A Study on Adoption of Modern Agricultural Technologies at Farm Level in Bihar

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Abstract

Among socio-economic, technological and managerial reasons, ineffective transfer of farm technology is important causal factors for poor performance of agriculture. Transfer of technology has been the major obstacle in achieving the targets in past. Present study deals with level of adoption of modern agricultural technology, access and quality of modern technology, outreach of agricultural extension institutions and problems faced by extension officials in transfer of farm technology in Bihar. Study is based on primary data obtained through survey of farm households, agricultural scientists and extension officers in Bihar. Study revealed the coverage of agricultural development programmes limited to few villages, and line departments still dominating technology transfer arena. Institutions like ATMA and KVK were limited to few activities only. Adoption level of artificial insemination is comparatively high due to active participation of co-operatives and private sector, but less than one fourth of farmers could adopt advanced horticulture and modern crop seeds in Bihar. Small size of land holding and fragmented land emerged as main constraint to adoption of modern horticultural technology in Bihar. While analyzing use of modern varieties of principal crops, comparatively high level of adoption on small and medium farms was observed. Dissemination of information about modern agricultural development projects/ schemes is a necessary factor for adoption of modern technology. ATMA and KVK have performed better in dissemination of the information, however, inadequate staff, infrequent supervision and lack of conveyance facility are most important constraints faced in transfer of technology in Bihar.

Key words: Transfer of technology, Adoption of technology, Modern agricultural technology, Bihar

Running Title: Adoption of Agricultural Technologies in Bihar

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Introduction

A large number of agricultural development programmes have been launched for transfer of modern agricultural technologies in Bihar. There are several other schemes/programmes launched recently which have been indicated and detailed in the Road Map prepared by the State Government and put to implementation. Despite implementation of these agricultural development projects, there is a paradoxical situation of agricultural performance in Bihar, particularly with respect to input use and realization of yield of principal crops. Per hectare higher fertilizer consumption (180 kg/ha), higher irrigated area (62%) and larger coverage under HYV of seeds (rice 74%, wheat 92% and maize 77%) as compared to corresponding national averages per hectare productivity of principal crops (rice and wheat) are still lower than the corresponding national average during last five years. Among various socio-economic, technological and managerial reasons, ineffective transfer of farm technology might be an important causal factor for poor performance of agriculture in Bihar. As per NSS survey, only 0.4 per cent farmers had access to public extension workers for information on modern farm technology in Bihar against 5.7 per cent at national level and 22 per cent in Gujarat. As far as quality of information received by farmers through different sources is concerned, about 10.4 per cent of farmers received quality information from extension workers in Bihar against 51.5 per cent at national level. It clearly indicates inadequate and poor quality of information passed on through extension workers to farmers in Bihar (NSSO, 2005).

Transfer of technology has been the major obstacle in achieving the targets set in the past. There is a wide gap between the potential yield and the actual yield. A large number of agro-economic and socio-political factors are responsible for this yield gap but the weak and ineffective agricultural technology transfer has been one of the important factors for the higher yield gap in Bihar. However the detailed study based on primary data on transfer of agricultural technology is not available with respect to Bihar. The Planning Commission constituted the working group on Agricultural Extension for formulation of Eleventh Five Year Plan (2007-12). The recommendations of the Working Group are quite useful but almost all the recommendations are based either on secondary information or observations/experiences of the experts. The Steering Committee on agriculture is also engaged in identifying the constraints and opportunities of agricultural development in Bihar but methodology adopted by them has no scope for using ground level information and reality.

Against this background, there is a need to identify the farm technologies adopted by farmers because non-adoption of recently developed modern farm technologies (seed, fertilizer, pesticide, package of practices, irrigation schedule) might be the main reason of poor performance of agriculture in Bihar. The present paper deals with the level of adoption of modern agricultural technology, access and quality of modern technology, outreach of agricultural extension institutions and problems faced by extension officials in transfer of farm technology in Bihar.

Methodology

Locale of the study

The study is based on primary data obtained through survey of farm households, agricultural scientists and extension officers. The study covers whole state (Bihar) and required information was collected from all the four agro-climatic zones i.e. North-west alluvial plain (Zone I), North-east alluvial plain (Zone-II), South-east alluvial plain (Zone-IIIA) and North-west alluvial plain (Zone-IIIB). Sample farmers were selected using Stratified Random Sampling technique. At the first level, all the four agro-climatic zones of Bihar are considered as first stratum for selection of sample districts. At the second level, two representative districts were selected from each of four zones, with a restriction that sample districts are not located adjacent to each other. These districts were selected to reflect the range of agro-ecological condition in the zone and to capture the expected variations in technology transfer process, including level of adoption of agricultural technology. At the third level, one block from each selected districts and at fourth level, two villages from each sample block were selected, making sample of 16 villages for selection of farmers.

A sample of 10 farmers representing different class and social groups were selected randomly from each sample village, making total sample size of 160 farmers for obtaining desired information. Attempt was made to include representative farmers of the village in the sample through interacting farm households of diverse spectra of class, social and wealth categories and different size of farm holdings.

Data and analytical approach

Data were collected through Focused Group Discussion (FGD) and Survey method using pre-tested schedules. Information on profile of farmers, irrigation status, crop production, use of inputs, sources of inputs, sources of knowledge, package of practices, participation in agricultural development schemes, govt. assistance, knowledge about modern agricultural technologies, livestock, fish production and Govt. services in allied agricultural sector etc. were obtained from sample farmers. Particular attention was given to the adoption level of modern agricultural technology and the process of flow of related information. Primary data from the village survey were summarized using descriptive statistics. These results were complemented by the information gathered through interviewing agricultural scientists and officers. The descriptive statistics not only helped gain a better understanding of the adoption level and process of technology transfer to the field but also showed extent of variation in the four agro-climatic zones of Bihar. The descriptive statistics were also useful in examining informal hypotheses about the concentration of technology transfer efforts in few villages of Bihar.

It is important to remember that the present study, by its very nature, is not designed to provide definitive answers but rather to flag issues for subsequent in-depth research. Therefore, the emphasis of the study method was learning through drawing on available information and current knowledge from feed-back from agricultural scientists and extension officers, interpreting and synthesizing the data from these sources and finally identifying gaps both in the information and our knowledge about adoption level process of agricultural technology transfer and monitoring of different agricultural development schemes in Bihar.

Results and Discussion

There are seven main agricultural development programmes in Bihar which have been launched for transfer of technology. These programmes assume special significance in terms of agricultural productivity and livelihood of millions of rural households in Bihar. Department of agriculture (DOA) is engaged in implementation of all the project whereas Krishi Vigyan Kendra (KVK) is implementing Front line demonstration and Integrated Scheme of Oilseeds, Pulses, Oilpalm & Maize (ISOPOM) and Agriculture Technology Management Agency (ATMA) are involved in implementation of programmes of National Horticulture Mission (NHM), National Food Security Mission (NFSM) and Integrated Scheme of Oilseeds, Pulses, Oilpalm & Maize (ISOPOM).

An attempt was made to find out number of villages covered under various agricultural development schemes by ATMA, KVK and Department of agriculture under study area. Analysis of data revealed that the KVKs covered less than one per cent of villages under their jurisdiction. On the other hand, their participation in other agricultural development programmes was almost negligible (Table 1). Line department officials (DAOs/BAOs) were engaged in transfer of technology programme through schemes like, ISOPOM, NFSM, Rashtriya Krishi Vikas Yojana (RKVY), Macro-mode and Micro-irrigation by covering, on an average, 70 villages in each district. Despite a large number of agricultural development programmes handled by them, comparatively small proportion of farmers reported their access to line department officials. ATMA, on an average, could cover only 5 villages and 280 farmers in their respective districts.

It may thus be inferred that the line departments are still the main agency for implementation of agricultural development schemes whereas KVK and ATMA were only helping the line department in execution of various schemes. KVK and ATMA should be given more responsibility for implementation of various agricultural development schemes for faster transfer of technology in Bihar. The officials were also probed to know the criteria followed by them in selection of village for implementing agricultural development schemes. Majority of respondents reported the distance from office; easy access and acquaintance in village were important criteria for selection of village for project implementation. It is also worth pointing out that all the three institutions were mostly operating in same set of villages. It was further observed that all the three agencies were working in same villages in most of the districts under study. In some cases the same set of farmers were targeted for various agricultural schemes. They did not take pain to select different villages/ farmers for different schemes. Educated farmers of larger land holdings and irrigated area were generally selected for almost all the agricultural development schemes. Small, illiterate and tenant farmers were not given chance for implementing agricultural development projects in Bihar.

Adoption of modern agricultural technology

Adoption of modern agricultural technology by farmers is necessary factor for faster agricultural development. Adoption of modern farm technology helps farmers in increasing productivity by more than three-fold, particularly in field crops. Despite sincere efforts of Bihar Government, only 22.8 percent interviewed farmers used modern seeds in surveyed villages. Among different size group of farms, the higher proportion of medium farmers (46.67%) used modern varieties of seeds however only 13.89 percent

marginal farmers were found using modern seeds in surveyed villages (Table 2). In spite of resources available to large size of farm households, only 18.75 percent of them used modern seeds for crop production. It may be inferred that size of holding does not have any association with adoption of modern seeds, particularly in surveyed villages. Medium and small farmers emerged as better adopters of modern seeds since they might have tried to realize higher yield by using modern seeds and method of scientific crop production from their small size of land holdings. However, the adoption level of modern varieties of seeds was much higher in agro-climatic zone IIIB (South-west alluvial plains) than Agro-climatic Zone I, II and IIIA in Bihar. It was mainly due to assured irrigation facilities through Sone Canal and risk free agriculture in the zone.

On the other hand, comparatively high proportion of large farmers (50 %) adopted scientific methods of production of horticultural crops including medicinal and aromatic plants in surveyed villages. Comparatively low proportion of marginal, small and medium farmers adopted scientific method of horticultural crop production technology because they had smaller size of landholding and could not afford to put their land in horticultural crops and preferred to produce food grains for meeting their household consumption need instead. Financial and technical assistance under NHM was also available to farmers for cultivation of horticultural crops but only 2.50 percent farmers in surveyed villages could avail assistance for production of horticultural crops.

Farmers reported that the assistance in NHM is available for cultivation of horticultural crops in large area (i.e. one acre and above) but the majority of them do not own area of one hectare at one place. While interviewing agricultural officers they reported that assistance of NHM is available to a group of farmers who like to work together on consolidated piece of land but neither of the surveyed village had this type of group nor any official claimed to make effort to encourage farmers for forming group for the purpose.

The level of insecticide/pesticide use in crop production, particularly in food grain production is very low in Bihar. In surveyed villages, 6.25 percent farmers used pesticide in crop production however 12.50 percent large farmers used pesticide but none of the medium farmers used pesticide in the surveyed year; however about 8 percent marginal farmers used pesticide in crop production, mainly in cultivation of vegetable crops. Farmers using pesticide reported about availability of poor quality pesticide in the local market. Besides, they do not get reliable information about formulation, quality and appropriate type of pesticide to be used for controlling insects/pests in a particular crop.

Hence, there is a need to improve the knowledge of farmers about use of appropriate pesticide along with recommended doze for controlling insects/pests through strengthening the system of transfer of technology. In addition to this, a system needs to be developed for ensuring availability of quality insecticides/pesticides in rural area. In Bihar, a centre of plant protection was established in Third Five Year Plan in each block headquarters, which were operational for few years and helped farmers. But these centres are now abandoned. The mere revival of the centre at block level would help farmers in solving their plant protection problems.

Animal production is the one of the most important secondary occupation in rural areas. About three-fourth of farm households had animal husbandry as secondary occupation in surveyed villages. Artificial insemination is only practicable and economically feasible method to improve breed of livestock for increasing livestock production. Artificial insemination is now common practice in Bihar since about three-fourth farm households adopted this method for their dairy animals. But farmers were dependent on co-operatives or private sources because a few Government Centres (450) were operational in Bihar, not even one in each block.

Seed is an important critical input for increasing production and, the reliability of seeds is very important issue, but there is abundance of spurious seeds in Bihar. Farmers were asked to indicate "whether they ever purchased modern seeds of principal crops" from public sources. About 37.50 percent interviewed farmers reported that they purchased wheat seeds from government sources however access to government sources for wheat seeds was higher for large and medium farmers (<50%) but only 25 percent of marginal farmers purchased wheat seeds from government sources in interviewed villages, indicating less priority to marginal farmers in seed distribution programme of Government. It is worth pointing out that only 15 percent farmers purchased maize seeds from government sources and mainly due to fact that two interviewed villages were adjacent to headquarters of Rajendra Agricultural University, Pusa. None of the farmers of Banka and East Champaran districts purchased maize seeds from government sources because private seed companies dominate the maize seed market in Bihar (Table 3). About one-fourth interviewed farmers of all the four categories purchased paddy seeds from govt. sources. It could be possibly be due to revival of government farms for seed production in Bihar. But almost all farm households used local variety seeds of pulses and only 12.5 percent farmers purchased modern varieties of pulses/ oil seeds from government sources including National seeds Corporation (NSC) and State Farm Corporation (SFC), but none of these were not released within the period of five years.

In Bihar, vegetable and fruit crops are grown on only 10 percent of cropped area but they generate 50 percent of income, still governmental efforts have not made any dent in production and sale of vegetable seeds/ fruit saplings in the state. About 97.50 percent of respondents reported use of vegetable seeds either home grown or purchased from market. Despite implementation of NHM, farmers' access to modern varieties of vegetable seeds has not been improved. State government programmes indicated in *Road Map of Agriculture and Allied Sectors* for production and distribution of vegetable seeds has not yet been implemented. Thus an urgent need to launch a massive vegetable seed multiplication and technology transfer programme for increasing quality vegetable production in Bihar.

Adoption of Quality Modern Seed Varieties

As mentioned earlier seed is a critical basic input for attaining sustainable growth in agricultural production. Seed is a carrier of new technology for crop production and purity of even self-pollinated seeds is maintained up to five years of release. In Bihar, farmers are using seeds which were released way back in 1970s. The statistics relating to use of High Yielding Varieties (HYV) seeds published by government indicates more than 90 percent coverage under HYV seeds of wheat and maize crops and more than 70 percent in case of paddy but majority of farmers used old variety seeds, particularly in

case of rice and wheat. In the present investigation, an attempt was made to find out aging of seeds of principal crops[1] used by farmers in surveyed villages. The seeds used were categorized in four major categories, viz.; varieties released during last five years, last 5 - 10 years, last 10 - 20 years and more than 20 years. Farmers were asked to indicate the name of varieties of principal crops which were used by them to know the year of their release for our analysis purposes. Only crop varieties released within five years as quality modern seed varieties were considered (Table 4).

Analysis of information revealed that only about 12.50 percent farmers used paddy seed varieties released within the period of five years. The majority of farmers (76.25%) used paddy varieties released during last 10-20 years. Farmers were still using paddy varieties namely *Sita*, *Pankaj*, *Rajshree*, *Mahsuri* etc in surveyed villages. which were released more than 15 years ago. One-fourth of interviewed farmers reported using varieties which were released more than 20 year ago. Similar was the case of wheat, where only 16 percent farmers used recently released varieties which were released within five years. Almost identical proportion of farmers (16.25%) used wheat varieties released within 5 to 10 years. It is important to note that 29 percent of farmers used wheat seeds which were released during last 10 to 20 years. However, 35 percent of farmers used wheat seeds (UP 262), which were released more than 20 years ago. Also, majority of farmers were not able to recognize the varieties used by them for cultivation.

Bihar is a leader in production of winter maize in the country. The majority of interviewed farmers (56%) used maize varieties released during last 10 years. Only 12 out of 104 maize growers used maize seeds released during last 10-20 years. Majority used recently used maize varieties as they cultivated hybrid maize and used seeds purchased from market. Maize seed market is the domain of private sector in Bihar. The stake of state university, Bihar Government and public sector seed corporations has been dismal so far as maize seed is concerned.

Pulses are principal crop in Bihar but farmers do not have access to modern varieties of seeds. Only 1.25 percent farmers could use recently released varieties (released during last 5 years), however, 75 percent of farmers were using local varieties of pulses because recently released pulses varieties were not available, mainly due to poor performance of agricultural research system in breeding modern varieties of pulses, particularly in Bihar. Pulses production also got less priority in research and transfer of technology programmes, resulting in unavailability of recently released pulses varieties, low level of awareness among farmers about pulses varieties and poor access of farmers to modern varieties of pulses in Bihar.

An effort was also made to analyze the various facets of technology transfer process to farmers in Bihar. Firstly, the sources of information about agricultural technologies and agricultural development schemes were examined. The main public sources of information about agricultural technologies identified were Deptt. of Agriculture, ATMA and KVK. It was observed that KVK were the main source of information in surveyed villages as 58.75 per cent farmers reported getting information from this source. ATMA was the second important source of information to farmers (48.75%) whereas only 25.75

[1] The age of seed was considered from the date of release of that variety for cultivation of that particular crop.

per cent farmers could get agricultural technology information from Deptt. of Agriculture (Table 5).

It was further observed that the comparatively high proportion of large farmer had access to KVK and ATMA than other categories of farm households under study whereas less than one-third of marginal farmers had access to Deptt. of Agriculture for information relating to modern technologies and agricultural development projects. It may hence be said that the newly created institutions (KVK and ATMA) performed better in transfer of technology than line departments of State Government (Agriculture, Animal husbandry and fisheries). The problem faced by extension officials in effective transfer of technology and implementation of agricultural development projects were also probed and close ended questions were asked where the officers were required to 'Rank' the problems on the basis of their importance (Table 6). Analysis of data revealed that the inadequate staff was the most important constraint in monitoring of projects. However, it was more acute in ATMA followed by Line departments. The staff positions in Departments of Animal Husbandry, Dairy Development and Fisheries resources were equally thin which had adversely affected the transfer of technology process of these sectors in Bihar (Kisan Ayog, 2009).

Line department officers and scientists reported that the infrequent supervision were the second important reason of poor implementation and low level of monitoring of agricultural development projects. It was only due to shortage of officials and staff and absence of conveyance facility for frequent field visits. Monitoring activities were also adversely affected due to lack of unity of command on officers of Line departments. As for example, Block Agriculture Officers (BDOs) were responsible to District Agriculture officer for technical matter and BDO for administrative purposes. In this situation, they were not able to concentrate exclusively on agricultural development projects.

Inadequate feed-back from farmers emerged as fourth important reason for poor monitoring of agricultural development schemes in Bihar. Farmers were found hiding information about their activities and hesitate in reporting of real information. It may be due to their strategy to get the project in the next year also. They try to have the officials in humour so that they could get the agricultural development project in future also.

Untimely supply of inputs has also been identified as a constraint for poor monitoring of agricultural development projects. In Bihar, it is very common that the quality seeds of different crops are supplied after appropriate time of sowing. In this case, agricultural development officials have no moral right to visit fields and ask farmers about performance of their crops.

Conclusions:

Transfer of technology has been the main obstacle in realizing agricultural potential in the country in general and Bihar in particular. The present study focuses on level of adoption, access of farmers to farm technology, quality of modern technology, access to agricultural extension institutions and problems faced by extension officials in transfer of farm technology. It has been observed that the coverage of agricultural development programmes is limited to few villages; however, line department still dominates in spreading of modern agricultural technology. Mandate given to newly created institutions (ATMA and KVK) is still limited for few activities. Adoption level of artificial

insemination is comparatively high due to active participation of co-operatives and private sector in Bihar. Less than one fourth of farmers could adopt advanced horticulture and modern crop seeds in Bihar. Small size of land holding and fragmented land emerged as main constraint to adoption of modern horticultural technology in Bihar. While analyzing use of modern varieties of principal crops, a comparatively high level of adoption on small and medium farms was observed. Hence, there is no relationship between size of farm and adoption of modern varieties of seeds in Bihar. However, the majority of farmers are still using degenerated seeds of principal crops (except maize) mainly due to non-availability of quality seeds in the market.

Public system of seed production and distribution is still weak in Bihar. Dissemination of information about modern agricultural development projects/ schemes is a necessary factor for adoption of modern technology. In Bihar, ATMA and KVK have performed better in dissemination of the information. Inadequate staff, infrequent supervision and lack of conveyance facility are most important constraints faced by officials of public institutions in transfer of technology in Bihar.

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Table 1: Number of villages covered under various Agricultural Development Schemes in study area, Bihar during 2008-09.

Head	ATMA	Agri. Department	KVK	Total
Horticulture Mission	19	28	--	47
Front line department	--	1	55	56
ISOPOM	3	9	11	23
NFSM	4	272	--	276
RKVY	--	381	--	381
Macro-mode	--	9	--	9
Micro-irrigation	--	2	--	2
Total	26	702	66	792

Table 2: Adoption of Modern Technology by Sample Farm Households in study villages in Bihar.

Farmer's Categories	Percentage of farmers				
	Advanced Horticulture	Modern Seeds	Pesticides	Artificial Insemination of Animal	Advanced Fisheries
Marginal (72)	18.06	13.89	8.33	73.61	1.39
Small (57)	26.32	28.07	3.51	63.16	3.51
Medium (15)	20.00	46.67	0.00	60.00	0.00
Large (16)	50.00	18.75	12.50	56.25	0.00
Total (160)	24.38	22.50	6.25	66.88	1.88

Table 3: Farm Category wise proportion of farmers purchasing seeds from Government sources

Farmer's Categories	Percentage of farmers				
	Wheat	Paddy	Maize	Pulses/Oil seeds	Vegetables
Marginal (72)	25.00	20.83	15.28	6.94	0.00
Small (57)	43.86	29.82	15.79	19.30	5.26
Medium (15)	53.33	26.67	20.00	13.33	0.00
Large (16)	56.25	25.00	6.25	12.50	6.25
Total (160)	37.50	25.00	15.00	12.50	2.50

Table 4: Aging of seeds of principal crops in surveyed villages of Bihar

Crops	Period of Seed release							
	< 5 years		5-10 years		10-20 years		> 20 years	
	No. of farmers	%	No. of farmers	%	No. of farmers	%	No. of farmers	%
Paddy	20	12.5	60	37.50	62	38.75	39	24.38
Wheat	25	15.63	26	16.25	47	29.38	56	35.00
Maize	34	21.25	56	35.00	12	7.50	0	0.00
Pulses	2	1.25	20	12.50	17	10.63	0	0.00

Table 5: Dissemination of information about modern agricultural technologies & development Projects/Schemes in sample villages, Bihar.

Farmer's Categories	Percentage of farmers		
	Deptt. of Agriculture	ATMA	KVK
Marginal (72)	29.17	41.67	54.17
Small (57)	35.09	50.88	59.65
Medium (15)	6.67	53.33	53.33
Large (16)	25.00	68.75	81.25
Total (160)	28.75	48.75	58.75

*Some farmers are getting information from multiple sources

Table 6: Problems in Monitoring of Agricultural Development Schemes in Bihar

Sl. No.	Particulars	Rank			
		KVK	ATMA	Line departments	Overall
1.	Conveyance facility for village tour	II	V	I	III
2.	Posting of staff	III	I	II	I
3.	Infrequent supervision	I	IV	III	II
4.	Training & Demonstration	VIII	III	VI	V
5.	Inadequate feedback from farmers	II	IX	VII	VII
6.	Lack of unity of command on agril. Officer	IX	II	V	IV
7.	Farmers meeting	V	VIII	VIII	VIII
8.	Timely supply of inputs	VI	VII	IX	IX
9.	Management & coordination among agril. Scientists and officers	VII	VI	IV	VI

Source: Based on feed back from Agricultural Officers and Scientists