farming system, production to consumption system issues. Since they cannot be closed in our socio-political system, re-orienting them to the changed paradigm is a big challenge. To address this challenge, in the last 4–5 years, more attention has been given to the demand for research and technology and to the development of wider competencies, linkages, enabling attitudes, practices, governance structures and policies that allow the knowledge to be put into productive use. In fact, the concept of an innovation system has guided this more holistic approach to planning knowledge production and use (World Bank 2006).

An innovation means the use of new ideas, new technologies or new ways of doing things in place or by people where they have not been used before. Innovation is triggered by market (most often), policy changes (sometimes) and research (rarely). Invention is creation of new knowledge and innovation is first commercial use of new knowledge. How to capitalize on the existing knowledge has become a question, which is as important as how to generate and diffuse new knowledge. This is where the concept of a National

Agricultural Innovation System (NAIS) becomes important. The NAIS consists of all the actors and their interactions involved in the production and use of knowledge, and the institutional and policy context that shapes the process of knowledge access, sharing and learning. There will be multiple knowledge bases though knowledge created by research is a fundamental building block of an innovation system. NAIP is the first and bigger formal practical application of the concept of NAIS (ICAR 2006).

The charter

The charter of NAIP is to facilitate the accelerated and sustainable transformation of Indian agriculture for poverty alleviation and income generation by collaborative development and application of agriculture technologies by the public research organizations in partnership with farmer's groups, Panchayati Raj Institutions, private sector and other stakeholders. The innovativeness of the project lies in its emphasis on holism (plough to plate), integration of basic, strategic, applied and action research, social re-engineering in terms of consortia formation and participatory governance features and management and combining social, economic and ecological features.

The components

The NAIP comprises four components: (1) ICAR as the Catalyzing Agent for Management of Change in the Indian NARS; (2) Research on Production to Consumption Systems; (3) Research on Sustainable Rural Livelihood Security (SRLS); and (4) Basic and Strategic Research in the Frontier Areas of Agricultural Sciences (BSR) (ICAR 2006). The project components are briefly described as follows:

Component 1: ICAR as the catalyzing agent for the management of change in the Indian NARS In the context of the emerging Indian agricultural research system, the limited ability of partners to interact and communicate with each other was identified as a key constraint to streamlining the generation and use of new knowledge. This led to the choice of the "consortium" as the principal modality for project implementation in components 2, 3, and 4. In support of these components, Component 1 will allow the ICAR and the SAUs to strengthen their role as the catalyzing agents of the system by strengthening their information, communication and dissemination capacity, business planning and development of knowledge, skills in using new learning and capacity building models, policy analysis, visioning, gender market intelligence analysis, and ability to remodel financial and procurement systems suitable to a learning and performing organization.

Components 2, 3 and 4 (research consortia) Components 2, 3 and 4 are planned to be organized using a consortium concept. The consortium concept is central to facilitating flows of knowledge collaboration, experimentation and implementation and to articulate demands for knowledge and technology. The world over, collaborative research networks and consortia have been more effective than simple information exchange networks. The consortia to be supported by the NAIP will have to play a key role in more efficient use of scarce resources in national agricultural research, and in enhancing synergies among research and development actors. The NAIP will tackle the limitations of these partnerships, contribute to a better utilization of limited resources, and enhance synergies among participating institutions.

Table 1 Examples of possible value chains (Source: ICAR 2006)

Categories	Examples
Income augmentation and employment generation	Sorghum in SAT, Milk and Milk Products in Rainfed Areas, Marine Fish,Maize
Export promotion	Fruits, viz., Mango, Grapes, Passion Fruit, etc., Vegetables, Spices and Value Added Products, High Value Fish (Tunas, Pomfrets, Crabs) in Coastal/Island Areas and Mariculture
Agro-processing	Potato, Buffalo Meat/Fishes, High value Soya Products
Resource use efficiency	Conservation Agriculture, Water, productivity (Multiple Use), Bio-fuel Medicinal Plants

By making competitive grants available for large projects (from Rs. 10 to 25 crores for each consortium) strong incentives are created to build partnerships and share knowledge and information. An additional reason for the competitive mode is that it allows successful and innovative models to arise from the bottom, rather than imposing a design from the top. The consortium mode will then be applied to address main development challenges that the Indian agricultural research system faces.

Component 2: research on production to consumption systems (PCS) PCSs comprise the entire set of actors, materials, activities, services, and institutions involved in growing and harvesting a particular commodity, transforming it into higher value product and marketing the final product. The system includes the technologies used to grow and process the material, as well as the social, institutional and economic environment in which these processes operate.

The emphasis on PCSs is a simple reflection of the fact that agricultural growth in India is increasingly market driven and that the challenge to raise income and welfare to the agricultural community has to be met in a market context. The PCS implies a higher priority to among others, post-harvest processing, quality management and safety issues. The importance of the market also implies a shift in attention to products with large market and income growth potential.

Rural income augmentation and employment generation, agro-processing, export promotion, resource use efficiency will receive thrust under this component. Some examples of possible value chains are given in Table 1.

An example of how a PCS project is conceived is given below (See Fig. 1):

A production to consumption system (Value chain) is conceived above in respect of meat and meat products to provide significant boost to the sector and benefit everyone involved in the sector. All the aspects from production to consumption (production, processing, marketing and consumption) are covered. One can even add pre-production activities/inputs such as feed/fodder, breeding as well as post consumption activities including food chain issues in human beings and animals. Against these aspects, most critical links have been identified by the stakeholders, which need to be bridged in the project as interventions/ innovations. A list of potential institutions who have the capacity to bridge these missing links is also provided to choose from as consortium partners. They will provide their specific skills and share the resources. The whole PCS is planned, implemented and main streamed with the stakeholders like farmers, processors, traders/exporters, consumers and government departments.

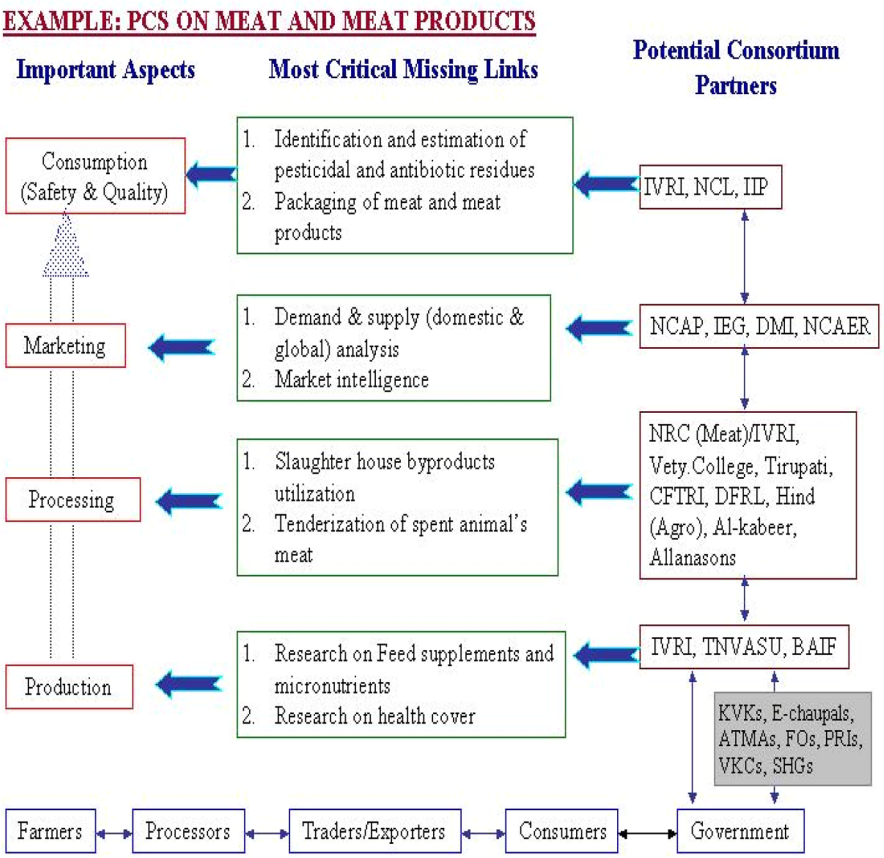

Fig. 1 PCS on meat and meat products. (Source: ICAR 2006)

Component 3: research on sustainable rural livelihood security The emphasis in Component 3 on rural livelihood security reflects that several million people in the country remain largely by-passed by the green revolution and modern agricultural practices. A large proportion of these people and of the rural poor live in less favored, marginal or more complex environments. Long-term social, political and environmental stability requires that attention be given to these areas. The relevance of less endowed areas to decentralized development, to resource conservation, to water harnessing and bio-diversity management is being increasingly recognized.

In component 3, emphasis will be given to improving the sustainability of the farming systems in terms of assured food, nutrition, employment and income and natural resource management in less favorable environments. Particular attention will be given to rain-fed, hill and mountain, coastal and island eco-regions. Partnerships will be built among all the stakeholders, farm men and women, agricultural labourers, rural industry entrepreneur or the researcher, development worker who will share their knowledge and resources and own the changes being brought in Consortia which propose to work for the rural areas in the 150 districts covering 27 states and 13 agro-climatic zones identified by the Planning Commission for support (Table 2) will be funded under this component.

Table 2 Grouping of 150 disadvantaged districts in 13 clusters (Source: ICAR 2006)

Cluster	No of districts	Zone	State	Districts
1	12	II	Arunachal P.	Upper Subansiri
			Assam	Kokrajhar, North Cachar Hills, Karbi Anglong, Dhemaji & North Lakhmipur
			Manipur	Tamenlong
			Meghalaya	South Garo Hills
			Mizoram	Siaha
			Nagaland	Mon
			Sikkim	North Sikkim
			Tripura	Dhalai
2	15	IV	Bihar	Araria, Vaishali, Gaya, Madhubani, Muzaffarpur, Nawadah, Samastipur, Sheohar, Katihar, Jamui, Lakhisarai, Monghyr, Purnea, Supaul & Darbhanga
3	5	I	H. P.	Chamba
			J & K	Doda & Kupwara
			Uttaranchal	Champawat & Tehri Garhwal
4	10	VII	Chhattisgarh	Bastar, Dantewada, Kanker, Korbia, Sarguja, Jaspur, Dhamtari, Raigarh, Bilaspur & Rajnandgaon
5	11	VII	Maharashtra	Gadchiroli, Gondya, Chandrapur, Bhandara
		IX	Maharashtra	Dhule, Nandurbar, Hingoli, Nanded, Aurangabad, Ahmednagar, Yawatmal 16
6	8	X	Karnataka	Chitradurga, Davanagere & Bidar
			Tamil Nadu	Tiruvannamalai, South Arcoti Cuddalore, Villupuram & Nagapattinam
		XII	Kerala	Wayanad
7	14	VII	Jharkhand	Saraikela, Singhbhum West, Godda, Simdega, Gumla, Chatra, Garhwa, Palamau, Latehur, Lohardagga, Dumka, Jamtara, Sehehganj & Pakur
8	12	IV	Uttar Pradesh	Sonabhadra, Mirzapur, Kushinagar
		V	Uttar Pradesh	Unnao, Raehareli, Sitapur, Hardoi, Fatehpur, Lakhimpur Kheri & Barabanki
		VI	Haryana	Saryamey Puram
			Punjab	Hoshiarpur
9	23	VIII	Uttar Pradesh	Lalitpur, Banda, Chitrakoot, Mahoba, Hamirpur

Table 2 (continued)

Cluster	No of districts	Zone	State	Districts
		VII	Orissa	Koraput, Malkangiri Nabarangpur, Rayagada, Mayurbhanj, Sundergarh, Keonjhar, Phulbani, Boudh, Nuapada, Kalahandi, Sambalpur, Deogarh, Jharsuguda, Sonepur, Bolangir, Dhenkanal
		XI	Orissa	Ganjam
10	6	III	West Bengal	Malda, West Midnapur, Bankura,West and North Dinajpur, Murshidabad
		VII	West Bengal	Purulia
11	15	VII	Madhya P.	Umaria, Shahdol Balaghat
		VIII	Madhya P.	Mandla, Barwani, Shivpuri, Sidhi, Tikamgarh, Chattarpur, Betul
		XI	Madhya P.	Jhabua, Khargone, Khandwa, Seopur & Dhar
12	13	VIII	Rajasthan	Banswara, Dungarpur, Udaipur, Sirohi& Karauli
		X	Andhra P.	Adilabad. Mahbubnagar, Rangareddy, Khammam, Warangal Nalgonda, Anantpur & Cudappah
13	6	XIII	Gujarat	Dangs, Dohad, Panch Mahals, Sabarkantha, Narmada, Banaskantha
13 Clusters	150	13 Zones	27 States	150 Districts

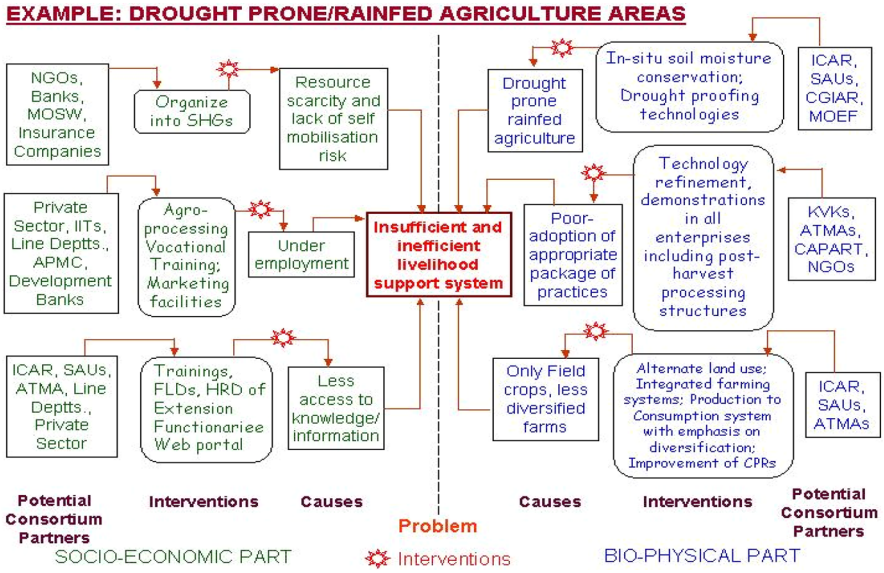

Fig. 2 Drought prone/rainfed agriculture areas

An example of how a sustainable rural livelihood security consortium is conceived is given in Fig. 2.

As under PCS, the central problem of inefficient and insufficient livelihood support system in drought prone/rainfed agricultural areas is addressed in the above example by identifying causes, needed interventions, potential agencies who can make these interventions in a consortium mode both from biophysical and socio-economics parts. The needed interventions to make the system sufficient and efficient are also well defined. The consortium partners share the tasks according to their skills/capacity and commensurate resources to perform those tasks.

Component 4: basic and strategic research in frontier areas of agricultural sciences To sustain innovation for accelerated development, investments must also be made in basic and strategic research in frontier areas of agricultural sciences, in order to generate new knowledge and new findings that can later on be turned into the next generation of innovations. Recent research shows that the capacity of the Indian agricultural research system to produce high quality science was greater in the past than at present (NCAP 2005). Especially for a large country such as India, it is important to be at, and contribute to the scientific frontier. Component 4 therefore, addresses the widening knowledge gap that might appear in the absence of high quality basic and strategic research. Some of the thrust areas identified are given in Table 3.

An Example of how a project is conceived under Component – 4 is given below (See Fig. 3).

As in PCS & SRLS, a consortium to study genomics of cotton and fibre development is conceived above with diverse partners (an international centre of advanced research, an ICAR institute, a SAU, a general university and a private company) to contribute in well-identified areas of work and capacity. They share the task, project resources and IPR on mutually agreed terms and conditions.

Table 3 Indicative thrust areas under component 4 (basic and strategic research, Source: ICAR 2006)

Areas	Examples
Biotechnology	Gene discovery and allele mining, Bioprospecting the marine biota for bioactive molecules and products, QTL identification, cloning of QTL genes and use in MAS of plants and animals
NRM/IPM	Enhancement of nutrient use and uptake efficiency in plants and animals, Carbon pool conservation & enhancement using strategic combinations of physical manipulations of soil and, organic & inorganic sources of nutrients, Mitigation and adaptation strategies for managing the effects of climate change on agriculture
Post harvest technology and value addition	Quality assurance of agricultural products for nutritional value and food safety, Value addition to agricultural products for developing diversified high value commodities like health food, nuetraceuticals and pharmaceuticals, Conversion of agricultural residues and by products into high value products

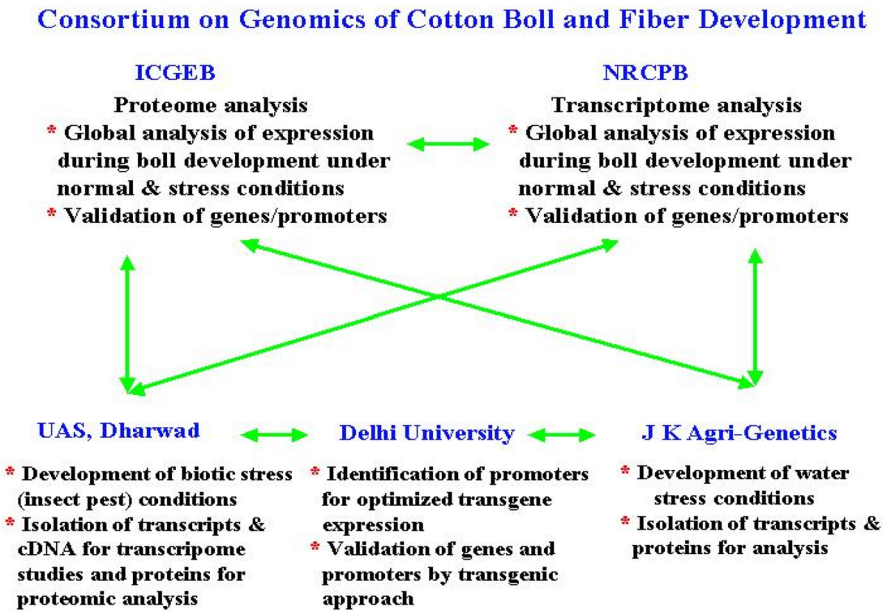

Fig. 3 Consortium on genomics of cotton ball and fiber development (Source: ICAR 2006)

Other features

A help desk is created to train and guide project proposal preparation and implementation of the project through consortia approach. Another major feature of the project is a strong institutional learning and capacity building plan for self-renewal of National Agricultural Innovation System. The plan includes comprehensive training need assessment, harnessing modern ICT in knowledge generation, management and dissemination, capacity building to deal with globalized agricultural market economy and visioning and foresight. A transparent governance structure and strategy is adopted for efficient working and implementation adopted using modern financial management tools and techniques and result oriented

framework with regular monitoring and on course correction mechanism to ensure continuous progress to achieve the expected output and outcome. The project is formally launched on 26 July, 2006 and has become effective from 18 September, 2006. The project activities in conjunction with the intensified on going research efforts will prove to be a worthy initiative in transforming Indian agriculture to be a commercial venture with enhanced on and off farm employment, profitability and livelihood security. In particular, the project would result in about 15 value chain development models for technology incubation and commercialization, 20 sustainable rural livelihood improvement models in disadvantaged areas and about 25 patents from basic and strategic research besides considerable number of research papers published in high quality impact research journals triggering next generation of innovations.

Various Committees and Advisory Groups connected with project execution are formed and functioning. To build awareness on the Project, 8 regional sensitization workshops and 12 satellite workshops were organized during August and September 2006 all over the country. More than 1200 stakeholders representing ICAR Institutes, SAUs, general Universities other public research institutions, private sector, NGOs, Civil Society Organizations, farmer's groups, etc. benefited in these meetings.

Call for concept notes under competitive mode was made during October 2006 and 992 concept notes have been received. The concept notes after preliminary screening and prioritization are under processing as per the prescribed procedure (ICAR 2006). Eight projects (1 under Component – 1, 4 under Component – 3 and 3 under Component – 4) have been approved and about 30 are under active consideration, the planning for the second call and well identified priority areas is in progress. The project is planned for 6 years with effect from July, 2006 at a proposed outlay of US $ 250 million, US $ 200 million as credit by the World Bank and US $ 50 million, Government. of India contribution. For more details on the project, visit NAIP website: http://www.naip.icar.org.in.

To sum up

The agenda for transformation of NARS to NAIS is big and complex. The idea of NAIS is debated and discussed particularly in the last 2–3 years, but in my view, NAIP is one major formal effort to make it functional as a pilot. The project is a major departure from our routine R&D business. It focuses on much needed commerce in agriculture, livelihood security of vulnerable people in disadvantages areas, strengthening basic and strategic research in frontier areas of agricultural sciences to push the production frontier up and improving the efficiency of the research system through O&M changes. It emphasizes end-to-end holistic approach in solving problems by consortium of diverse partners and supports small number of big projects to make system wide impact. All these, require change in the processes and mindset of all the concerned to do business differently. But change though difficult is a must. If we do not change, we soon become irrelevant. The choice has to be made and we have to make choice.

National fund for basic and strategic research (NFBSR)

The Indian NARS has not only to find solutions to the immediate problems of enhancing productivity in farming but also to keep its competency in technology development in the forefront to meet the emerging and unanticipated problems. Solutions to these problems

will require much focussed and highly innovative basic and strategic research in frontier areas of agricultural sciences.

Fully realizing the need, the finance minister while making the Budget announcement for 2005–06, had made an initial provision of Rs.50 crores towards creation and operationalization of a National Fund for Basic and Strategic Research (NFBSR) in agricultural sciences to be implemented in ICAR. The objective of the NFBSR is for strengthening basic and strategic research for development of technologies in enhancing the efficiency and effectiveness of Indian agriculture and also to promote research networks to advance the agricultural research base. This funding will be in addition to earmarked US$ 56 million funding for basic and strategic research under component – 4 of NAIP. For operationalizing the fund, an Empowered Committee with Dr. C.N.R. Rao as Chairman and other eminent experts as Members is constituted and is functioning.

The Fund Authority has fixed the broad priorities for inviting the proposals. The priority areas identified included genetic enhancement, resource management, value addition, diagnostics, vaccines, energy management, climate change and stress management. The proposals were invited in May 2006 and about 2700 concept notes were received. Guidelines to operate the fund have also been formulated and used.

During the year 2006–07, 14 projects have been sanctioned at a total outlay of Rs.25.00 crores focusing on crop improvement through biotic and abiotic stress management relating to rice, sorghum, pulses, oilseeds and cotton, animal improvement in buffalo, immune response in cattle, prolificacy studies in black Bengal goat, mitigation of methane emission and productivity enhancement in dairy animals and bio-stimulation and post-harvest conservation of seeds and agri-products. During 2007–08, already 7 projects have been approved at an outlay of Rs. 7 crore covering the priority areas of biotic and abiotic stress management in plants and livestock and enhancing input use efficiency in agriculture, stimulation and post harvest conservation of seeds and agri products.

Since agriculture is facing real complex problems, it needs out of box solutions for which collaborative, inter-institutional research networks covering scientists from all research institutions, universities and private sector becomes important All these would lead to advance the agricultural research base and raise the production frontier which is the main mandate of ICAR (more details are available on https://www.icar.org.in).

Indo-US agricultural knowledge initiative (AKI)

Indian agriculture needs new ideas and innovations to bring about rapid transformation in our rural economy and assume an increasingly important leadership role across Asia and the globe in 21st Century. The agriculture of today is more knowledge intensive, global and consumer driven and loaded with all complexities of trade and exchanges. To address all these concerns, modern agriculture has to be far more technologically grounded. The launching of Indo-US Knowledge Initiative is a step in this direction. The major aim of this partnership is to explore and work on mutually reinforcing priority areas in teaching, research, service and commercial linkage.

Among the several key areas identified for partnership, initially is on four strategic areas, viz., (i) Education, learning resources, curriculum development and training, (2) Food processing, use of byproducts and biofuels, (3) Biotechnology and (4) Water management.

To implement the objectives of the initiative, an Indo-US Knowledge Initiative Board is constituted with Prof. M.S. Swaminathan and Dr. Norman Borlaug as Honourary Advisors. The Board from the Indian side consists of representatives of the Central Government,

State Agricultural Universities/ICAR institutions and private sector/agri-business. Similarly, the US side consists of officials of USDA/FAS, representatives of Universities, NGOs and private sector.

The Board has developed a joint work plan for the next 3 years in the four focus areas. The priority activities reflected in the jointly agreed work plan under each focus area include:

Education, learning resources curriculum development and training Sharing US experiences in curriculum development, Constitution of Indo-US joint Working Group for advising on curriculum development, design and delivery, training and faculty exchanges, promoting public–private sector partnerships, extension and outreach activities, strengthening library resources and strengthening administration.

Food processing, use of by products and biofuels Post-harvest management and upgrading cold chain practices and operations, strengthening grades, standards and quality control, development of market information systems, strengthening agri-business investment in India, establishing food safety and animal and plant health regulations to facilitate trade, joint research programmes as technology for rapid detection and control of bio-toxins, chemical contaminants and heavy metals in agricultural produce and byproducts, advanced extrusion processing and extraction technology, by product utilization, modified atmosphere packaging and storage of perishable food products and bio-fuels. The training of Indian scientists in these areas will be taken up first.

Biotechnology Development of transgenic crops resistant to viruses of economic importance, tolerance to droughts, heat and salinity and micro-nutrient intake, genomics of legumes, diagnostics and vaccines. Training and workshops on the above will be taken-up on priority.

Water Management Research and training in water quality management and remediation, assessment and management of agricultural drought, soil water-plant interactions, sustainable use of ground water resources, use of modern tools in water management and capacity building in these areas.

Under the initiative, 16 Borlaug Fellows and 11 Cochran Fellows have been selected from the focus areas and have completed visit and training in the Universities and industries in USA.

To further develop these joint activities, continuous intensive stakeholder consultation is undertaken in each focus area. Already an interface with the private sector had taken place, which provided useful suggestions for active participation of private sector in the Initiative. Thus, a great opportunity is ahead under the Initiative, the benefits of which will rise agricultural productivity to promote food security, increase technology transfer including bio-technology, build a sound policy and regulatory environment, expand trade and investment and promote integration of India into the global economy, ensure key role for the Indian and US private sectors and reinvigorate India-US University partnerships for capacity building.

More details are available on the website (http://www.dare.gov.in/usa.htm).

Conclusion

Indian agricultural research and education system is on the move with new ideology and innovations. The new ideology is in accordance with the NDCs objective of expecting most of the gains from exploiting the potential of existing technology during 11th Five Year

Plan and long run gains by strengthening basic and strategic research. If it has to contribute to targeted 4% annual growth rate in agriculture during the 11th Five Year Plan, it has to increase its pace of innovations by pushing the frontiers of science, commerce and livelihood security. For this, apart from addressing several issues, creating first-rate scientists and thinkers like late Prof. LSV must receive our priority attention.

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