Adoption of Modern Agricultural Technologies: A Micro Analysis at Farm Level in Bihar

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Adoption of Modern Agricultural Technologies: A Micro Analysis at Farm Level in Bihar

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Abstract

Technology adoption 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 programme is limited to few villages; however, line department still dominates in spreading of modern agricultural technology. 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. Inadequate staff, infrequent supervision and lack of conveyance facility are some other factors responsible for poor transfer of technologies in Bihar.

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

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Introduction

Presently, there are a large number of agricultural development programme in Bihar. There are some other programme/schemes recently launched by the Government of Bihar as per Road Map prepared and finalized by the State Government with effect from the year 2008-09. There are several other schemes/programme 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 (170 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 about 30 to 40 per cent 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 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 (NSS 2005).

Bihar aims to achieve 5-7 percent agricultural growth rate in XI Five Year Plan. Transfer of technology has been among the major obstacles in achieving the targets set in the past. There is a wide gap between the potential yield and the actual yield. This is a country-wide phenomenon. 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.

Methodology

Study Location and Respondents

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). Farmers were randomly selected using stratified sampling approach. 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 from each of the four zones were selected, however, care was taken in selection of districts that these districts are not located adjacent to each other. (Table-1.)

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 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 required information. Farm category wise distribution of sample farm households are presented in Table 2. 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 collection

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. Particular attention was given to the adoption level of modern agricultural technology and the process of flow of related information.

Analysis of data

The 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

Profile of farm households:

Farm household respondents constituted 72 marginal (<1 ha), 57 small (1-2 ha), 15 medium (2-4 ha) and 16 large farm households (4 ha and above). Average age of

respondent is worked out at 44 years and there was no much variation in respondent's age belonging to different categories of farm households. In marginal and small farm categories, more than two-thirds of respondents belonged to younger age group of 20-40 years whereas about 44 percent respondents of large farm size group belonged to younger age group of 20-40 years(Table 5.1). None of respondents (except one in marginal farm category) belonged to age group of less than 20 years. It was mainly due to fact that the younger generation does not have interest in farming activities, probably due to low profit (NSS 2005). Moreover, farm households are generally headed by older family members and younger members are not allowed to interact with outsiders on agricultural, economic and social problems.

Analysis of educational information revealed that about 90 percent of respondent farmers were literate but the higher rate of literacy was observed on small farm households and the least on medium farm households. But about 81.25 percent of respondents of large farm category were educated above secondary level, indicating higher level of education in family members of large category of farm households in study villages (Table-3).

Agriculture was the main occupation of households under study. Out of 160, 157 households had agriculture as main occupation and only 3 households had service as main occupation. Farm category-wise analysis revealed that all the large and medium categories farm households under study had agriculture as main occupation whereas one marginal farm households and 2 small farm households had service as main occupation (Table-4). Animal husbandry was secondary occupation for 76.25 percent of surveyed

farm households. Service and agriculture were not important secondary occupation in surveyed villages.

However, petty business, casual wage earning and out-migration were important secondary occupations, particularly on marginal farm households in villages under study. None of the household under study had animal husbandry as main occupation whereas the majority of them had animal husbandry as secondary occupation. It clearly indicates importance of agriculture (crop production) and animal husbandry (dairy) in the rural economy of Bihar.

Analysis of occupational data of farm households under study revealed that all the surveyed households had agriculture as main occupation but the occupational diversification was more on smaller size of farm households than large categories of farm households.

In a developing economy, the exposure of farmers is an important for adoption of modern agricultural technologies as it increases awareness and knowledge of farmers. It was assumed that farmers who are member and/or officials of rural institutions would be more exposed and aware in uses of modern agricultural technology. A rural institution connotes Primary Agricultural Co-operative Credit Societies, Panchayat, Dairy Co-operatives, School Management Committee, Water Users Associations and ATMA, etc. (Table 5).

It was observed that 37.50 percent of farm households were either member or officials of rural institutions. The membership was higher on large farms (43.75%) and lowest on marginal farms (12.50%). Higher proportion of small farmers (14.03%) occupied official positions in rural institutions compared to medium (6.66%), marginal

(9.72%) and large farmers (12.50%). It shows that though small farmers did not have much access to rural institutions, they still got opportunity to occupy official positions in rural institutions, mainly due to caste based reservation policy of Government.

Irrigation Status

Water is one of the most critical inputs for increasing agricultural production. The proportionate irrigated area is much higher in Bihar (62%) than at national level (41%) but the irrigation intensity is one of the lowest in Bihar (132) than other states. In sample villages, 67.39 percent area in *Kharif*, 63.75 percent area in *Rabi* and 27.52 percent area in summer were irrigated. Sources of irrigation were categorized in three groups that is; canal, private tube wells and other sources (well, *ahar, pyne*, ponds etc). Government tube well was not operational in any of the surveyed villages (Table.6).

Among the sources of irrigation, private tube well emerged as the most important source of irrigation providing irrigation to 64 percent area in Rabi, 67 percent area in *Kharif* and 28 percent area. Canal was the second important source but this source is not a reliable source of irrigation due to irregular and inadequate supply of water, particularly in tail-end area. Other irrigation sources include traditional sources of irrigation like, wells, *ahar, pyne*, ponds etc, providing irrigation to about 5 percent of cultivated land.

Adoption of modern agricultural technology

Adoption of modern agricultural technology by farmers is necessary factor for faster agricultural development. Adoption of modern technologies has helped farmers increase productivity by more than three fold, particularly in field crops. In study villages only 22.8 percent farmers used modern seeds. Among different size groups, the higher proportion of medium farmers (46.67%) used modern seeds while only 13.89 percent

marginal farmers used modern seeds (Table-7). Despite resources available at large farms, only 18.75 percent used modern seeds. Implying thereby that size of holding did not have association with adoption of modern seeds in sample villages. Medium and small farms emerged as better adopters of modern seeds as they try to realize higher yield by using modern seeds and 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 IIIA (South-west alluvial plains) than Agro-climatic Zone I, II and IIIB in Bihar. It was mainly due to assured irrigation facilities through Sone Canal and relatively risk free agriculture in the zone IIIA.

On the other hand, the comparatively high proportion of large farmers (50%) adopted scientific method of production of horticultural crops including medicinal and aromatic plants in surveyed villages. The comparatively low proportion of (less than one-fourth) marginal, small and medium farmers adopted scientific method of horticultural crop production technology in surveyed villages because these farmers had smaller size of landholding and they did not afford to put their land in horticultural crops and preferred to produce food grains for meeting their household consumption need. Financial and technical assistance under National Horticulture Mission was also available to farmers for cultivation of horticultural crops but only 2.50 percent of farmers in surveyed villages could avail assistance for production of horticultural crops. Farmers reported that the assistance in National Horticulture Mission 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 National Horticulture Mission 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 under National Horticulture Mission for the purpose.

In Bihar the level of insecticide/pesticide use in crop production, particularly in food grain production is very low. 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. 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 of 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 of crop production.

As discussed earlier, animal production is the most important secondary occupation in rural area. About three-fourth of farm households have 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 are dependent on co-operative or private sources because a few Government Centres (450) are operational in Bihar, not even one in each block.

Conclusions

Technology adoption 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 programme is limited to few villages; however, line department still dominates in spreading of modern agricultural technology. 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. Inadequate staff, infrequent supervision and lack of conveyance facility are some other factors responsible for poor transfer of technologies in Bihar.

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Table-1 : Agro-climatic zone wise sample Districts, Blocks and Villages :

Agro-climatic Zone	District	Block	Village
Zone-I	Samastipur	Kalyanpur	(i) Somnaha (ii) Madhurapur
	East Champaran	Pipra Kothi	(i) Pipradih (ii) Jhakhada
Zone-II	Katihar	Katihar	(i) Sirsa (ii) Sardahi
	Madhepura	Bihariganj	(i) Padaliya Tola (ii) Lakshmipur
Zone-IIIA	Banka	Banka	(i) Dudhari (ii) Teliya
	Munger	Munger	(i) Satkhajuria (ii) Garhi Rampur
Zone-IIIB	Bhojpur	Udwantnagar	(i) Dewariya (ii) Chhotki Sasaram
	Nalanda	Harnaut	(i) Gosain math (ii) Chainpur

Table 2: Zone-wise distribution of selected farm households—respondents

Agro-climate zone	Marginal	Small	Medium	Large	Total
Zone-I	19	16	1	4	40
Zone-II	22	13	2	3	40
Zone-IIIA	19	11	7	3	40
Zone-IIIB	10	13	10	7	40
Total	**70**	**53**	**20**	**17**	**160**

Table 3: Education Level of the Respondents under study in Bihar

Categories	*Total*	*Illiterate*	*Middle*	*Middle-H.S.**	*Above H.S.*
Marginal Farmers	72	6 (8.33)	3 (4.16)	49 (68.05)	14 (19.44)
Small Farmers	57	1 (1.75)	5 (8.77)	19 (33.33)	32 (56.14)
Medium Farmers	15	2 (13.33)	1 (6.66)	3 (20.00)	9 (60.00)
Large Farmers	16	1 (6.25)	0 (0.00)	2 (12.50)	13 (81.25)
Total	**160**	**10 (6.25)**	**9 (5.62)**	**73 (45.62)**	**68 (42.50)**

*H.S.—High School (10^{th} Class)
Figures in the parentheses indicate percentage to respective totals

Table 4: Main & Secondary Occupations of the households under study.

Occupation	*Farmer's Category*				*Total*
	Marginal Farmer	***Small Farmer***	***Medium Farmer***	***Large Farmer***	
Main	**No. (%age)**	**No. (%age)**	**No. (%age)**	**No. (%age)**	**No. (%age)**
Agriculture	71 (98.61)	55 (96.49)	15 (100.00)	16 (100.00)	**157 (98.13)**
Service	1 (1.39)	2 (3.51)	0 (0.00)	0 (0.00)	**3 (1.88)**
Others	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	**0 (0.00)**
Total	**72 (100.00)**	**57 (100.00)**	**15 (100.00)**	**16 (100.00)**	**160 (100.00)**
Secondary					
Animal Husb.	55 (76.39)	43 (75.44)	12 (80.00)	12 (75.00)	**122 (76.25)**
Service	1 (1.39)	0 (0.00)	1 (6.67)	1(6.25)	**3 (1.88)**
Agriculture	1 (1.39)	2 (3.51)	0 (0.00)	0 (0.00)	**3 (1.88)**
Others	15 (20.83)	12 (21.05)	2 (13.33)	3 (18.75)	**32 (20.00)**
Total	**72 (100.00)**	**57 (100.00)**	**15 (100.00)**	**16 (100.00)**	**160 (100.00)**
Figures in the parentheses indicate percentage to respective totals					

Table 5: Farm size group wise membership and office bearers of Rural Institutions in study villages.

Farmer's	***Officer_Resp.***	***Mem_Resp.***	***Non_M/O_Resp.***
Categories	**No. (%age)**	**No. (%age)**	**No. (%age)**
Marginal Farmer - 72	7 (9.72)	9 (12.50)	56 (77.77)
Small Farmer - 57	8 (14.03)	22 (38.59)	27 (47.36)
Medium Farmer - 15	1 (6.66)	4 (26.66)	10 (66.66)
Large Farmer - 16	2 (12.50)	7 (43.75)	7 (43.75)
Total - 160	**18 (11.25)**	**42 (26.25)**	**100 (62.50)**

Figures in the parentheses indicate percentage to respective totals

Table 6: Season-wise Sources of Irrigation Area by Different Categories of Farm Households (in Ha.).

Rabi Season									(in ha)
Farm Categories	***Total cultivated area (in Ha.)***	**Canal**	**%age of Canal**	**Pvt. Tube Well**	**%age of Pvt. TW**	**Other Source**	**%age of Other Source**	**Total Irrig. Area**	**%age of Total Irrig. Area**
Marginal Farm	56.06	4.88	8.70	33.88	60.42	6.88	12.26	**45.63**	81.38
Small Farm	103.88	18.25	17.57	49.25	47.41	2.50	2.41	**70.00**	67.39
Medium Farm	42.50	7.50	17.65	17.88	42.06	1.00	2.35	**26.38**	62.06
Large Farm	96.00	11.25	11.72	32.00	33.33	5.00	5.21	**48.25**	50.26
Total	**298.44**	**41.88**	**14.03**	**133.00**	**44.57**	**15.38**	**5.15**	**190.25**	**63.75**
Kharif Season									**(in ha)**
Farm Categories	***Total cultivated area (in Ha.)***	**Canal**	**%age of Canal**	**Pvt. Tube Well**	**%age of Pvt. TW**	**Other Source**	**%age of Other Source**	**Total Irrig. Area**	**%age of Total Irrig. Area**
Marginal Farm	56.06	9.5	16.95	32.75	58.42	2.63	4.68	**44.88**	80.04
Small Farm	103.88	26	25.03	49.13	47.29	1.13	1.08	**76.25**	73.41
Medium Farm	42.50	8	18.82	15.75	37.06	2.50	5.88	**26.25**	61.76
Large Farm	96.00	17.5	18.23	30.75	32.03	5.50	5.73	**53.75**	55.99
Total	**298.44**	**61.00**	**20.44**	**128.38**	**43.02**	**11.75**	**3.94**	**201.13**	**67.39**
Summer Season									**(in ha)**
Farm Categories	***Total cultivated area (in Ha.)***	**Canal**	**%age of Canal**	**Pvt. Tube Well**	**%age of Pvt. TW**	**Other Source**	**%age of Other Source**	**Total Irrig. Area**	**%age of Total Irrig. Area**
Marginal Farm	56.06	0.75	1.34	17.08	30.47	2.06	3.68	**19.89**	35.47
Small Farm	103.88	0.25	0.24	28	26.96	1.75	1.68	**30.00**	28.88
Medium Farm	42.50	0.25	0.59	4.75	11.18	0.50	1.18	**5.50**	12.94
Large Farm	96.00	0	0.00	14.25	14.84	12.50	13.02	**26.75**	27.86
Total	**298.44**	**1.25**	**0.42**	**64.08**	**21.47**	**16.81**	**5.63**	**82.14**	**27.52**

Table 7: Adoption of Modern Technology by Sample Farm Households in sample villages

Farmer's Categories	*Advanced Horticulture*	%age	*Modern Seeds*	%age	*Pesticides*	%age	*Artificial Insemination of Animal*	%age	*Advanced Fisheries*	%age
Marginal Farmer	13	18.06	10	13.89	6	8.33	53	73.61	1	1.39
Small Farmer	15	26.32	16	28.07	2	3.51	36	63.16	2	3.51
Medium Farmer	3	20.00	7	46.67	0	0.00	9	60.00	0	0.00
Large Farmer	8	50.00	3	18.75	2	12.50	9	56.25	0	0.00
Total	**39**		**36**		**10**		**107**		**3**	
Total	**24.38**		**22.50**		**6.25**		**66.88**		**1.88**	

Fig-1 Map Showing surveyed districts of Bihar under the project