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Agricultural Technology Management Agency (ATMA):
A Study of its Impact in Pilot Districts in Bihar, India

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Introduction

The basic extension machinery in India and Bihar is the outcome of the short-lived Grow More Food (GMF) campaign that was started by the then Food Minister Shri K.M. Munshi in 1947. This campaign was unsuccessful for want of a formal extension organization. In 1948, Albert Mayer spearheaded the first post-independence extension program in the district of Etawah, in Uttar Pradesh. This was the first example of peoples' participation in rural development. It also marked the beginning of the multi-purpose, village extension worker that exists even today in India. Experiences generated through this pilot project were the precursors of the Community Development Programme (CDP) that was initiated in 1952 by the Indian Planning Commission.

The CDP was conceived as the main instrument of rural transformation in the country. The Ministry of Community Development and Cooperative was constituted to implement this project on a pilot basis in 55 project areas having 300 villages and a population of 200,000. The block was taken as the basic unit of development and administration. At this level, a team of subject matter extension officers were posted to undertake extension work in the fields of agriculture, animal husbandry, cooperation, rural industries, social education, etc. Since rural people responded favorably to the CDP, the program was scaled up in 1953 as the National Extension Service (NES) to provide widespread extension coverage and with more people's participation. This arrangement became the permanent extension setup for the country.

The late 1950s saw large-scale food deficits, thus compelling the Government to abandon its comprehensive rural development strategy and to concentrate solely on increasing food production. In April 1959, an agricultural production team sponsored by the Ford Foundation highlighted the importance of food self sufficiency. This team, in its report entitled "India's Food Crisis and Steps to Meet It," suggested that intensive efforts should be made to increase food production by using a combination of technical know-how and concentrating manpower and resources in selected areas. This was the beginning of the Intensive Agricultural District Program (IADP) or, as more commonly known, the *Package Program*.

The introduction of the Training-and-Visit (T&V) Extension system was an important milestone in the history of extension in India. The basic premise of T&V was that there was enough technology available awaiting diffusion to and adoption by farmers. The T&V Extension system was first introduced in 1974–75 on a pilot basis in the Chambal Command area of Rajasthan and Madhya Pradesh. Based on positive feedback, the project was further extended to 17 other states in 1978–79. Thus the CDP's multi-purpose approach was gradually replaced by a single-line of command extension system that focused on the major food grains toward the national goal of food security.

Problems and Constraints

The Training and Visit (T&V) Extension System was effective in disseminating *Green Revolution* technology, especially in the high potential, irrigated areas, but it had little effect on the productivity and incomes among farmers in rainfed areas. In addition, by the early 1990s, many other systemic problems were apparent:

- The introduction of T&V Extension *greatly expanded the number of village extension workers* (VEWs) in the Department of Agriculture (DOA), resulting in long-term financial problems for state governments. Since most state government funds go for salaries, most extension activities are dominated by top-down, central government programs.
- Government's continuing focus on increasing food production resulted in *extension being commodity and supply-driven*, in contrast with a focus on diversification and farm income (i.e., *being more market-driven*).
- Dissemination of Green Revolution technology substantially increased the production of food staples; therefore, commodity prices fell during the 1980–90s resulting in *declining farm income*.
- The emphasis on food security during the 1960–80s resulted in an extension system that was limited to the staple food crops and dominated by the DOA. The other line departments, including Animal Husbandry (DAH), Horticulture (DOH), Fisheries (DOF), Sericulture (DOS), etc., had a very limited extension staff, virtually no extension programs and operated separately from each other. As a result, there was no integration of programs across departments (i.e., lack of a *"farming systems" approach*)
- By the 1990s, the line departments primarily focused on the distribution of centrally funded subsidies and inputs. This situation had the following effect:
    - Line department staff became increasingly *accountable to government*, rather than to farmers;
    - Since government was partially involved in input supply, the government field staff viewed private input supply dealers more as *competitors* than as partners;
    - Given this focus on central government schemes, there was less need for extension to work closely with researchers, resulting in *weakening research-extension linkages*.
- Finally, with the exception of donor sponsored schemes, extension gave very little attention to *organizing farmers into groups* and, thereby, empowering farmers.

Need for a Decentralized Model

The main extension system primarily responsible for delivery of technical messages is operated by the State Department of Agriculture (DOA), through the state, district and block level machinery. Other state governments departments, such as Animal Husbandry, Horticulture, Soil and Water Conservation, and Fishery have been providing very limited extension services. The research centres and agricultural universities play a very limited role in extension service. The system however is more pre-occupied with implementation of a number of central and state sector schemes having input/subsidy delivery. The performance of the main extension system has been adversely affected by the difficulty in recruiting and retaining extension staff due to budgetary constraints, depleting operational support and inadequate technical background of the majority of the staff commensurate to the changing scenario of agriculture, resulting in the dependence of farmers on input dealers and others, as sources of information. Their role in technology up-scaling has been minimal and even non-existing.

During the mid-1990s, the Government of India and the World Bank began exploring new approaches to extension that would address these system problems and constraints. The result was a new, decentralized extension approach, which would focus more directly on agricultural diversification and increasing farm income and rural employment. The central institutional innovation that emerged to

address these system problems was the Agricultural Technology Management Agency or "ATMA" model that was introduced at the district level to:

1. Integrate extension programs across the line departments (i.e., more of a farming systems approach),
2. Link research and extension activities within each district, and
3. Decentralize decision-making through "bottom-up" planning procedures that would directly involve farmers and the private sector in planning and implementing extension programs at the block and district-levels.

This model was pilot-tested through the Innovations for Technology Dissemination (ITD) component of a World Bank-funded, National Agricultural Technology Project (NATP) that became effective in 1998 and concluded in June 2005. As a follow up on the success of ATMA model under ITD component of NATP the Govt. of India has initiated a new Centrally Sponsored Scheme on Support to State Extension Programmes for Extension Reforms, and had funded the setting up of Agricultural Technology Management Agency (ATMA) in all 588 rural districts in India. The ATMAs are expected to support the state extension system by making it more broad-based and participatory for planning, implementing and monitoring the extension activities of a district.

The next sections of this paper describe how this decentralized extension model was organized and how it operates. Further, the impact ATMA of model in the overall development of extension system in Bihar has been discussed.

Formation of ATMA in pilot districts under NATP-ITD

The National Agricultural Technology Project (NATP) was initiated in India with World Bank support in year 1998 and phase wise ATMAs were established in pilot project districts. ATMA was considered a dynamic instrument of introducing major changes in the Agricultural Research and Extension systems of the country, besides developing their capabilities to meet future challenges. The project was initiated by Ministry of Agriculture, Govt. of India with the financial assistance of World Bank and would be implemented with the assistance of MANAGE in 28 districts covering 7 states, viz. Andhra Pradesh, Bihar, Jharkhand, Himachal Pradesh, Maharashtra, Orissa and Punjab over a period of 5 years (1998-2003) which was further extended up to June 2005 with the concurrence of the World Bank.

The Extension component termed as **"Innovations in Technology issemination"(ITD)** envisages an integrated extension delivery at district level and is being pilot tested in seven participating states, viz. Andhra Pradesh, Bihar, Jharkhand, Himachal Pradesh, Maharashtra, Orissa, and Punjab.

The purpose of this component was to test new approaches to technology transfer, new organizational arrangements, and operational procedures. One of the goal is to decentralize decision making to the district level through the creation of Agricultural Technology Management Agency (ATMA) as a registered society. The second goal is to increase farmer input into programme planning and resource allocation especially at the block level and increase accountability to stakeholders. The third goal is to increase programme coordination and integration. Funds would be provided to 28 pilot districts in seven states to create Agricultural Technology Management Agency which will bring together researchers, extensionists, farmers and other stakeholders (including NGOs and the corporate sector) to make, on the basis of joint diagnostic studies, district Extension Plans and recommendations for expanded adaptive research to introduce innovations in technology dissemination matched to local needs and characteristics.

Four districts in each of the seven participating states are identified for pilot testing as detailed below.
Andhra Pradesh : Kurnool, Prakasam, Adilabad and Chittoor
Bihar : Muzaffarpur, Madhubani, Munger, Patna Rural
Jharkhand : Dumka, Jamtara,Palamau,Chaibara
Himachal Pradesh : Shimla,Hamirpur,Kangra,Bilaspur
Maharashtra : Ahmednagar, Amaravati, Aurangabad, and Ratnagiri
Orissa : Khurda, Koraput, Ganjam, Sambhalpur
Punjab : Gurdaspur, Jalandhar, Sangrur and Faridkot

In each of the pilot districts, an Agricultural Technology Management Agency(ATMA) was established as a registered society for integrating research and extension activities.

Table-1: Details of Phase-wise establishment of ATMAs under NATP in Bihar[1]

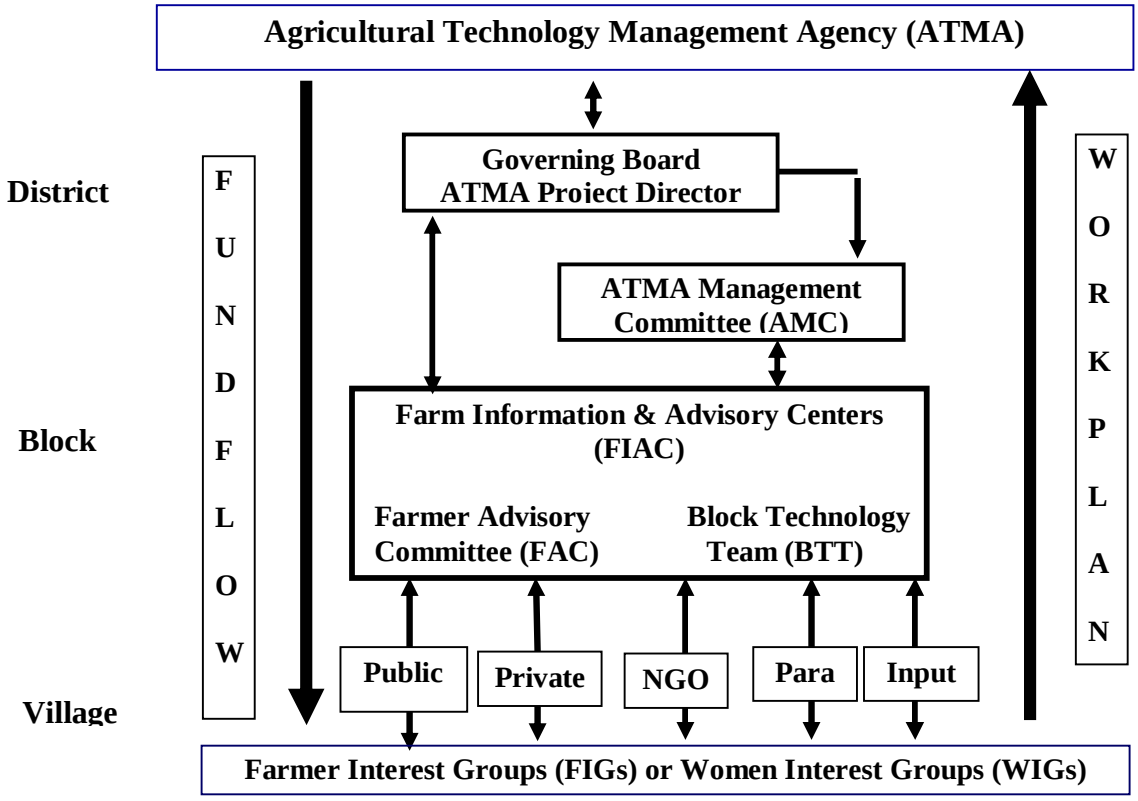
Phase	Name of ATMA district	Year of Establishment	Date of Establishment	Total Period up to June 2005
I	Dumka*	1998-1999		
II	Muzaffarpur	1999-2000	14-09-1999	5 years 9 months
III	Madhubani	2000-2001	08.05.2001	4 years 1 month
IV	Munger	2000-2001	10-05-2000	5 years 1 month
V	Patna	2002-2003	03-03-2002	3 years 3 months

ATMA Model

Overview: The Agricultural Technology Management Agency (ATMA) is an autonomous organization registered under the "Societies Registration Act of 1860" that has considerable operational flexibility. For example, it can receive and dispense government funds, enter into contracts, maintain revolving funds, collect fees and charge for services. In addition, it operates under the direction and guidance of a Governing Board (GB) that determines program priorities and assesses program impacts. ATMA is headed by a Project Director or PD who, reports directly to the GB. The PD serves as chair of the ATMA Management Committee (AMC), which includes the heads of all line departments and the heads of research organizations within the district, including the Krishi Vigyan Kendra (KVK) and Zonal Research Station (ZRS). Each district has a KVK; therefore, this multidisciplinary KVK plays a critical role in both on-farm research and training farmers in new production and value-added processing technologies. However, it is the PD that helps coordinate and integrate all agricultural research and extension activities carried out within the district. The organizational structure of the ATMA model is shown in Figure 1:

[1] ATMA Dumka was started as the 1st phase district of Bihar but with the bifurcation of the state of Bihar in year 2000 between Bihar and Jharkhand this pilot district went to Jharkhand and one new ATMA district in Bihar namely Patna and three new ATMA districts namely Jamtara, Palamau, and Chaibasa were selected in Jharkhand state.

Figure 1: Organizational Structure of ATMA



ATMA Governing Board: The ATMA GB sets program priorities and provides guidance as to how research and extension programs are implemented within the district. The composition of the GB provides an equal balance between the heads of the line departments and research units within the districts and the stakeholder representatives, including a cross-section of farmers, women and disadvantaged groups, and private sector firms within the district. The GB is chaired by the District Magistrate or Collector who is the highest ranking government official in the district; the ATMA PD serves as Member Secretary.

ATMA Management Committee: The ATMA Management Committee (AMC) serves as the Secretariat of the GB and helps coordinate and integrate research and extension activities within the district. Program requests come from each block and the AMC scrutinizes these requests on the basis of technical, financial and management criteria. The AMC then sends these requests to the GB for review and final approval.

ATMA Personnel: By design, the number of personnel assigned to ATMA's headquarters is very small, so this organization does not become another government agency. The ATMA staff includes the PD, a deputy project director (DPD), an accountant, computer operator, secretary, driver and watchman. With the exception of the PD and DPD, all of the support staff is hired on a contract basis, so they do not become government employees.

Farm Information and Advisory Centers (FIACs): Established at the block-level FIAC in each project district and by design has become the single-window delivery mechanism for extension programs within the block. It has two arms, namely; Block Technology Teams (BTTs) and Farmers Advisory Committee (FACs) as described below

BTT: It includes technical officers from the Departments of Agriculture, Horticulture, Plant Protection, Soil Conservation, Animal Husbandry (including Veterinary Service), Fisheries, Sericulture, Cooperatives and Marketing. TThe most senior officer within the block serves as the head or convener of the BTT. The role of the BTT is to consult with the Farmer Advisory Committee (FAC) and then to develop a comprehensive extension program called a Block Action Plan (BAC) that is consistent with farmer needs.

FAC: FAC is composed entirely of farmers who represent different socio-economic categories of farmers within the block. The role of the FAC is to advise the BTTs on extension priorities for the block. In addition, the FAC reviews and approves the annual BAPs prepared by the BTTs before they are submitted to the ATMA for funding. Then, the FAC monitors and provides feedback to the BTT on BAP implementation. In short, these FACs have become an integral part of the formal feedback mechanism between farmers and the heads of the research and extension programs within the district.

Farmer Interest Groups (FIG): One important objective of the ATMA approach is to redirect extension activities toward diversification into high-value crops and products and the overall goal of increasing farm income and rural employment. Therefore, in pursuing this market-driven approach to extension, it became essential to get farmers organized around specific crops or products where there is market demand and that are appropriate for the agro-ecological conditions and resources of different farmer groups. In addition, to successfully supply different markets, it was also essential to get these groups organized to achieve economies of scale and to create an efficient supply chain. Once these different FIGs are organized at the village level, they soon began to organize along crop or product lines as block-level farmer associations (FAs) and district-level Farm Federations (FFs).

The present study

Final impact assessment included both the process and outcome of the project on the crop yields and farmers' income, etc. assessment of impact on the technology dissemination system and processes was conducted over the period of three years (from 2002 to 2004) by IIM, Lucknow along with routine monitoring & evaluation at different levels, i.e., state, district, block and village levels. In addition, special field visits were made to revisit the data collected by the IIM, Lucknow so as to have a comprehensive and terminal assessment of the functioning of the new institutional arrangements being pilot tested in the project districts.

For evaluation of field level impact of ATMA model, beneficiaries (target farmers) were compared with themselves across the pre-intervention and post-intervention scenarios. To facilitate such temporal comparison of agro-economic situations facing the target farmers, baseline and impact assessment surveys were conducted to reflect upon pre-intervention and post-intervention scenarios respectively. Further, in order to provide reflections upon 'with project' and 'without project' situations inclusion of out-of-project area farmers in the sample was necessary, and accordingly sample farmers from control districts were also covered under the study.

Methodology

The baseline taken for the study was the same as done by IIM, Lucknow during the period of June-July 2002, which was more on recall basis with reference to the pre-project crop year. Reference crop year for baseline survey, therefore, varied from district to district depending upon the year of project launch. The impact survey by IIM, Lucknow was conducted during the period June-July 2004, with reference to crop year 2003-04, however during revisiting for the current study, data was also recorded for crop year 2004-05 from the same set of sample villages and farmers.

The study was conducted through pre-tested semi-structured interview schedule keeping in mind the final output and outcome/impact indicators. The units of data collection included selected households as well as community organizations (FIG and SHG, etc.). Sample units were selected through multi-stage stratified random sampling method. Adequate number of sample households representing different farm-size classes was selected from each region. In order to have a comparative picture of temporal changes in non-project areas vis-à-vis project area, a set of households from non-project district were also selected (table-2). For comparison, three villages equidistant from three circles/clusters of equal distance from non-project districts were selected randomly as control.

From each of the project districts 9 representative villages (3 villages from each of the three equidistant blocks) and 15 farmers (from each selected villages) representing different land holding classes were selected randomly. Similarly, 15 sample farmers from each selected villages from non-project district, representing different farm-size classes were selected as control. Total sample size was 540 (405 from project districts and 135 from non-project districts)

Table- 2: Number of selected districts, blocks, villages and farmers in different districts

Particulars	Project district	Non-project district (Control)	Total
Districts	1	1	2
Blocks	3	1	4
Villages	9	3	12
farmers	135	45	180

Impact of the project

Impact can be seen in two parts (1) Process change and (2) Farm level changes. Since the main focus of the project was to change / improve the existing process of technology dissemination system, through creation of various new institutions and strengthening the existing ones, it was expected that flexibility in systems would respond positively in facilitating the introduction of new crops/ enterprises, enhancement in yield and income as the intermediate output. This exercise needs to be broadened by including issues relating to overall developments such as NRM, Rural Development, Post-Harvest Technology and Marketing issues. Interventions undertaken by ATMA have resulted in multifarious outcomes, ultimately leading to greater impact even during a short span of time. The impact could be perceived from various angles such as strategic planning changing the mindset of people with coordinated/ integrated community approach, operational changes with flexible decision making system, use of IT tools and media, strengthening of institutional linkages specifically for research and extension, effective coordination between all stakeholders, focus on gender issues, bringing in eco-friendly outputs and helping to address poverty in the rural areas. Final outcome was

observed in the improvement of quality of life and empowerment of farming community, including women leading to the sustainability of the approach/ system and equity.

Overall Performance of the Project:

Table I clearly shows that overall performance of the project has been quite successful and effective in creating several institutions for strengthening the process of both development and dissemination of new/ improved technologies. This has been quite effective in facilitating the identification of real constraints faced by the farmers and adoption of new technologies/ farm practices, new enterprises, etc. promoted by the project. The information technologies have also started playing effective role and farmer-led extension has empowered farming community, including women. The time-lag in adoption of new technologies has considerably reduced and weaker sections of the society also have benefited from this process strengthening.

Table 3- Performance Indicators of the Project:

S.No.	Performance Indicators	Units	Baseline	Actual
I. Impact Indicators				
1	Absolute Income Gain In Project Districts	Rs./ household/Year	61256	68797
2	Absolute Income Gain In Non-Project Districts	Rs./ household/Year	60512	66951
3	Net Gain In Household Income In Project Districts household Over Non Project Districts household	Rs./ household/Year	744	1846
4	Per Household Annual Income a. Project Districts b. Non-Project Districts	Rs./year	 89049 93542	 99423 85331
5	Adoption Ratio Of ATMA Field Programme-Training Activities a. Small Farmers b. Medium Farmers c. Large Farmers d. Overall	% of targeted farmers		 80 74 82 79
6	Percent Farmers Adoption New Technologies And Practices In Project Districts - IPM/INM - Medicinal & Aromatic Plants Cultivation - Horticulture - Fishery, - Bee Keeping -Dairy - Vegetables	Range in %		 24.03 to 34.23 0.1 to 0.7 28.9 to 29.4 0 to 3.5 0 to 0.7 9.6 to 15.6

				26.2 to 28.9
7	Inclusion Of New Enterprises In Existing In Existing Farming System In Project Districts.	Range in %		25 to 43.3
8	Cropping Intensity a. Project Districts b. Non-Project Districts	%		 196 194
9	Benefits Of Adopting New Technologies - Increase In Crop Yield - Increase In Farm Income	%		 13 14
10	Farmers in project districts/ village adopting released management and technological options/ interventions	%		50
11	Number of significant new technology options facilitated/ developed and adopted by farmers	No.		10
12	**Reduction in lags due to NATP for adopted technologies**			
	Research	Years		1-2
	Adoption	Years		1-2
13	**Improved Research-Extension-Farmer linkages**			
A	**Farmer' visit to extension officers and scientists**			
	Village level workers	%	10.28	28.72
	Block level line department officers	%	13.82	50.35
	District level line department officers	%	3.90	26.95
	NGOs	%	0	6.38
	Extension staff of agri-business enterprises	%	11.70	29.43
	Scientists of SAU/ZRS/KVK	%	10.28	31.20
B	**Visit of extension officers and scientists to farmers**			
	Village level workers	%	8.10	31.56
	Block level line department officers	%	12.05	51.06
	District level line department officers	%	3.50	30.14
	NGOs	%	0	7.09
	Extension staff of agri-business enterprises	%	1.77	26.95
	Scientists of SAU/ZRS/KVK	%	5.31	23.04
14	**Women Empowerment**			
	Training programmes organized for women's technological empowerment	No.		418
	Women trained for technological empowerment	No.		13555

	SHGs formed for Women empowerment	No.		411
	Villages covered for SHG & empowerment	No.		148
II	**Outcome Indicators**			
A	**Institutional Development**			
1	Farmer representation in new institutional setup at District and Block level a. ATMA-GB b. FAC			 27 69
2	Extension activities coordinated and monitored by Inter-Departmental Working Group established in project Districts	%		100
4	ATMA GB having representation of farmers and other stakeholders takes policy decisions, prioritizes and allocates budget, reviews progress and coordinates activities in project districts	%		100
5	FAC reviews BAP, prioritizes and monitors the activities within blocks	%		100
6	BTT actively involved in preparation of BAPs and implementation of programmes and activities	%		100
7	Autonomous agriculture management and extension training institutes focusing on farmer-driven extension agenda fully functional in project state	No.		1
8	Number of public private partnerships established in extension	No.		24
9	Farmers aware of ATMA institutions	%		47.8
B	**Operational Innovations**			
1	Technical support in SREP preparation and operationalization provided by MANAGE (%)	%		100
2	Activities are reviewed/ coordinated and monitored by Inter-Departmental Working Groups established in each project state (%)	%		100
3	Nodal Officer has been identified to facilitate and coordinate the project activities (%)	%		100
4	Fund flow mechanism streamlined	%		100

	(%)			
5	Operational guidelines on Procurement and Reimbursement, financial powers of the PIAs, Audit and Account, SREP preparation, R-E linkages etc. have been developed and circulated among PIAs (%)	%		100
6	GB approval for plans, priorities and allocations to PIAs (%)	%		100
7	Resources generated by ATMAs and SAMETIs	Rs. Million		0.54
III	**Output Indicators**			
1	Constitution of IDWG at state level	No.		1
2	SAMETI –creation of new SAMETI	No.		1
3	Establishment of ATMA in project districts	No.		4
4	Creation of BTT at block level	No.		69
5	Creation of FAC at block level	No.		69
6	Establishment of FIAC at block level	No.		69
7	Organizing farmers into groups (FIG/SHG/FO) to review and disseminate technology and to solve their farm related problems	No.		2708
8	Male and female representatives (Lead farmers) trained to share technology dissemination responsibilities	No.		35189 (M) 13555 (F)
9	Demonstrations undertaken using new technologies	No.		369
10	Exposure visits (No. of farmers, non-officials, officials)	No.		1664

Process Improvement

Demand-Driven Extension

Participation of farmers in GB, AMC and FAC provided them an opportunity to highlight various problems facing the farming community. In addition to giving feedback on action plans prepared by extension officials, farmers have also been raising different issues of wider relevance. Thus, farmers played an important role in setting extension priorities of the district. With accountability to solve farmers' problems and in-built operational flexibility, ATMA made suitable interventions**.** Earlier the officials were more particular about instructions from their superiors and farmers were not in a position to insist on their suggestions. With new institutional arrangements farmers' position was strengthened, with change in officials' approach and now, farmers have some say in extension planning and officials now listen to the farmers. Some examples of demand-driven extension are:

- Cultivation and processing of medicinal & aromatic plants in Bihar initiated by the ATMA, Patna and later on adopted by other ATMAs of the state.

- (Note: ATMA, Patna acted informally as nodal agency for technology dissemination for aromatic and medicinal plant for the entire state. The agency provided technology for the cultivation, processes for harvesting the yield and post harvest management. The highlight of the effort was to provide market linkage for the producer. As a result of these effort approximately, 400 ha. of land has been brought under this cultivation.)
- Preparation of Directory of Service Providers by ATMA, Patna.
- Establishment of Info Shops on P-P-P Mode by ATMA, Madhubani.
- Training and exposure visit of farmers of all ATMA to IIVR, Varanasi on cultivation of Exotic Vegetables.
- Training, exposure visits and demonstrations on vermi compost production as per need of the farmers for replacement of inorganic fertilizer in all the ATMA of Bihar.
- Successful introduction of organic cultivation of Paddy and vegetables for getting higher returns in by ATMA, Patna, Munger & Madhubani.
- Demonstration of Integrated Farming as a better substitute to Horticulture or fisheries alone in ATMA, Munger.
- Demonstration of Integrated farming comprising floriculture, medicinal & aromatic plants and vegetables by ATMA, Patna.

These examples show that extension system is responding well to farmers' demands and problems. ATMA did not limit them to SREP; rather they accommodated farmers' needs that come intermittently during the implementation. However, regular need assessment at local (block and village) level has not yet become a normal practice.

Bottom up Planning

The traditional top-down approach of planning has been reversed and now planning process has started from the lower level. Strategic Research and Extension Plan (SREP), which was prepared at district level after identification of technological gaps through participatory field assessment was introduced for the first time. This was a clear departure from the traditional approach, provided need-based priorities of the farmers, and had wider coverage of crops and enterprises. Numerous technological gaps in different crops and enterprises were identified, which were earlier never assessed in such a systematic manner.

The SREP contained technology and adoption issues/gaps regarding different crops and enterprises of the district and helped in preparing suitable research and extension strategies, SREPs of second-phase districts (Madhubani) were re-visited and modified accordingly to address emerging issues. Thus, SREP prepared and used under the project was really dynamic document helping not only for the implementation of field program component of the project but also for regular activities of agriculture and other line departments. Subsequent to identification of issues/gaps, plans were prepared for addressing them. FIACs prepared block action plans based on the local needs of the farmers. Block action plan were thoroughly scrutinized and then approved by Farmers' Advisory Committee (FAC) Based on the feedback of farmers and their local conditions these plans were prioritized for implementation.

After approval from FAC, block action plans were submitted to ATMA office and it was further scrutinized by AMC for their technical and financial soundness. ATMAs took innovative step of organizing annual planning workshops involving extension officials, scientist, farmers, FIAC, GB and AMC members before finalization of action plans. This management facilitated fine-tuning of proposed intervention in accordance with farmers' needs and priorities along with research findings. After thorough discussion with farmers' needs and priorities along with research findings, discussion in AMC, block action plans were consolidated into district action plan for extension activities. By adding

plan for HRD and capacity building at district level and infrastructure aspects an Annual Action Plan or Investment Proposal was prepared by the ATMAs office and submitted to Governing Board for its approval after thorough discussion. Since GB comprised to both officials and farmer member's the action plan got consent of all stakeholders. Finally, AAT/IP was submitted to the Technology Dissemination Management Committee (established in the Ministry of Agriculture, Government of India) for consideration and approval.

First-phase Project districts got sufficient time of about five years to address most of the extension issues but other Project districts which started functioning late could only partially cover such extension issues. Bottom-up planning process could also contribute in capacity building and empowerment of farmers. Awareness among farmers about the recommended technologies for various crops and enterprises has also increased and now they are better placed to put their demand on the extension system through grassroots workers and FAC.

Integrated Technology Transfer System

It was observed that the multi-point disjointed system was replaced by an integrated technology transfer system and has started working in planning, extension and review of extension activities. The ATMA, Governing Board (GB) provided robust integrating–mechanism for proper decision-making, guidance, review and control towards integrated delivery of services. The ATMA Management Committee (AMC) at district level and Block Technology Team (BTT) at block level brought the line departments together for planning, implementation/delivery, review and reporting the extension activities in an integrated manner. FAC provided feedback to the BTT on the needs and problems facing the farmers of the concerned area. Integrated approach was also reflected in prioritization of extension interventions for farming system. After integrated/holistic (with respect to farming system) planning line departments took up implementation of various selected activities individually under the coordination of AMC and BTT. Such integrated system became functional both at the district and block level but, village level integration could not take concrete shape. However, it was also observed that the project performance was more PD-centric and the experiences indicate that even village level integration is quite possible. Integrated implementation of field activities during last five years clearly indicate that such a system is workable, provided is strong commitment on the part of state governments to internalize and mainstream these new concepts.

Broad Based Extension System

A good beginning has been made and now the system is planning its activities for field crops, tree crops, animal husbandry, fisheries, etc in integrated manner at common crops, tree crops, animal husbandry, fisheries, etc in an integrated manner at common platforms (Such as ATMA Management Committee) at district level and (Block Technology Team) at block level. Narrow focus of extension system was widened and as extension was no more limited to major cereals and providing subsidized inputs. Efforts were made to introduce less attended crops such as coarse cereals and minor horticulture crops into the farming system. More than 45 per cent of FIGs have adopted new crops than major cereals. New technologies focusing on environment and sustainability like IPM, organic farming, natural resource management etc, were adequately promoted by the project. Moreover, new extension system could divert its attention from distribution of subsidized inputs to transferring the complete technology to farmers. Farmers could immensely benefit from training, exposure visit and demonstrations on the latest technology.

Mobilization of Communities

The farmers groups were encouraged at village level and these groups in turn, evolved into commodity associations, marketing cooperatives at the block and village level. This approach has brought the field

functionaries more closely to the farmers and facilitated them to understand their problems and ground realities. ATMA have adopted two pronged approach towards farmers/ community mobilization on one hand new farmers groups were organized and on the other existing groups were identified and oriented with the ATMA system. This has helped the farmers providing them easy access to new technologies, collective procurement of inputs as per their needs and disposal of their produce at a better negotiable price than the practice in past i.e. individual approach. It has helped to a great extent in diversification and introduction of new commodities/ areas. A large number of success stories have been witnessed with the community approaches in various areas namely seed production, diversification, production of milk, fruits, (mango and litchi) and vegetable, organic farming, aromatic and medicinal plants, mushroom production, fisheries, floriculture, etc.

Decentralized Decision Making

Apart from reversing the planning process (from top-down to bottom-up) decision-making has also been decentralized to a great extent. After approval of the Annual Action Plan of ATMA the funds were directly released to the ATMA from Govt. of India. ATMA office in turn releases project funds directly to the Officer In-Charge of Block Technology Team against the GB-approved Block Action Plans. Such mechanism of keeping the state government and district heads of line departments out of fund flow channel (for field program component) has proved quite useful. The ATMA Governing Board was fully authorized to sanction any activity towards agricultural development of the district. District Technology Plans were prepared (by AMC) and finalized (by GB) at the district level. Such district plans were nothing but compilation of block plans after their technical and financial scrutiny by AMC. Block plans were prepared and finalized by the Block Technology Team in consultation with FAC. ATMA were allowed to make permanent adjustment up to 10 % and temporary adjustment up to 100 % in the approved plan. This arrangement provided ATMA ample flexibility to alter even approved plan depending upon intermittent requirements. Decentralized decision-making mechanism and in-built operational flexibility enabled ATMA to take innovative steps and respond promptly and adequately to farmers' needs/problems.

Convergence of programmes

The process of dovetailing has already begun whereas convergence would require policy decisions by government. In addition to integrated planning and implementation of extension interventions, ATMA tried to undertake dovetailing of their activities with schemes of line departments with some successes. Such dovetailing has benefited in two ways. On one hand, it has improved the extension efficiency due to farmer involvement in planning and implementation and on the other; it has bettered the effectiveness of departmental schemes resulting in better adoption due to capacity building of beneficiaries.

Market-Led Extension

With the globalization of market, farmers have to transform themselves from mere producers-cum-sellers in the domestic market to organized market driven production as per consumer demand to realize the better returns on investments, risks and efforts. Effective linkages of production systems and marketing, agro-processing and value added activities would play an increasingly important role in the diversification of agriculture. Market-led-extension system establishes its position by helping the farmers realize high returns for the produce and minimize the production cost and improve the product value as marketability. A number of capacity building programme on Market Led Extension, WTO and its implications, change management in agriculture sector were organized and the field level functionaries from line departments, scientists from SAU/KVKs, Innovative farmers representing various commodities/ enterprises, NGOs, Private Sector etc were involved in these programmes.

Public- Private Partnership

In the wake of increasing involvement of private sector in agricultural extension in meeting the multifarious demands of the farming community, Public-Private Partnership in various modes / forms can provide synergistic approach in the extension efforts. Thus, Public-Private Partnership has emerged as one of the crucial areas in agricultural extension. All the four ATMAs have taken initiatives to develop partnership with the private sector like processing industry, farmer's organizations, cooperatives, corporate bodies etc. in different areas. Despite all support and encouragement NGOs were not actively involved prior to ATMA concept, they have now been brought to mainstream by assigning them specific roles. This partnership has facilitated dissemination of technologies, supply of quality inputs (seed, fertilizers, micro-nutrients, bio -fertilizers, pesticides and bio-pesticides and other technological tools) and marketing of farmers produce.

Partnership for Sustainability

Some ATMAs also charged a small fee for rendering their services in form of transfer of technology, training, exposure visits, and membership of FIG/WIG etc. This showed the acceptability of ATMA concept among the farming community and also change in the mindset of the farmers from subsidy oriented extension services to cost sharing for these services. Besides, ATMA has been successful in roping in good NGOs in mobilising and organising farmers into FIGs/WIGs, conducting training programmes on cost sharing basis and other extension activities without sacrificing on quality and cost. ATMA have also been successful in orienting NGOs for self sustenance. It is important to note here that, though the full cost is not being recovered at present but it gives an indication that in future extension activities can be taken up on full cost sharing basis. This has also given an opportunity towards sustainability of the institution beyond project period. Some of the examples are given below:

- Charging for study tours, trainings and demonstrations.
- Charging for supply of inputs such as seeds, IPM kits, fingerlings, Artificial Insemination services,
- Fee for testing of soil samples wherever laboratory / diagnostic clinics were available
- Consultancy services to corporate and other stakeholders
- Providing infrastructure on hire basis
- Sale of publications and CDs

Farmer-To-Farmer Extension

Project experiences indicate that farmer-to-farmer extension is quite efficient (cost-effective) and effective (leading to good adoption). Majority of ATMA have developed a pool of Farmer Resource Persons who are by and large FIG/WIG leaders, extending technical know-how to farmers/ farmwomen in their area of expertise.

Impact of ICT Interventions

The most visible impact of ICT interventions under ITD component of NATP has been the increased awareness and technical capacity building of ATMA and FIAC staff and officers. The ICT capacity building has also helped the ATMA staff to develop different matrices for collation and submission of monthly, quarterly, annual reports/ returns, reimbursement claims, office accounting, documenting the project achievements and also share their successes across the state and so also at national level. The reporting improved in terms of regularity, consistency and also in terms of articulation. The ICT initiatives have facilitated Public-Private-Partnerships in dissemination of technologies. The ICT intervention under ITD component of NATP has made significant and long-term positive impact in improving R-E-F-M linkages by:

- Providing reliable connectivity and state-of-the-art infrastructure at District level;
- Providing market and technology related information to the farmers and other stake holders;

- Providing in-depth and on the job Training support to ensure optimal use of ICT infrastructure;
- By promoting media linkage and coverage of Agricultural Institutions/ Agencies and their programmes;
- Establishing new models of public-private-partnerships; and
- Hoisting web sites for the benefit of all stake holders.

Gender sensitization

Women participation in agriculture has been well recognized by all the development agencies. Accordingly, due importance was given at every level. Women were involved in decision-making system right from the level of GB to FAC. Two non-official members representing the interest of women farmers and NGO were represented on ATMA Governing Body. The provision of nominating 30 per cent non-official women representatives on GB, ATMA was followed meticulously. Women participation was quite encouraging at grass root level in FAC meetings. A number of different positions in different PIAs were also occupied by women. The participation of non-official women members on decision-making bodies had also helped in involvement of women farmers in various field activities. Over 13,555 women farmers have been benefited with the new technologies through exposure visits, farmers training and demonstrations under the ATMA activities. More women groups have been developed in vermi-composting, dairy, bee keeping, floriculture, mushroom cultivation, vegetable cultivation, backyard poultry and more particularly women groups were more active in preparation of food processing.

Environmental issues

Majority of the ATMA have promoted eco-friendly technologies namely use of Integrated Pest Management (IPM) by promoting bio-pesticides and neem cake, Integrated Nutrient Management (INM) by use of green manuring, improved soil and water conservation practices, by changing the cropping patterns and organic farming, promoting the use of Vermi-composting.

Farm Level Impact:

The field level impact of various interventions on the farmers has been provided in the following section.

Operational holding

Operational holding is defined as total holding owned by a household minus net land cultivated on lease, excluding permanent fallow. Average operational holding was observed to be the largest in Munger (3.02) and the smallest in Madhubani & Patna in case of project district and Banka (3.48) being the largest in non- project district and Nalanda and Darbhanga being the smallest. Over the period, size of operational holding has marginally increased in Munger (0.48) followed by Madhubani and Patna. The acquirement of additional cultivable land by farmers is possibly attributed to the better prospects of income from farming due to emerging diversification and value addition in their farm produce.

Table 4: Average operational holding per household (ha) in different Districts

	Project District			**Non Project District**		
	Patna	**Munger**	**Madhubani**	**Nalanda**	**Banka**	**Darbhanga**
Baseline	2.04	3.02	2.04	2.18	3.48	2.18
Current	2.22	3.5	2.22	2.18	3.48	2.18
Change	0.18	0.48	0.18	0	0	0

Irrigated area

Proportion of gross cropped area receiving irrigation shows that Madhubani and Patna had relatively higher irrigated area compared to other districts and the increase in the irrigated area was also high in both the project and non-project districts. It is also clear from Table that in the project districts intervention was able to increase irrigated area but in the non-project districts, also increased in irrigated area was due to various on-going programmes. However, interventions were quite effective in the project districts because of joint effort of various line departments.

Table 5: Percentage irrigated area (as % of gross cropped area) in different districts

	Project District			**Non Project District**		
	Patna	**Munger**	**Madhubani**	**Nalanda**	**Banka**	**Darbhanga**
Baseline	93.5	65	93.5	92.6	90	92.6
Current	97.3	83.7	97.3	97.7	94.6	97.7
Change	3.8	18.7	3.8	5.1	4.6	5.1

Cropping Intensity

The change in the cropping intensity indicates that it increased marginally in both the projects and non-project districts but this increase was higher in the project districts Munger than in the non-project district, Moreover net increase in the cropping intensity was higher in those districts where it was quite low in initial period compared to those districts where intensity of cropping was quite high. This can be attributed to the fact that in the project district, efforts were made to introduce new crops; especially horticulture crops while in non projects districts efforts were made by various on going programme but was relatively weak and also major focus was on superior cereals (Table 6).

Table 6: Cropping intensity (Percent) in different districts

	Project District			**Non Project District**		
	Patna	**Munger**	**Madhubani**	**Nalanda**	**Banka**	**Darbhanga**
Baseline	199	147	199	185	185	185
Current	200	187	200	191	200	191
Change	001	040	001	006	015	006

Diversification of Cropping System

Apart from diversification on farming system as whole, the project also intended to diversify the cropping system through partial shift from cereal crops to more remunerative/high value crops such as Horticultural crops. The extent of diversification of cropping system was assessed comparing the cropping pattern across pre and post-project situations. On an average, in general some shift in the cropped area under horticulture, oilseeds and medicinal and aromatic crops from superior cereals was noticed in both the project and non-project districts. But across districts the shift was relatively higher in the project districts than in non-project districts in the state. However, across different project districts, the net shift area was quite high in Madhubani (14.26 percent as compared with Nalanda the non-project districts where the cropped area shifted by 15.62 percent (Table 7). These fluctuations may be attributed to the fact that in case of Munger the percent sown area in mustard declined due to poor market rates in the previous year and in case of Nalanda the demand price of potato increased and the sown area also increased marginally leaving scope for more expansion.

Table 7: Percent of gross sown area under horticulture crops and oilseeds

	Project District			Non Project District		
	Patna	**Munger**	**Madhubani**	**Nalanda**	**Banka**	**Darbhanga**
Baseline	7.5	4.5	3.31	14.58	0	0.61
Current	11.42	4.0	17.57	30.60	0	3
Change	3.92	(-)0.5	14.26	15.62	0	2.39

Households' affiliation with farmer's groups/organizations

One of the project objectives was to mobilize farmers, especially marginal and small farmers, into farmer's group's organizations and commodity associations. The main aim of mobilization of such farmer's organizations was to use them as channel for group-based technology dissemination and soliciting farmer's feedback and ensuring their active participation in the planning and implementation of research and extension activities. Project districts adopted two-pronged approach in this regard. On one hand new groups were mobilized and on the other, existing groups (that were formed under other schemes) were linked with the ATMA for their strengthening and use in meeting the project objectives.

Table 8: Percent of households affiliated with Farmer's Organizations

Project District			Non Project District		
Patna	**Munger**	**Madhubani**	**Nalanda**	**Banka**	**Darbhanga**
38.90	28.9	60.23	-	-	-

Table 8 shows that a higher number of households in the project districts were associated with farmer's groups/organizations as the project approached the groups rather than individual farmer. It may be noted that size of holdings in Munger was higher than in the other project districts. The mobilization of farmers in Interest Groups and Organization received tremendous response particularly farmers having small holdings, however, the farmers in project districts who were big enough and thus reluctant to join the groups. Most of them feel that their individual scale of farming operations is quite large and there was no pressing need for them to associate with the group. The formation of FOs and FIGs in the project districts were taken up extensively and received tremendous support and remarkably Patna which started in the V^{th} phase had 38.9 percent household affiliated with household in contrast to Madhubani formed in the II^{nd} Phase had 60.23 per cent groups, followed by Munger.

Awareness about ATMA institutions

Since ATMA and its modus operandi was a new concept for the research scientists, extension functionaries as well as well as mass farmers, it took long time in generating adequate awareness, especially among farmers. In view of utmost pertinence of such awareness, the impact study attempted to ascertain the level of awareness about ATMA and its different constituents. Awareness level of farmers was classified into 5 categories, viz, good, fair, average, poor and nil.

On the basis of awareness level, farmers were regrouped into aware and not aware. While aware includes the farmers having good, fair or average awareness about ATMA institution, while the not aware group comprises of those farmers who were either unaware or had only poor knowledge of such institutions. The percentage of farmers of project districts aware about ATMA institutions is given in the following Table 9.

Table 9: Percent of farmers in project districts aware about different institutions

Districts	ATMA	AGB	AMC	BTT	FAC
Patna	99	44	41	74	75
Munger	100	10	6	69	64
Madhubani	99	37	38	70	76
Overall	99.33	30.33	28.33	71	71.67

The information presented in the table 9, reveals that majority of sample farmers of project districts were aware about Agricultural Technology Management Agency as such, BTT and FAC. However, lesser farmers were aware about the ATMA GB and AMC. The observed pattern appears obvious because the emphasis was laid on popularization of ATMA concept as well as its block level operational mechanism of which BTT and FAC were the key constitutions. There was some spill over effect on the farmers of non-Project districts where a few of the farmers were aware about ATMA. ATMA Patna had a record number of farmers from various non project district visiting and getting research and extension support. ATMA, Patna played proactive role in familiarizing ATMA through setting up Farmer's Call Centre. Media focused on the activities of ATMA more vigorously as compared other on going agricultural projects as the mechanism and functioning of ATMA appealed more to them.

Farmers-Research-Extension Linkage

Improving research-extension linkage was another major objective of the project. To attain these objects, number of steps was taken in addition to in built institutional and operational mechanism .The governing board, management committee and block technology team provided robust mechanism for regular interface among research scientist, extension functionaries and farmers. In addition joint workshop and training programme were also organized; moreover, scientist and extension officers were sensitized to regularly interact with farmers in order to obtain their feedback on research and extension activities. The projects initiatives have wieldy positive results. The study attempted to assess the two-way linkage between farmers and extension officers of different levels and between farmers and scientists.

The two-way interaction between farmers and extension officers and between farmers and research scientists of Krishi Vigyan Kendra, State Agricultural University and Zonal Research Station has increased over the project period. Now more farmers are visiting/approaching extension officers and scientists for seeking their technical guidance on agriculture. Similarly, extension officer and scientists visit more farmers to provide guidance to them at their doorstep and obtain their feedback (table-10).

Table 10: Percentage Interface between farmers and researchers and extensions

Particulars	Project districts			Non-project districts		
	Baseline	**Current**	**Change**	**Baseline**	**Current**	**Change**
A. Farmers visiting: different extension officers and scientists						
Village Extension Workers	10.28	28.72	18.44	6.81	12.12	5.31
Block level line department Officers	13.82	50.35	36.53	1.51	10.61	9.1
District level line department officers	3.90	26.95	23.05	0	9.09	9.09
NGO	0.00	6.38	6.38	0	0	0
Extension staff of agri-business firms.	11.70	29.43	17.73	2.27	36.36	34.09
Scientists of KVK/SAU/ZRS	10.28	31.20	20.92	2.27	3.78	1.51
B.Extension officers and scientists visiting farmers						
Village Extension Workers	8.10	31.56	23.46	3.03	8.33	5.30
Block level line department Officers	12.05	51.06	39.01	0.75	3.03	2.28
District level line department officers.	3.50	30.14	27.64	0	2.27	2.27
NGO	0	7.09	7.09	0	0	0
Extension Staff of agribusiness firms	1.77	26.95	25.18	1.51	6.06	4.55
Scientist of KVK/SAU/ZRS	5.31	23.04	17.73	0	1.51	1.51

ATMA Governing Board and Management Committee provided common platforms for regular and face-to-face interaction among scientists, extension functionaries, and farmers. On the one hand, it improved awareness level of farmers and on the other, scientists' and extension personnel's understands of farmers' needs and problems. Some of the steps taken by ATMA for improving such linkages include organization of joint workshops, meetings and training programs. A few examples of such interventions are given in Table 11.

Table – 11: Interventions for improving researcher-farmer extension linkage.

S. No.	Selected Interventions	ATMA Districts
1	**Appointment of researchers as Project Directors and Deputy Project Directors**	Patna, Madhubani
2	Nomination of Project Director as member on Scientific Advisory Committees of KVKs and extension education council of SAD	All project districts
3	Linkages with KVKs and ZRSs.	All project districts
4	ATMA developed linkages with Farmers Advisory Services of the SAU.	All project districts
5	Joint activities of research and extension included on-farm trials, workshops, trainings, exposure visits to research stations, and interface with the scientists.	All project districts

The project substantially contributed in strengthening the R-E-F linkage. Extension system could put demands on research system and received feedback/solutions from them. Farmers also found their due place in this link-chain through representation in GB and AMC. Moreover, FAC has provided them an access to linkage mechanism through which they could articulate their problems and influenced research and extension priorities. However, in spite of the fact that farmers' feedback somehow reached to the research and extension system but this mechanism and loop is yet to take permanent shape, as FAC is yet to attain the desired institutional status.

Farmers could take their problems and queries to extension workers who themselves provided the solution or forwarded them to research system and got solution that was communicated back to the farmers. This could enrich the capacity of the researchers in responding quickly to the needs of the farmers and developing location-specific technologies. Besides, active participation of farmer's right from planning to implementation and close coordination between extension and research systems reduced the cost of technology dissemination and time lag in adoption of new/improved technologies. The process has started taking place in' the project districts. But it is just beginning.

Research system has become more and more demand-driven. Instead of issuing blanket recommendations on the identified problems (as expressed by the farmers) system carried out various adaptive trials and issued recommendations on those location-specific priority identified in the SREP. The adaptive research conducted so far was successful in providing solutions to many farming system related problems of the farmers. A few of the researchable issues identified in SREP and successfully taken up by KVKs / ZRSs for on farm research trials include:

Researchable Issues taken up by KVK/ZRS

- INM in rice-wheat based cropping system.
- Introduction of pest resistance to gene pool of Tal pulses
- IPM in vegetable based cropping systems
- Micro-nutrients scheduling for irrigated Rice-Wheat system
- Soil organic matter studies with green maturing to keep healthy balance of organic carbon in soil
- Introduction and validation of medicinal & aromatic plants cultivation in the district,

- Introduction of mushroom production technology and
- Introduction of commercial floriculture.
- Development of situation specific Tal pulses of required duration
- Introduction of organic cultivation of vegetables
- Introduction of vermi compost in farming system

Diversification of farming system

In ATMA's field program activities, the major emphasis was laid on diversification of the farming system as a strategy for risk management and sustainable income for the farmers. Farmers were motivated and trained through trainings, exposure visits to successful sites within and out of state and suitable demonstrations on the latest technology and practices. Table 13 a reveals that existing farming systems were diversified by inclusion of animal husbandry/dairying, horticulture, fisheries, goat rearing, poultry and bee keeping.

Table 13: Inclusion of new enterprises in the farming system in the project districts

New enterprise	Patna	Madhubani	Munger
Dairy/animal husbandry	25.00	10.8	32
Vegetable cultivation	8.69	10.8	25.8
Horticulture	3.26	-	1
Fisheries/duckery	-	7.5	1
Pig/goat/sheep rearing	-	-	-
Poultry	-		-
Bee keeping	2.17	4.30	-
Vermi Compost	4.34	-	1
Management of Nursery Farm	5.43	-	1
Aromatic & medicinal plants	8.69	-	-
Floriculture	3.26	-	-
Exotic vegetables	2.17	-	-

(Figures in % of adopting farmers)

Table 14: Inclusion of new enterprises in the farming system in the Non-project districts

New enterprise	Nalanda	Darbhanga	Banka
Dairy/animal Husbandry	2.20	17.80	0
Horticulture	0	0	0
Fisheries/duckery	0	0	0
Pig/goat/sheep Rearing	0	0	0
Poultry	0	0	0
Bee keeping	0	0	0
Vegetable cultivation	28.90	0	0

(Figures in % of adopting farmers)

Such a high level of change is attributed mainly to shift in the area under food crops to horticulture crops due to introduction of medicinal & aromatic plants cultivation, vegetable farming, floriculture and vermi composting by large number of farmers. Diversification initiatives yielded very positive results in Patna and Madhubani districts. For example, about 33.67 percent farmers in Patna started taking horticulture activities. In Madhubani, the major change consists of horticulture and dairy along with fish farming by farmers.

Public-Private Partnership

For the first time, need of partnership has been realized in true sense and the project implementers initiated the process to promote both public-public and public-private partnership. The line departments came together at common forum (AMC and BIT) for planning and implementation of integrated and broad-based extension system. A few examples of such initiatives taken by various ATMAs are given in Table 15.

Table 15: Various initiatives taken by ATMAs in different districts

Name of ATMA	Name of Private partner	Profile of Private Partner	Nature of Arrangement	Terms and Conditions
Patna	Baidyanath Ayurveda Bhawan Ltd., Patna	Ayurveda drug manufacturer	Assured purchase of raw herbs	Pre-Fixed Buying Rates based on quality of Herbs.
	Pamer Agro Ventures (P) Ltd.	Canned food manufacturer	Assured purchase of mango and other fruits	Pre-Fixed Buying Rates based on quality
	Patliputra Samaj Kalyan Sansthan	Social Marketing	Assured purchase of Mushroom	Training to FIG/WIG and Buy Back of produce
	Prasad Refrigeration and Agro Industries Pvt. Ltd., Betiah	Medicinal Herb Processor	Supply of seed material of medicinal plants and assured buy-back of raw herbs	Buy-Back tripartite arrangement
	Ayurved Shri Herbals Ltd., Patna	Ayurveda drug manufacturer and exporter	Assured purchase of raw herbs	Buy-Back tripartite arrangement
	Fragrance Herbs, Muzaffarpur	Supplier of herbs and distillation	Supply of seed material of medicinal &	Purchaser at open market rates

		plants	Aromatic plants and assured buy-back of raw herbs and essential oils.	
	Maa Danteshwari Hi-tech Herbal Farms, Kondagaon, Bastar, Chhattisgarh	Provider of seed material and trader	Supply of seed material of medicinal plants and assured buy-back of raw herbs	Buy-Back tripartite arrangement
	Vijay Herbs & Natural Essential Oils, Harda, M.P.	Provider of seed material and trader	Supply of seed material of Aromatic plants and assured buy-back of essential oils.	Purchaser at open market rates under tripartite arrangement
	S.V. Healthy Herbs India, Indore	Provider of seed material and trader	Supply of seed material of medicinal & Aromatic plants and assured buy-back of raw herbs and essential oils	Purchaser at open market rates under tripartite arrangement
	Jeevan Kalp Vatika, Patna	Processed Food Manufacturer and floriculturist	Supply of spawns of Mushrooms and assured buy-back of produce and cut flowers	Purchaser at open market rates under tripartite arrangement
	Amrapali Foods Limited, Patna	Processed Fruit Manufacturer	Assured purchase of mango and other fruits	Pre-Fixed Buying Rates based on quality
	Swaraj Herbals Ltd., Barabanki, UP	Service Provider for implements	Supply of distillation plants to Farmers of Aromatic Plants.	Installation of distillation plants and buy-back of essential oils at market rate
	Raj Agrico, Patna	Seed material traders	Assured purchase of cereal crops seed.	Purchase of seeds at pre fixed rates under tripartite agreement

				with ATMA & KVK, Patna
	Eastern Foods India Ltd., Patna	Processed Fruit Manufacturer	Assured purchase of mango, papaya, chillies and other fruits	Purchaser at open market rates under tripartite arrangement
Muzaffarpur	Monsanto	Multinational	Supplier of seeds for cereal crops	Demonstration at farm level and sale of materials from FIACs
	KRIBHCO	Cooperative Organization	Manufacturer & Supplier of Fertilizer	Demonstration at farm level and sale of materials from FIACs
	M/s Pamer Agro Ventures	Canned food manufacturer	Assured purchase of mango and other fruits	Purchaser at open market rates under tripartite arrangement
Madhubani	Drishti	NGO	Service Provider in Information & Technology	Establishment of Information Kiosk and service provider under P-P-P Mode
	Shakti Sudha Industries Ltd., Patna	Processor of Makhana	Assured Buy-Back of Makhana	Pre-Fixed Buying Rates based on quality.
Munger	BAIF	Dairy Service Provider	Service Provider for AI centres and assured buy-back of vermi compost	Service Provider under P-P-P Mode.
	Excel Crop Care Ltd.	Input supplier	Service provider of inputs.	Training and Supply of biological agents at pre determined prices through FIAC under P-P-P Mode
	SEWA	NGO	Purchaser of goods	Training and purchase as

			manufactured by WIG	well as marketing of finished goods at pre fixed rates under tripartite agreement
	ITC Ltd.	Processed Food Manufacturer	Purchaser of cereals and support for women entrepreneurs finished product.	Purchase at open market rates under tripartite arrangement
	Vijay Herbs & Natural Essential Oils, Harda, M.P.	Provider of seed material and trader	Supply of seed material of Aromatic plants and assured buy-back of essential oils.	Purchase of essential oils at open market rates under tripartite arrangement
	Eastern Foods India Ltd., Patna	Processed Fruit Manufacturer	Assured purchase of mango, papaya, chillies and other fruits	Purchase at open market rates under tripartite arrangement

Adoption of New Technologies / Practices

The project put ample efforts in promoting sustainability-enhancing and environment friendly technologies as well as latest improved farm practices. Some of these include integrated pest management, integrated nutrient management, intercropping, mixed cropping, organic farming, green manuring, seed treatment, line sowing, summer ploughing, drip/sprinkler irrigation, vermi compost use, zero tillage, bio-fertilizers, Poly house technology, etc. A number of training programs and exposure visits for farmers were conducted through ATMA initiatives to promote these technologies/practices.

IPM/INM practices have quite wide acceptability among farmers in the Project Districts. Inter-cropping/mixed cropping has been adopted on large scale in Patna and Munger. Organic farming started to take roots in Patna. Farmers of Madhubani and Patna have accepted seed treatment as an essential practice. Line sowing has become quite popular in Patna. Summer ploughing has been started to some extent in Munger and Patna. Zero tillage technology has been accepted by farmers of Patna as a measure for sustainability and cost reduction (Table-16, 17).

Table 16: Percent of farmers adopting various technologies in the project districts

ATMA district	New Technological practices	Percent of farmers adopting
Patna	Vegetable production	21.7
	Paddy Production	17.4
	Use of green manure	10.9
	Sowing of seed in line	8.7
	Use of FYM	6.5
	Adoption of HYV	8.7
	Fertilizer and pesticide use	4.3
	IPM in paddy	2.3
	Piperment production	3.3
	Moong cultivation	0
	Onion cultivation	0
	Oilseed farming	0
Madhubani	Vegetable production	25.8
	Paddy Production	20.4
	Wheat Production	6.5
	Disease Control	3.2
	Fruit Production	5.4
	Integrated pest management	2.2
	Fodder Cultivation	1.1
	Fish Production	1.1
	Dairy Production	1.1
	Potato Maize Intercrop	1.1
	Makhana Production	1.1
	Sunflower Farming	1.1
Munger	Vegetable production	40.2
	Paddy Production	13.4
	Pulse farming	3.1
	Use of green manure	11.3
	Line sowing	11.3
	Use of HYV	8.2
	Fruit cultivation	2.1
	Nursery of fruit farming	1
	Fishery	1

Table 17: Percent of farmers adopting various technologies in the Non-project districts

Non-ATMA district	New Technological practices	Percent of farmers adopting
Nalanda	Vegetable production	13.3
	Paddy Production	0
	Use of green manure	0
	Sowing of seed in line	0
	Use of FYM	0
	Adoption of HYV	0
	Fertilizer and pesticide use	0
	IPM in paddy	0
	Piperment production	0
	Moong cultivation	8.9
	Onion cultivation	11.1
	Oilseed farming	2.2
Darbhanga	Vegetable production	-
	Paddy Production	-
	Wheat Production	-
	Disease Control	-
	Fruit Production	-
	Integrated pest management	-
	Fodder Cultivation	-
	Fish Production	-
	Dairy Production	-
	Potato Maize Intercrop	-
	Makhana Production	-
	Sunflower Farming	-
	Use of HYV	
	Green Manuring	
Banka	Vegetable production	0
	Paddy Production	0
	Pulse farming	0
	Use of green manure	0
	Line sowing	0
	Use of HYV	0
	Fruit cultivation	0
	Nursery of fruit farming	0
	Fishery	0
	Moong farming	0
	Green pea growing	0

Adoption by farm size class

As mentioned earlier, ATMAs carried out diverse field program activities including farmers' training, exposure visits and demonstration on varied subjects/topics. The impact assessment study has assessed

the adoption ratio for various technologies/practices propagated through trainings, exposure visits and demonstrations.

Training

During the project period, several training programs were organized on varied topics and areas and most interested farmers got the priority for such training programs. Table 18 indicates that about 65.55 % of the farmers adopted various technologies and practices propagated through these training programs. The adoption ratio was observed to be the highest among marginal farmers (70.83%) followed by large and small farmers (65.92% & 59.88% respectively).

Table 18: Adoption ratio of various training programs and farm practices provided by project in different Districts

Districts	Adoption ratio			
	Marginal farmers	Small farmers	Large farmers	Overall
Patna	59.96	66.02	60.86	62.28
Munger	63.32	50.60	55.64	56.52
Madhubani	89.33	63.02	81.28	77.87
Overall	70.83	59.88	65.92	65.55

[Figures in adopting farmers as % of farmers who received training]

Exposure Visit

In addition to training programmes, exposure visits were also organized for the interested farmers. During such exposure visits farmers could learn new enterprises and farm practices. In general around 36% of the farmers adopted new farm practices and new enterprises. However, 44% of the resource-poor farmers (Marginal) could get more benefit from such exposure visits than the resource-rich farmers (38.72%). (Table 19).

Table 19: Adoption ratio of technologies / farm practices through exposure visits organized by the project in different districts

Districts	Adoption ratio			
	Marginal farmers	Small farmers	Large farmers	Overall
Patna	66.6	16.67	50	44.42
Munger	12.5	6.25	4.75	7.83
Madhubani	46.66	60.30	61.42	56.12
Overall	41.92	27.74	38.72	36.12

[Figures in adopting farmers as % of targeted farmers]

Demonstrations

Various demonstrations were organized by the project to familiarize the farmers about the new techniques and practices. Table 20 indicates that it was very effective and about 11% farmers adopted the techniques demonstrated by the project authorities. However, across the states there was a sharp difference in the adoption of these demonstrations by different categories of the farmers. These demonstrations could encourage the poor small farmers in adopting the new techniques and practices demonstrated by project authorities. This shows that this demonstration by the project was equally

beneficial in promoting the adoption by the small farmers.

Table 20: Adoption ratio of various techniques and practices from demonstration by the project

Districts	Adoption ratio			
	Marginal farmers	Small farmers	Large farmers	Overall
Patna	0	0	0	0
Munger	0	0	20	6.67
Madhubani	0	50	33.3	27.76
Overall	0	16.67	17.76	11.47

[Figures in adopting farmers as % of targeted farmers]

Overall, it can be concluded that adoption of various improved techniques and farm practices (received through training, demonstration and exposure visits) was quite effective in transfer of new technologies. They all had synergetic effect and jointly contributed in the adoption of new practices and improved technologies. Highest adoption ratio was observed in Madhubani followed by Munger. Adoption level among large farmers was generally higher than that among Marginal and small farmers. However, in Madhubani, farmers of all the categories fully adopted what they learned through training programs, exposure visits and demonstrations. Similarly, adoption level was very high in Patna also irrespective of farmers' category. Overall, adoption level was very encouraging. Such a high level of adoption is attributed to identification and selection of only interested farmers for training, exposure visits and demonstrations. Active involvement of farmers' advisory committees and farmers' organizations in nomination of farmers for training programs, etc played an important role in this exercise (Table 20).

This can be attributed to the fact that the farmer in general have a poor resource base as a result there risk bearing ability is also quite low. The farmers across different size groups are reluctant adopters they adopt new technology only after they are perfectly sure of its success and when they have seen the success through their own eyes (table-21).

Table 21: Adoption ratio of overall field program activities by the project in different districts

Districts	Adoption ratio			
	Marginal farmers	Small farmers	Large farmers	Overall
Patna	42.18	27.56	36.95	**35.56**
Munger	25.27	18.95	26.79	**23.67**
Madhubani	45.33	57.77	58.66	**53.91**
Overall	**37.59**	**34.76**	**40.80**	**37.71**

[Figures in adopting farmers as % of targeted farmers

Crop yield

The adoption of various improved technologies and farm practices has resulted into yield enhancement in both project and non-project districts. However, increase in the yield was higher in the project districts due to several interventions made by the project. Average yield of some of the important crops are given in Table 22.

Table 22: Change in the Yield of some important crops in different Districts

Crop	Project districts			Non-project districts		
	Baseline (qt/ha)	Current (qt/ha)	Gain (qt/ha)	Baseline (qt/ha)	Current (qt/ha)	Gain (qt/ha)
Paddy	31.05	33.65	2.60	31.20	32.60	1.40
Wheat	29.99	32.10	2.11	30.01	27.09	(-)2.92
Maize	56.82	56.00	(-) 0.82	48.23	48.80	0.57
Potato	172.40	175.22	2.82	195.90	184.83	(-)11.07
Tori	9.55	9.99	0.44	4.35	9.00	4.65
Onion	190.40	205.70	15.30	123.30	157.16	33.86
Yellow sarson	13.43	14.43	1.00	8.50	8.96	0.46
Lentil	11.45	11.71	0.26	10.90	10.22	(-)0.68
Gram	11.21	9.64	(-)1.57	10.56	8.89	(-)1.67
Lathyrus	10.8	12.40	1.60	-	-	-
Brinjal	222.44	214.34	(-)8.10	-	-	-
Cauliflower	199.40	202.46	3.06	-	-	-
Bhindi	101.12	140.65	39.45	-	-	-
Moong	11.09	11.46	0.37	5.55	10.41	4.86
Sugarcane	576.55	500.00	(-)76.55	-	-	-
Arhar	15.60	13.84	(-)1.76	-	-	-

Total Household income

Diversified farming system, adoption of improved farming technologies/practices and increased crop yield resulted into the increase of income from various sources. Average per household total annual income of sample households in the project districts by state is given in Table 23. On an average, per household annual income in the initial period was relatively high i.e. Rs.75758 in the project districts compared to the non-project districts (Rs.73374). The proportionate high increase in the household income may be attributed to various project interventions. The incremental income owes to rise in crop yield as well as shift in cropping pattern towards high value crops.

Table 24: Per Household annual total income (in rupees) of sample households

District	Project districts			Non-project districts		
	Baseline	Current	Net gain	Baseline	Current	Net gain
Patna	99462	107312	7850 (7.89)	117763	124299	6536 (5.55)
Munger	111223	116602	5379 (4.83)	118230	121535	3305 (2.79)
Madhubani	56463	74355	17892 (31.68)	44632	55096	10464 (23.44)
Overall	89049.33	99423	10373.66 (11.64)	93541.66	85331	6768.33 (7.23)

Figures in brackets indicate percentage increase in the income over the project period.

Table 23 also shows that on an average the income of a household increased by more than 11 per cent in the project districts as compared to 7.23 per cent in the non-project districts. This clearly shows that the strengthening/improvement in the process of existing extension system were able to reduce the

adoption lag and people could diversify their income sources. However, the increase in the income was higher in those districts, which were highly developed and base income was already quite high. However, farmers in non project districts also experienced overall 7 percent increase in the household income.

Contribution of Agriculture in Total Income

It is also to be noted that agriculture, including horticulture, animal husbandry, crops, sericulture, and fisheries was the major contributor of income and accounted for more than 3/4th of the total household income. Contribution of agriculture in total household income was more than 54 percent in the project and non project district. Non-agriculture sources like trade, wages, salary, etc. also contributed substantially to the net increase in income (Table 24). This was mainly due to adoption of diversification strategy and following of farming system approach. Anyhow, major focus of the project was on crop centered technologies but resource centered technologies also were adopted at many places and hence sustainability was assured.

Table 24: Percentage contribution of agriculture in total income in the project and the non-project districts. [Percentage to total income]

State	Project districts		Non-project districts	
	Baseline	Current	Baseline	Current
Patna	46.32	44.81	32.16	31.63
Madhubani	60.98	64.92	65.09	66.32
Munger	52.17	52.59	67.62	66.67
Overall	53.15	54.10	54.95	54.87

Table 25: Percentage Contribution of agriculture in net gain in the total income of sample households in the project and non-project districts

Project districts	Net gain in total income (Rs)	
	Share of Agriculture (%)	Non-Project districts
Patna	25.71	22.12
Madhubani	77.37	71.57
Munger	61.25	32.46
Overall	54.77	42.05

But it is to be noted that net gain in income was quite high in the project districts of Madhubani where most of the income gain (in fact total income gain) was from agriculture sources. Compared to this, in Patna, agriculture contributed little more than half to the net gain in income. This shows that in Patna non agriculture enterprises were promoted more than in the non-project districts.

Conclusions

The results demonstrate that there has been improvement in the extension system and farmers have taken keen initiatives in the development process leading to their empowerment. The mind-set of the officials changed considerably and they contributed jointly for the success of the project. Earlier disjointed extension system has taken the shape of integrated system and many new enterprises have been included in the farming system. In the state the new institution SAMETI was created for the capacity building of the farmers as well as the field functionaries. They have been quite useful in

imparting need-based training to the farmers and officials. During the project period they have been able to generate some financial resources and developed infrastructure to facilitate trainings.

The role of information technology was also realized by the project and at many places good infrastructure has been created and the relevant information was provided to the farmers. The farmers' response was found to be quite encouraging. However, the relevant information relating to the improved technologies and farm practices need to be provided in local languages for easy dissemination of knowledge. Information per se is necessary but efforts have to be made to convert them into enhancement of knowledge base of the farmers.

For the first time a very systematic effort was made to identify the major constraints faced by the farmers and research gaps. Scientists have become more responsive to the needs of the farmers and have sharpened their focus of research to meet the location-specific requirement of the farmers of different size groups. The need-based training and exposure visits to the farmers and farmer-led extension have played a very effective tool for the technology dissemination.

There has been considerable improvement in the adoption of new technologies and farm practices by all the categories of the farmers and the *time lag in adoption has considerably reduced from 4-5 years to 1-2 years e.g. MAPs.* It is to be noted that the project was not started in all the districts at the same time. Hence, all the districts did not get same time to demonstrate their performance equally. Madhubani started functioning early in the second phase and performed well. But at the same time even *a new one like Patna which could get less time started functioning learning from the experiences of the earlier ones performed well.* While at the same time a few of the ATMAs started earlier could not maintain their pace of development. However, *the performance of ATMA was more dependent on the support received from the state level officials and continuity of project directors*. Besides, *it was a successful experiment of having either project directors or deputy project director from the university.* Various interventions made by the project for improving and strengthening the process could substantially increase the income of farmers in the project districts and almost all sections of the farmers benefited. *The spill over effect of these interventions was seen in the nearby districts e.g. Cultivation of Medicinal and Aromatic crops, which was started by ATMA, Patna but within no time it spread to almost all the districts of Bihar.*

Overall, it can be concluded that the pilot testing of this experiment shows quite encouraging results and should be started in the whole state. A few of the states, where this project was implemented on pilot-testing basis, have already started thinking on these lines and also a few of the other states have started thinking to implement this project on a larger scale in the whole state. However, this project intervention requires some more time to make them fully operational, especially in the new districts. *The results of this project indicate that this indigenously developed concept of innovative transfer of technology in an integrated manner can be adopted in the state and national policy and implemented with full governmental support in the same format.*

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