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Article *in* SSRN Electronic Journal · January 2005

DOI: 10.2139/ssrn.2780105

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Extension Strategies and Economics of Boro Rice Cultivation in Madhubani District, Bihar: A Case Study

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The Setting

Madhubani district located in the north-eastern part of Agro-Climatic Zone-I, is predominantly an expanse of the deposit of Adhwara - Kosi River system comprising of 18 rivers and rivulets. There are 18 rivers flowing through the Madhubani district and most of them originating from Himalayan valley in Nepal, as a result floods are a common phenomenon. The slope is from north to south. Due to its low level situation (district. is situated only 45-80 in above from sea level) and numerous rivers the district is severely affected by floods and about 45.2 % area of the total geographical area are under water for varied periods from July to October every year. Bowl shaped land depression locally known as chaur accounts for about to 8-10 % of total area of Madhubani. Water logging in these chaurs ranges from 25 Jun to 15 March. Farmers grew photo sensitive Agahani paddy these chaurs which had low yield potentials (0.5- 1.0 T/ ha) making paddy cultivation uneconomical. They also faced problem of growing nursery because of inundation.

Agronomy of Boro Paddy

The cultivation of paddy during Rabi crop season (Nov.-May) was unknown probably till the new paddy strains through Bangladesh refugees were introduced in eastern parts of India. “Boro” a Bengali term derives its name from the Sanskrit word 'Borob' and refers to a special type of paddy cultivation in lowlands during November-May months. Boro paddy has traditionally been cultivated in the river basins, deltas, chaurs or saucer shaped depressions, where water accumulates during the monsoons but cannot be drained, thus providing ideal settings for boro paddy cultivation during winter season. Although, boro paddy cultivation has been an old practice in deep water areas, it is only recently that it has emerged as a major breakthrough in enhancing paddy productivity, not only in traditional, but also in non-traditional boro paddy areas with assured irrigation and modern inputs. Madhubani district is characterized by high water level and during good monsoon years, large tracts of land become unsuitable for traditional Rabi crop due to water logging and flooding from rivers and its many tributaries. With Paddy crop destroyed due to recurring floods and wheat cultivation in this region becoming a remote possibility due to water stagnation, paddy was the only option left with the farmers.

Process

Through the intervention of ATMA, Madhubani, he has formed several FIGs which are engaged in growing paddy nursery through modified depog method and selling it. Sri Benam Prasad, first planted "Gautam" variety of boro paddy in Partapur chaur adjacent to Kamala river in winter season and yield was recorded at 10.0 T/ha . ATMA, Madhubani organized exposure visit of farmers of other chaurs, they procured seed from Sri Prasad and started growing boro paddy in their chours and within 3 years it covered around 10,000 ha area. Average yield of 6.5 to 7.0 T/ ha. is now being harnessed. Sri Prasad organized a society named Boro Vikas Samiti in three blocks namely, Jhanjharpur,

Lakhanaur and Madhepur and these Smitis are now engaged in expansion of boro paddy cultivation technology.

Role of Different Stakeholders

ATMA Madhubani started its efforts to popularize boro paddy cultivation through the local Rice Research Station, Jhanjharpur and Deep-water Rice Research Station, Biraul, both units of RAU, Pusa along with the local KVK at Basaith, Chainpura, in form of training, and capacity building with the help of local line department officers of the BTT and FAC members. Through the intervention of ATMA, Madhubani, several FIGs were formed and trained in depog method of raising nursery. One of the successful farmers Sri Benam Prasad is regularly used by the scientists to demonstrate the effectiveness of the process. ATMA, Madhubani with the help from BTT and FAC organized several exposure visits of farmers of other chaurs, to the fields of Sri Prasad. Visiting farmers were very impressed from what they see in these fields and the replication of this technology of boro paddy has started gaining popularity. Farmers have started growing boro paddy in their chaurs and within 3 years the area has increased to 10,000 ha area. Average yield of 6.5 to 7.0 T/ ha is now being harnessed. A society named Boro Vikas Samiti promoted with the help of ATMA and the FACs in three blocks namely, Jhanjharpur, Lakhanaur and Madhepur are now engaged in expansion of boro paddy cultivation technology.

Replication and Future Implications

Boro paddy has come as a boon to the farmers of this region, but it has become popular only recently with the introduction of cold tolerant paddy varieties like 'Gautam' one of the recently released varieties, from Rajendra Agricultural University, Pusa (Samastipur). Boro paddy produces more yields than the kharif paddy in the same ecology. Higher productivity of boro paddy has been attributed to factors like higher solar radiation, low night temperatures throughout the crop growth period in winters and favorable temperatures during ripening. Any variation in these factors can affect the yield significantly. The economic advantages provided by boro paddy have caused revolutionary changes in north-eastern parts of Bihar, not only in terms of socio-economic changes among the farmers of this region, but to the economy of the state as a whole. The area under boro paddy in Madhubani alone has increased tremendously from nil in 2000 to about 20,000ha. Through the exposure visits organized by ATMA, now this technology is reaching in others chaurs also, especially located in western part of district.

Outcome and Lessons Drawn

The cultivation of boro paddy in unexploited chaur land brought a significant change in livelihood system of this district (plagued by perennial floods year after year) and as a result useful agreement were reached between land lords, and land less labourers. Since boro cultivation was highly labour intensive this led to lower migration of labour from this area. The poor and landless were able to meet their daily requirement of paddy, twice in day rather than once. They were now able to withstand the floods less dependent on governmental relief supplies during monsoons and had developed resistance to flood situation. This shows that if right technologies are made available to the farmers, along with dedicated efforts to popularize it success is always there.

A study was conducted with the help of ATMA, Madhubani to find out the economics of boro paddy cultivation and also to study different agronomic practices followed by the farmers, along with its impact on the local economy, the salient features are presented below:

Agronomic Practices Followed By Farmer's:

Farmers irrespective of their size of holding followed identical agronomic practices in the study area. They used seeds of Sujata, Pusa 2-21, and Saket-4 along with the newly released variety Gautam for boro paddy crop. The seed rate varied between 70-75 Kg./ha. and the farmers were not treating it with any chemicals. The farmers were found to be using banana sheath and gunny bags to facilitate seed germination in cold weather of winters, and the seeds were then broadcasted in the seedbeds, some ash was also spread on the seeds to protect them from low temperatures. Urea was also broadcasted in the beds at this time. The transplanting was done when the seedlings were 40-45 day old in a very well prepared field trough ploughing and puddling. Lot of family labor is used in the process. Transplanting was using mostly family labor and exchange labor. A basal dose of 40 Kg N_2, 40 Kg P_2O_5 and 20 Kg K_2O per ha. at the time of puddling. 20 Kg N_2 is applied about 30-40 days after transplanting and again at the time of panicle initiation.

Table1: Variety-wise details of boro rice grown

Variety grown	No. Of farmers growing
Sujata	10
Pusa-2-21	12
Saket-4	8
Gautam	30
All farms	60

Table 2: Farmer's profile: occupation pattern and literacy.

Size group	Sample size	Total adults	Adults engaged in agriculture	Engaged in non-agril. Occupations	Total literates
Marginal	26	146 (5.62)	84	62	29 (19.86)
Small	16	98 (6.13)	64	34	39 (39.80)
Medium	10	66 (6.6)	36	30	35 (53.03)
Large	8	46 (5.75)	18	28	29 (63.04)
All farms	60	356 (5.93)	202	154	132 (37.08)

Figures in the parentheses denote the percentage of all farms under the respective categories.

Water Management:

Water management in boro paddy is a very important aspect and farmers use stagnated water and bamboo bore wells for irrigation. An interesting feature observed during the course of the study was the cultivation of wheat and boro paddy side by side in the study area. While wheat was grown on the uplands of the chaurs from where water had receded

and boro paddy in the lower reaches of the chaur, which had water. It seems that farmers on their own have devised a game to minimize the risk and uncertainty. In favorable monsoon years they successfully grew boro paddy but during unfavorable years they cultivated wheat, linseed, lentil, and rape-mustard to maximize their gains. Water level being high in the area made irrigation relatively easier and bamboo bore wells brought it within reach of small and marginal farmers.

Labour Use Pattern:

On various categories of farms the total human labor used was found to be highest on medium and large farms (286 man days/ha.) followed by small (275 man days/ha.) and marginal (261 man days/ha.).

Table 3: Operation-wise labour-use per hectare in boro paddy cultivation on sample farms (Man days)

Size group	Land preparation	Trans-planting	Inter-culture operation	Manuring/ Fertilizer. Application	Irrigation	Harvesting and threshing	Total
Marginal	59 (22.61)	70 (26.82)	44 (16.86)	6 (2.30)	42 (16.09)	40 (15.33)	261 (100)
Small	52 (18.91)	83 (30.18)	45 (16.36)	8 (2.91)	45 (16.36)	42 (15.27)	275 (100)
Medium	51 (17.83)	78 (27.27)	42 (14.69)	7 (2.45)	53 (18.53)	55 (19.23)	286 (100)
Large	45 (15.73)	77 (26.92)	40 (13.99)	10 (3.50)	52 (18.18)	62 (21.68)	286 (100)
All farms	51.75 (18.68)	77 (27.80)	42.75 (15.43)	7.75 (2.80)	48.00 (17.33)	49.75 (17.96)	277 (100)

Figures in the parentheses denote the percentage of total labour used under each category.

Factor-Wise Cost in Boro Paddy Cultivation:

Cost incurred on various factors of production on sample farms has revealed that the imputed value of land took the highest share of the factor cost which ranged from 25.96 per cent on large farms to 29.50 per cent on small farms. The cost incurred on human labour got second highest share ranging from 22.01 per cent on small farms to 25.39 per cent on large farms. Cost of irrigating the crop got the third highest share of factor cost that varied between 17.35 per cent on large farms and 18.80 per cent on medium sized farms. So far as the total factor cost was concerned it was found to be highest on small farms (Rs.10,984 per ha.) while it was lowest on large farms (Rs.10402 per ha.). The average factor cost for all the farms was Rs.10675.25 per hectare. The same trend was observed so far as the contribution of various factors of production towards the factor cost was concerned. The contribution of imputed value of land was again highest (27.96%) followed by cost of human labour (24.29%), cost of irrigation (17.83%), cost of manure and fertilizers (9.87%), cost of bullock (6.79%), misc. cost (6.00%) , cost of seed (5.82%) and cost of plant protection (2.15%) respectively.

Table 4: Factor-wise cost in boro rice cultivation on sample farms (Rs./ha)

Size-group	Cost of human labour	Cost of bullock labour	Cost of seed	Cost of manures & fertilizer	Plant protection cost	Cost of irrigation	Misc. Cost	Imputed value of land	Total factor cost
Marginal	2407 (22.62)	800 (7.52)	551 (5.18)	850 (7.99)	151 (1.42)	1850 (17.38)	914 (8.59)	3120 (29.32)	10643 (100)
Small	2418 (22.01)	852 (7.76)	578 (5.26)	1008 (9.18)	205 (1.87)	1954 (17.79)	729 (6.64)	3240 (29.50)	10984 (100)
Medium	2603 (24.40)	632 (5.92)	665 (6.23)	1120 (10.50)	260 (2.44)	2006 (18.80)	502 (4.71)	2880 (26.99)	10668 (100)
Large	2641 (25.39)	613 (5.89)	690 (6.63)	1235 (11.87)	301 (2.89)	1805 (17.35)	417 (4.01)	2700 (25.96)	10402 (100)
All farms	2592.2 (24.29)	724.25 (6.79)	621 (5.82)	1053.25 (9.87)	229.25 (2.15)	1903.75 (17.83)	640.5 (6.00)	2985 (27.96)	10674 (100)

- Figures in the parentheses denote the percentage of total factor cost.

Returns from Boro Paddy:

A close look at the shows that the grain yield was highest on small farms (61 qtls./ha.) followed by marginal (57 qtls./ha.), medium (53 qtls./ha.) and large farms (51 qtls./ha.). The net returns as a result were highest on small farms (Rs.18, 000 per ha.) despite the high factor cost and lowest on large farms (Rs.12548.00 per ha.). Overall boro paddy was a profitable venture on all size groups of farms. The cost of producing boro paddy was lowest on small farms (Rs.180.07per quintal) and highest on large farms (Rs.203.96 per quintal), the average cost of production for all the farms being Rs.192.33 per quintal resulted in a positive B-C ratio of 1:1.34 thereby giving a decent return to the farmers this showed that there was no positive correlation between the size of farm and cost of production. Boro paddy cultivation despite being a new phenomenon in Bihar plains has been able to make a significant impact in the economy of North Bihar areas.

Table 5: Return per hectare from boro-paddy cultivation on sample farms. (Rs./ha)

Size group	Grain yield (Qtls.)	Gross returns	Total factor cost	Net returns	B: C Ratio	Cost of production
Marginal	57	25650	10643	15007	1:1.41	186.72
Small	61	27450	10984	16466	1:1.50	180.07
Medium	53	23850	10668	13182	1:1.24	201.28
Large	51	22950	10402	12548	1:1.21	203.96
All farms	55.5	24975	10674.25	14300.75	1:1.34	192.33

* Farm gate sale price of boro-rice @ Rs. 450/- per quintal.

Table 6: Post harvest uses of boro paddy on sample farms. (Quintals)

Size group	Total produce	On-farm consumption	Kept for seed	Marketed quantity
Marginal	1188.45	645.57 (54.32)	72 (6.06)	470.88 (39.62)
Small	1744.60	1008.55 (57.81)	94.05 (5.39)	642.00 (36.80)
Medium	1552.90	881.27 (56.75)	99.32 (6.40)	572.31 (36.85)
Large	2387.82	983.54 (41.19)	122.34 (5.12)	1281.94 (53.69)
All farms	6973.77 (100)	3518.93 (50.46)	387.71 (5.56)	2967.13 (42.55)

* Figures in the parentheses show the percentage of the total produce in the respective category of farm.

Conclusions

Boro rice cultivation has been an old practice in deep water areas, it is only recently that it has emerged as a major breakthrough in enhancing rice productivity, not only in traditional, but also in non-traditional boro rice areas with assured irrigation and modern inputs. The credit primarily goes to the farmers' own initiatives in adopting its cultivation in a big way. But proper research inputs have not been fully exploited by the farmers. It is therefore worthwhile to examine the current scenario and analyze the future concerns. Boro rice has come as a boon to the farmers of this region, but it has become popular only recently with the introduction of cold tolerant rice varieties. Boro rice produces more yields than the kharif rice in the same ecology. Little information is available about the impact of boro rice cultivation in Bihar, its role in improving rural economy in general and the farmers' economic condition in particular. Available literature suggests about the tremendous potential of boro rice cultivation in enhancing the production and productivity of food crops. Adoption of this new technology has been difficult for resource poor farmers of these regions. Agronomic practices followed by the farmers varied from farm to farm but it was observed that in general the farmers followed most of the recommended practices. The high water requirement of the crop was met with a local innovation called "bamboo boring" which served as the chief source of irrigation during the months of April-May when there was a scarcity of surface water in the region and farmers had to use ground water resources, this led to the higher cost to be spend on fuel etc. by the farmers. The study strengthened the belief that farmers are better innovators and a little support to them in terms of research and infrastructure could lead to even better results.

Labor-use is another important aspect in boro rice as the crop is highly labor intensive. The findings showed that land preparation, transplanting along with irrigation and harvesting utilized more than 80 percent of total labor used. The factor –wise cost of cultivation was lowest on marginal farms and highest on small farms, whereas the returns per hectare were highest on small farms and lowest on large farms clearly indicating that farm size did not have any positive correlation with the from boro rice cultivation. The marketed quantity was lowest on marginal farms and highest on large farms as the

marginal farmers consumed most of what they produced owing to their poor resource-base and lower income. Large farmers on the other hand had alternative sources of income so they were in a better position to market their produce at their own convenience. Overall boro rice was a profitable crop on all size groups of farms and promises to bring new revolution in production of food crops in Bihar.

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