An Innovative Approach to Agricultural Technology Development and Transfer in India

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SYNOPSIS OF PROJECT DATA

Project: National Agricultural Innovation Project
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DEVELOPMENT CONTEXT

Almost 85 percent of India's poor live in rural areas and depend on agriculture for their livelihood. Despite the large potential of India's agricultural sector, overall growth in agricultural production and productivity is low. Agricultural practices for managing natural resources (land, water, and biodiversity) remain unsustainable, and the transition to a market-oriented, globally competitive agricultural sector has been slow. The Government of India views agricultural R&D as a critical means of improving agricultural productivity and increasing agricultural growth. Strengthening institutional capacity in the NARS, improving coordination among institutions within and outside the agricultural research system, and promoting partnerships between national agricultural research institutions, the growing private sector, and NGOs are essential to speed the transition to a more competitive agricultural sector. The National Agricultural Innovation Project (NAIP), fourth in a series of projects funded by the World Bank to improve agricultural research and technology in India, addresses these challenges by changing the way in which scientists, farmers, and agricultural entrepreneurs interact in the national AIS.

PROJECT OBJECTIVES, DESCRIPTION, AND EVOLUTION

NAIP incorporates lessons from the three earlier projects (representing almost 25 years of experience), including the need to develop public-private partnerships, integrate technology development and transfer mechanisms, and finance research through competitive research grants. The project's development objective is "to contribute to sustainable transformation of agriculture and accelerate the collaborative development and application of agricultural innovations between public research organizations, farmers, the private sector, and other stakeholders."[1]

The project seeks to achieve this objective by strengthening the role of the Indian Council for Agricultural Research (ICAR) in catalyzing and managing change in the NARS and by financing agricultural research through innovative consortiums of public organizations, universities, private enterprises, NGOs, and other stakeholders. Activities pursued under the project include:

- Strengthening ICAR's technology foresight and policy analysis to envision and plan for future needs.
- Strengthening ICAR's communications and information capacity through better dialogue and interaction with the public at large, farming community, private sector, and within the ICAR system itself.
- Reinforcing the research system's capacity through national and international training.
- Improving technology transfer and commercialization through business planning and development units and IPR management.
- Adopting organizational and management reforms such as M&E, procurement, and financial management throughout the ICAR system.

The project also promotes the development of three kinds of multistakeholder, multidisciplinary consortiums of public and private organizations, universities, NGOs, and others focusing on three high-priority research themes. *Market-oriented, collaborative research alliances* focus on sustainably improving the productivity, profitability, and

sustainability of selected agricultural value chains. *Livelihood research alliances* focus on strategies to sustain secure rural livelihoods in about 110 disadvantaged districts, mostly in rainfed, hilly and mountainous, dryland, tribal, and coastal areas. *Basic and strategic research alliances* focus on well-defined areas of frontier science with potential applications for problems in Indian agriculture.

Promising consortiums and research alliances are selected through a competitive process, and NAIP funds their proposed research. Members of each consortium are jointly responsible for the governance, design, and implementation of their research programs; maintaining satisfactory fiduciary and safeguard arrangements; applying the resulting innovations; and disseminating new knowledge through conferences, innovation marketplaces, networks, and communications strategies.

INNOVATIVE PROJECT ELEMENTS

India has one of the world's largest public agricultural research systems.[2] In this context, NAIP produced three critical innovations: scenario planning, new kinds of partnerships, and the Helpdesk.

- ***Scenario planning.*** ICAR and World Bank teams conducted a scenario planning exercise that identified and analyzed critical policy and institutional challenges facing the agricultural sector and identified corresponding reforms that would strengthen the research system's ability to meet those challenges. Scenario planning enabled ICAR management to assess the consequences of alternative reform scenarios, including their likely benefits and impact, and identify specific reforms to be supported through NAIP. This process has not only increased government ownership of the reforms but also its commitment to implement them.
- ***Expanding capacity and resources via partnerships.*** The underlying principle of NAIP is the formation and management of consortiums that bring research institutions together with those who use research results. The collaborative arrangements developed by these stakeholders optimize the use of research resources in an enhanced process of innovation, value addition, commercialization, and technology transfer that solves specific agricultural development problems. Research proposals prepared by the consortiums clearly define the roles of the consortium leader and the other partners, including the budget for each institute. The broad array of participants and clarity about their specific roles and contributions lead to significant synergies and value addition in the design and implementation of their research projects. ICAR and NAIP management have invested considerable time in building partnerships and providing support through meetings, workshops, and the Helpdesk.
- ***Helpdesk.*** The Helpdesk was established to support the new and more challenging partnerships that the consortiums represent. The project outsourced Helpdesk functions to one national institute and informed the prospective consortiums that it was there to help them in a number of ways: by providing guidance for preparing concept notes and full research proposals, assisting in matching consortium partners, and helping to overcome initial problems in managing the consortiums. The Helpdesk does not charge for its services. The experts managing the Helpdesk understand all of the process and details involved in forming consortiums; developing, selecting, and approving concept notes and full proposals; and the priority research themes. Users found the Helpdesk effective in facilitating the proposal selection process and forming consortiums. The Helpdesk used a number of tools in its work: the Helpdesk portal, e-learning and multimedia modules, databases of potential partner institutions and organizations, case studies of agricultural projects using direct e-mail responses to potential consortium members.

BENEFITS, IMPACT, AND EXPERIENCE

NAIP was approved in April 2006 and the approval of consortiums was completed only in December 2009. The sections that follow describe some of the early results. Readers interested in tracking the project's progress are directed to the NAIP website (http://www.naip.icar.org.in).

Overwhelming national interest in the consortium approach

The number of consortiums was three times the number anticipated, far exceeding expectations. The overwhelming response enabled consortium leaders to assemble the consortium partners with relative ease. From a total of 188 consortiums, 142 were selected through a two-stage competitive review, and the remaining 46 were sponsored. The average consortium budget is about US$1.4 million, of which approximately 62 percent of the committed amount went to the 188 consortium leaders and 38 percent to the

646 consortiums' partners. Table 4.8 summarizes the types of participating institutions, their relative commitments, and their budgets.

EXPANDING THE INSTITUTIONAL BASE FOR AGRICULTURAL RESEARCH

NAIP introduced greater pluralism into agricultural research, given that 38 percent of consortium institutes (leaders and partners combined) come from outside the ICAR–state agricultural university system. Through NAIP, ICAR has promoted public-private partnerships on a large scale for the first time. The project has provided the opportunity for ICAR and the state universities to collaborate with the Indian Institutes of Technology (IITs), the Indian Institutes of Management (IIMs), general universities, and institutes in the Council for Scientific and Industrial Research. The main motivations for these institutions to participate in NAIP are the opportunity to work with agricultural scientists and access their skills and facilities, the opportunity to work in ICT and biotechnology applications in agriculture, and the availability of research grant funds.

Positive experience from partnerships

As of this writing, field visits, workshops, and supervision missions indicate that the consortiums have been working smoothly. There is consensus in ICAR and among consortium partners that the consortium approach has promoted pluralism, synergy, teamwork, value addition, learning, and better research; they believe that as a result the development impacts will be much larger. On average, each consortium has four partners. Box 4.28 summarizes the main issues raised by partners.

Focus on high-priority agricultural research themes

Through the competitive selection process, a number of potentially high-quality and high-impact subprojects were selected to address the research themes described earlier. The focus on value chains is intended to solve practical problems in commercial agriculture and agribusiness (box 4.29 describes achievements in research for two value chains). At the other end of the spectrum, work in 110 disadvantaged districts with NGOs has given researchers opportunities to address poverty and growth problems.

Improved quality and relevance of research

The synergy created through partnerships has improved the quality and usefulness of research results. Agricultural scientists now have access to unique skills (in ICT and biotechnology, for example) and research facilities provided by the scientists who had generally never worked with scientists from the national agricultural research system. Through their work with the private sector and NGOs, more public sector researchers have been exposed to the perspectives of these partners and their sense of urgency for solving clients' practical development problems. Box 4.30 summarizes the project's preliminary results and likely impact.

Institutional development

By sponsoring formal training and, even more important, developing new kinds of partnerships, the project has strengthened the institutions that serve agriculture, agribusiness, and livelihood security and is preparing them to deal with the development challenges of 21st century agriculture. A vital element of institutional development is the continuous interaction between public, private, and NGO sectors and the willingness of ICAR institutes to work

Table 4.8 Consortium Leaders and Partner Institutions in the National Agricultural Innovation Project, India

Type of institution	Institutions as consortium leaders (%)	Institutions as consortium partners (%)	Share of participating institutions in the NAIP budget (%)
ICAR institutes	46.5	37.2	50.8
State and central agricultural universities	30.9	22.9	26.3
International institutes	2.7	1.4	1.9
Central institutes	8.0	7.1	6.6
State institutes	–	2.0	0.6
Private agencies	3.2	10.4	3.9
Other universities	3.2	2.3	2.4
NGOs	2.7	13.3	6.3
Other institutions	2.7	3.4	1.2

Source: NAIP Project Implementation Unit.

Box 4.28 Issues and Experience of Partners in Consortiums Funded by the National Agricultural Innovation Project

The 188 consortiums consist of 188 consortium leaders (one leader for each consortium) and 646 partners, coming from about 370 public, private, and nongovernmental organizations. (Together, the consortium leaders and their partners comprise 834 project-implementing units.) Many consortium partners are working together for the first time in addition to participating in a World Bank-funded project for the first time. In this situation, implementation challenges are expected. They are being addressed as part of the learning process for the consortium approach.

The coordination of the consortiums generally appears to be working well, but some partners have experienced problems arising from poor coordination. The performance of 188 consortiums was rated in 2010 using a scorecard system, and 15 (8 percent) were rated Not Satisfactory. Milestones were developed to upgrade their performance. Instances of problems with staff commitment, staff skills, and the flow of funds to partners have occurred. Most consortium partners had problems with World Bank fiduciary requirements (procurement and financial management), environmental and social safeguard requirements, and monitoring and evaluation. They find the requirements too rigid, especially the reporting requirements. Often funds have been delayed. Most of these issues have been or are being addressed. Finally, capacity has been strengthened through training, workshops, the Helpdesk, and manuals. Although some problems continue, the project implementation team is committed to addressing them and learning how to make the consortium approach more sustainable for all involved.

Source: Based on surveys conducted by NAIP Project Implementation Unit.

Box 4.29 Achievements by the Bioethanol and Banana Pseudostem Consortiums Funded under the National Agricultural Innovation Project, India

A value chain model for producing bioethanol from sweet sorghum in rainfed areas through collective action and partnerships. This consortium is led by the International Crops Institute for the Semi-Arid Tropics (ICRISAT) and six partners (five research institutes, one private company). Although it is only partway through its research program, the consortium has increased awareness of sweet sorghum's multiple uses in the project area (food, feed, fodder, and fuel) and organized farmer groups to produce the sweet sorghum crop. Farmers increased sweet sorghum yields by growing improved varieties and using better management practices, and new farm equipment provided under the project reduced the drudgery of farm operations. Farmers now use sorghum grain for food and feed, stalks for syrup production, and bagasse for fuel and fodder. A crushing unit (owned by the private partner) using ICRISAT's bioethanol conversion technology was established to produce syrup and the organizational structure of the unit is designed to manage the supply chain**.** One ton of stalks produces 269 liters of juice and 50 kilograms of syrup. Syrup production costs were reduced by increasing juice recovery, syrup recovery, and labor efficiency. The syrup is sold to the bioethanol, food, and pharmaceutical industries. Although farmers who cultivate sweet sorghum and raise livestock have benefitted from this arrangement, the profitability of bioethanol production ultimately depends on crude oil prices.

A value chain of banana pseudostem for fiber and other value-added products. This consortium is led by a university and four other partners participate (one research institute and three private business partners). Banana pseudostem is generally regarded as a waste product and source of pollution after bananas are harvested. In seeking to develop a value chain for banana pseudostem, the university and research institute have focused on the backward linkages (to banana farmers)

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Box 4.29 Achievements by the Bioethanol and Banana Pseudostem Consortiums Funded under the National Agricultural Innovation Project, India (continued)

and the private sector has focused on the forward linkages (developing useful, marketable products from banana pseudostem). Consortium members have already been able to produce fiber, yarn, paper, candy, woven fabric, artificial leather, cellulose powder, vermicompost, and liquid fertilizer from banana pseudostem; the machinery needed to produce these value-added products has already been designed, fabricated, and commissioned under this project (although not yet commercially available in India). Having demonstrated that these products are technically feasible, the consortium is currently analyzing the financial and economic prospects for various products (and conducting experiments on producing yarn from banana and synthetic fiber). Farm income has improved because farmers have been able to sell pseudostem through the project, and the conversion of banana pseudostem into various products has generated employment.

These examples demonstrate achievements that would not have been possible without the complementary resources provided by each consortium partner. These examples also demonstrate substantial economic and social impact through value addition for all the stakeholders and the country.

Source: Based on information provided by NAIP Project Implementation Unit and the consortiums.

Box 4.30 Preliminary Results of the National Agricultural Innovation Project, India

Catalyzing and managing change in the national agricultural research system. Knowledge can be a powerful change agent, and NAIP has given considerable attention strengthening research capacity through the provision of knowledge. Students, teachers, and scientists now have access to a much deeper knowledge base. Over 2,000 scientific and professional journals can be accessed in 124 libraries; 155 of 368 e-courses have already been developed; 6,000 PhD theses have been digitally uploaded; electronic information on agriculture is available through an "agro-web"; and 10 business planning and development units have been established. Significant formal training should have a long-term effect on the human resources available to the national research system (and wider AIS): already 1,611 experts have been trained (1,441 nationally, 170 internationally).

Research to strengthen value chains. The project supports research for value chains representing a wide spectrum of potentially high-value agricultural products: banana pseudostem, briquettes from industrial residues, industrial agroforestry, oceanic tuna, potato and potato products, natural dyes, bioethanol, coconut, seed of spices and flowers, millet foods, sorghum foods, and maize and maize products—among others. Preliminary results for most of these value chains appear promising with respect to the new technologies used and the potential economic gains. For example, it may be possible to develop a new industry involving a large number of small-scale entrepreneurs in producing and distributing briquettes.

Research on more sustainable and secure rural livelihoods. Subprojects encompass a wide range of topics, including: scaling up crop production technologies; increasing water storage capacity through improved natural resource management (extremely important in drought-prone parts of India); backyard poultry production; generating employment through various natural resource management interventions; expanding irrigated area; improving grain storage capacity through storage bins; vermi-composting units; rice-fish-poultry farming; drought mitigation measures; and water harvesting. A few consortiums report early results in improving yields of maize (by 30 percent), rice (37 percent), soybeans (22 percent), wheat (32 percent), sorghum (24 percent), and cotton (126 percent). Improved resource-use efficiency and increased productivity are likely to raise incomes

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Box 4.30 Preliminary Results of the National Agricultural Innovation Project, India (continued)

among marginal and small-scale farmers. To mainstream the best practices they develop, some consortiums are establishing sustainability funds.

Basic and strategic research (frontier science). Results from these subprojects are expected to advance scientific knowledge and yield economic benefits for farm families, the agricultural sector, and the economy as a whole. Subprojects focus on natural resource management innovations as well as innovations that improve agricultural productivity, quality, and value added in staple crops, horticultural products, livestock, and fish. Promising results include the identification of 30 genes specific to cotton fiber development; 10 herbal extracts to control ticks in cattle; a chip-based biosensor and a micro-well chip platform to detect ultra trace concentrations of pesticides and adulterants in milk; and a prototype rubber dam for small-scale watersheds.

Source: Information provided by NAIP Project Implementation Unit and consortiums.

outside their system. ICAR has started to mainstream the consortium approach and competitive selection process throughout its institutes. If these actions continue on a large scale, the process, interventions, and impacts initiated through NAIP are likely to be sustained and substantial. The consortium approach has encouraged partner institutes to consider new strategies for solving real agricultural problems. The technical solutions emerging from the consortiums appear to have benefited from increased interaction and creativity, given their quality, economic potential, effectiveness, and level of appropriateness to clients' needs.

LESSONS LEARNED AND ISSUES FOR WIDER APPLICATION

The formation of consortiums, partnerships, and the competitive selection process has been a major but time-consuming achievement. Innovation is needed to shorten this process without sacrificing quality and pluralism. All heads of research organizations must be encouraged to reach out to scientists whose work complements the project's research themes and overall benefits—a strategy that should be pursued for all agricultural research, irrespective of the funding source. Based on experience to date, the consortium approach is likely to emerge as a best practice for agricultural research, if indeed it ensures high returns to investments in agricultural research and promotes collaboration throughout the wider AIS.

Project teams must develop a strong sense of the number of proposals that are likely to be submitted and plan accordingly. Subproject selection and review in NAIP were delayed by 18 months by the high number of proposals submitted for consideration. The proposals were not only numerous but complex to develop, review, revise, and approve. The involvement of new partners from diverse backgrounds and inclusion of research issues that the public research system is formally pursuing for the first time (value chains and sustainable livelihood security) also extended project selection and approval. If future projects fund a larger-than-expected number of subprojects, they must make appropriate arrangements to handle the increased workload for management, procurement, financial management, monitoring, evaluation, and safeguard management. Otherwise implementation will be delayed.

From the start, all consortiums must be aware that they are required to follow agreed procurement procedures and receive appropriate procurement training. The procurement of goods (especially scientific equipment and supplies), services, and works must keep pace with the implementation of the project and research subprojects. Procurement under NAIP was very slow, especially in the beginning. Most consortium partners had never worked with Bank-funded projects. It took some time to convince and train them to use World Bank procurement procedures.

The Helpdesk seems to be a best practice to adopt in collaborative programs for agricultural research. In NAIP, the Helpdesk portal has been extremely useful in forming consortiums and preparing proposals, and it should be available to address implementation problems as they arise, especially considering the large array of consortiums and organizations involved in the project. It could also be useful for disseminating success stories.

At the beginning, establish an effective M&E system for internally tracking the project's progress and performance as well as its likely impact. A good M&E system provides regular feedback to project management about potential

problems as well as progress, results, and impact. Supplement the internal M&E system with an independent external M&E system for the benefit of the project management team.

Establish an effective outreach and communications system from the start. This system should promote emerging best practices, share success stories, disseminate knowledge and experience about consortiums that perform well, and share the emerging outcomes of the project with policy makers, the scientific community, and general public. The communications system will use a range of media and formats (not simply print, or scientific journals, but electronic and visual media in appropriate languages) if it is serious about reaching stakeholders and the public.