Theme 7 : Socio-economics, Technology Transfer and HRD.

7.1 : Participatory technology development

7.1.1 : Economic assessment of horticultural technology through participatory research

(I.Tirkey, R.S.Pan, J.P.Sharma and S.Kumar)

The potential of two cowpea varieties viz. Swarna Sweta and Swarna Harita for economic viability and potential to generate employment was assessed in six blocks of Ranchi and Gumla districts of Jharkhand. The economic viability was worked out for each category of marginal, small and large farmers.

Table-20 : Cost and return of varieties in vegetable crops (Rs/ha)

Crop	Variety	Category of Farmers	Cost of cultivation	Gross return	Net profit	BC Ratio	Productivity (t /ha)	Cost of production per kg.
Cow pea	Swarna Sweta	<1ha	45469	89219	43750	1.96	8.92	5.10
		1-2ha	48140	91600	43460	1.90	11.45	4.20
		>2ha	45761	77778	32017	1.70	9.69	4.72
		Overall	46398	83924	37526	1.81	10.06	4.61
	Swarna Harita	<1ha	47482	97500	50018	2.05	10.36	4.58
		1-2ha	48094	90625	42531	1.88	9.06	5.31
		>2ha	43592	83615	40025	1.92	10.31	4.23
		Overall	44924	86842	41918	1.93	10.11	4.44
	Indigenous	<1ha	33625	48101	14476	1.43	4.90	6.86
		1-2ha	35330	51620	16290	1.46	6.67	5.30
		>2ha	44312	69825	25513	1.58	6.56	6.76
		Overall	37756	56515	18759	1.50	6.04	6.25

It was observed that the cost of cultivation ranged from Rs. 43,592 to Rs. 48,140/ha. The highest yield was recorded in case of *Swarna Harita* (10.11 t/ha) (Table 20). This variety also had highest benefit cost ratio of 1.93. The potential of these varieties to generate employment ranged from 455 to 560 labour days/ha among different categories of farmers (Fig. 30).

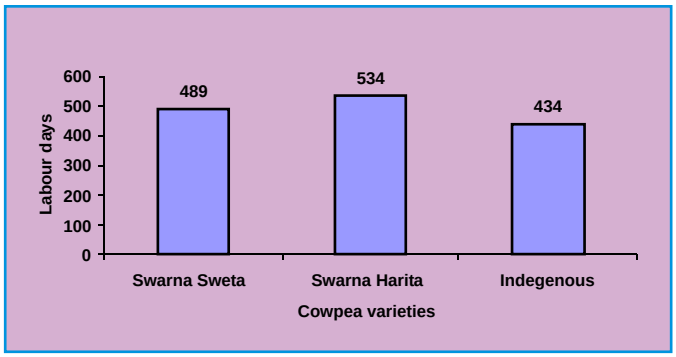

Fig.30. Employment generation through technology in vegetable crop (Labour days/ha)

7.2 : Technology transfer, assessment and refinement

7.2.1 : Frontline technology acceleration programme

Demonstration on seedling raising of tomato and brinjal through soil solarisation technique conducted on farmers' fields in Ranchi district are given below:

Crop	Variety	No. of Blocks	No. of farmers	No. of seed beds (size 3m x 1 m)
Tomato	Swarna Lalima	10	32	119
	Swarna Naveen	7	18	49
Brinjal	Swarna Shyamli	9	21	108
	Swarna Pratibha	10	25	106
Total		**36**	**96**	**382**

The following advantages in raising seedlings in vegetable crops through soil solarisation techniques were realised.

- Seedlings of *Swarna Lalima & Swarna Naveen* raised through soil solarisation technique in tomato and *Swarana Shyamli & Swarna Pratibha* in brinjal were free from the incidence of pests and diseases by adopting nylon net.
- Seedlings of *Swarna Lalima* and *Swarna Naveen* in tomato were raised in 18 days and *Swarna Shyamli* and *Swarna Pratibha* in 20 days for transplantation in field.
- Seedlings of all the varieties in tomato and brinjal were healthy as the seeds were free from the weeds.
- The seedlings were sold @Rs 12 for 100 seedlings.
- Germination of seeds for both the crops was found 80 per cent under this technique.
- Additional income of Rs15,000-20,000 from 40 beds (3m x 1m) under this technique was obtained.

7.2.2 : Technology Acceleration Programme

(Ujjwal Kumar, U S Gautam, A K Singh, D K Kaushal, A Dey, Y.P Singh and A K Sikka)

Multi-tier Horti - based cropping system : The mango based cropping system developed by Horticulture and Agroforestry Research Programme, Ranchi, was undertaken by the six farmers of villages namely; Bhelura Rampur (Patna) and Dhakaich (Buxar) of south Bihar. The aonla- based cropping system was taken by a small farmer of Bhelura Rampur .

Multi tier Horti-based cropping system in Bhelura Rampur (Patna)

Mushroom production by landless families : Institute is providing technical back-up for mushroom production. Women and youth from urban and peri-urban areas are taking mushroom as an income generating activity at larger scale and earning Rs10,000/month during the season. Milky white mushroom(C*alocybe indica*), which is grown during summer was also introduced in the villages of Patna district.

A couple with seeded Oyster mushroom

Produce of milky white mushroom

A woman with milky white mushroom

Poly house for raising early vegetable nursery and early summer crops : The low cost polyhouse technology was popularized among women, youth and landless farm families. Three groups are using polyhouse and each group is earning Rs 2500 to Rs 4000 / annum from the sale of vegetable seedlings.

A farmer of Amarpura village carrying vegetable seedlings grown in polyhouse

Multiple uses of water : More than 200 farmers from different parts of Bihar were exposed to different models of multiple uses of water at institute. Same model has also been replicated in the farmer's field. Net income of Rs 50,000/ to Rs 65000/ha was reported through adoption of this diversified system which is much higher than the income from traditional rice-wheat system.

Around 20 farmers from the Village Beeranchak, Aspura, Nisarpura, Bhelura Rampur and Amharha in Patna district have converted their low lands or water logged areas into fish ponds and are generating income from fishes**.** Relative performance of different diversified systems in canal command area of Patna main canal indicated significant benefits when fish and horticulture are integrated (Table 21).

Supplementary feeding in a fishpond in Aspura village

Table 21: Relative returns (Rs/ha/year) of different diversified systems in farmers' field in canal command, Patna, Bihar (2006-07)

Different systems	Gross income (Rs)	Cost of cultivation (Rs)	Net income (Rs)	Per cent contributions to net income				
				Rice & Wheat	Fish	Fruits	Vege-tables	Others
Rice & Wheat	45,750	23,555	22,195(-)	100				
Rice fallow	24000	9800	14200					
Rice -fish in water logged area	47736	13500	34236 (141)*	27	63			
Fish in sunken trenches, horticulture on raised beds	55900	6950	48950 (120)**		83	7.5	9.5	
Fish in dug out pond and horticulture & pigeon pea on dykes	111,000	44,580	66,420 (199)**	0	89.5	2.8	5.8	3.9

* Value indicates per cent increase over traditional rice production

** Values in parenthesis indicate per cent increase over traditional rice-wheat system

Backyard poultry for livelihood improvement of resource poor farmers : For improvement of livelihood and household nutrition of economically poor farmers, birds of Divyan Red breed of poultry were distributed for rearing in backyard. In 2nd year, a bird laid 152.42 ± 12.56 eggs with average egg weight of 52.40 ± 1.29 g. On an average, a farmer earned Rs 457 from a single female. Attack by predators, high cost of concentrate feed and unavailability of vaccines were some of the constraints identified.

Small-scale duck farming for livelihood of landless and unemployed rural youth : Khaki Campbell breed of ducks were distributed among 41 landless farmers and unemployed youth. In 2nd year, a bird laid 144.42 ± 11.94 eggs with an average weight of 65.08 ± 1.14 g. On an average a farmer earned Rs 435 from a single bird by the sale of eggs. One Youth purchased 60 Khaki Campbell ducklings. Attack by predators, lack of water in ponds/canals during summer, habit of some ducks in laying eggs during daytime and unavailability of vaccines are some of the constraints faced by the farmers.

Animal health-care support to farmers : Disease diagnostic support for quick and better health care of livestock and poultry were extended to the farmers. During the year, a total of 186 cases were attended in 6 villages. Incidence of anoestrous in primiparous cow was found higher than multiparous cow (Fig. 31). Crossbred cow showed the higher incidence of repeat breeding than indigenous cow or buffalo.

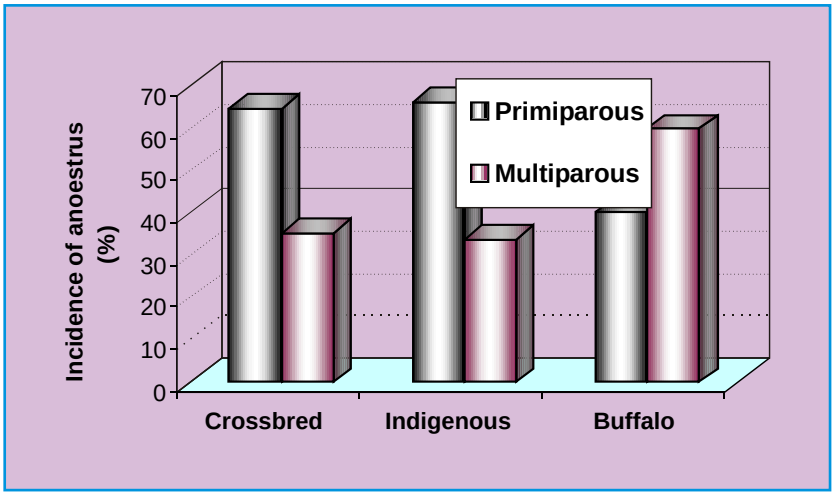

Fig. 31. Incidence of repeat breeding in cattle and buffalo in village

Bund height

Fifty farmers of eleven different villages covering around 18 ha area were motivated to raise the height of their field bunds upto 20 to 30 cm from existing height of 7 to 15 cm. On an average 0.6t/ha additional rice yield was reported from these plots in comparison to the conventional plots with additional investment of Rs 500-800/ha in raising the bund height. In wheat, total 50 plots were under this intervention comprising of 9 ha. In addition to this, there was a saving of 2 to 3 irrigations in comparison to fields having lower bund heights. Farmers reported additional benefit of growing Arhar, which has

Arhar on raised bund

provided opportunity to fetch additional income, and compensated the expenditure, which they incurred on raising the bund height.

7.2.3 : Demonstration of improved varieties of vegetable crops

The varieties viz., *Swarna Lalima* and *Swarna Naveen* in tomato and *Swarna Shyamli* and *Swarna Pratibha* in brinjal released by Horticulture and Agro- forestry Research Programme, Ranchi for commercial cultivation in vegetable crops were considered to conduct Front Line Acceleration Programme in Jharkhand state. The seedlings of these varieties were facilitated from the community nursery laid out under the soil solarisation techniques for raising seedlings. The details of Front Line Acceleration Programme are given in Table 22.

Table-22 : The details of Front Line Acceleration Programme

Crop	Variety	Block villages	No. of farmers	No. of acres	Area in yield (t/ha)	Average
Tomato	Swarna Lalima	10	62	243	24.06	45.00
	Swarna Naveen	8	35	88	10.87	41.00
	HATH-5	4	6	7	0.35	78.65
	HATH-9	4	6	7	0.35	99.87
	Swarna Sampada	9	16	17	3.25	90.50
Brinjal	Swarna Shyamli	8	61	148	21.33	40.30
	Swarna Pratibha	10	63	195	25.83	40.13
	HABH-8	4	6	8	0.40	65.00
	HABH-13	4	6	8	0.40	82.10
	HABH-17	4	6	8	0.40	112.75
	HABH-18	4	6	8	0.40	86.40
Pointed gourd	Swarna Alaukik	5	5	5	0.42	3.88
Total				**742**	**88.06**	

7.3 : Livelihood analysis and impact assessment of agricultural technologies

7.3.1 : Basin scale analysis of the vulnerability of the food System to Global Environmental change (GECAFS)

(Alok K. Sikka, Abhay Kumar, A. R. Reddy, Adlul Islam and Abdul Haris A.)

This project, in collaboration with Global Environmental Change and Food Systems (GECAFS), UK is operational since 1st February 2006. It focuses on understanding the interactions between food systems and global environmental change (GEC). The entire Indo-Gangetic Plain (IGP) has been divided into five regions and one district from each region has been selected for the detailed study on vulnerability of food systems to GEC. The task to study the fourth region of IGP was assigned to ICAR Research Complex for Eastern Region, Patna and district Vaishali was selected for the detailed study. A household survey was conducted in Vaishali district to analyze the vulnerability of food system activities to climatic change in Vaishali district of eastern India. Secondary information about the district was also collected. The total land area of the district is 2036 sq. kms with a population of 27.1 lakhs. The district is characterized by high population density (1332 persons per sq. km) and a growth rate of 2.3 percent. About 93 percent of the population lives in rural areas and are mainly dependent on agriculture. The annual growth rate in agriculture is a meagre 2 percent. Since the district has been blessed with highly fertile land, some cash crops like banana and vegetables are grown in abundance. These are marketed to the nearby district towns through the existing dilapidated roadways and to the nearby local haats (markets - organized weekly or biweekly) through local means of transportation. Rice and wheat comes into the district through Food Corporation of India as part of Public distribution System from western IGP. Egg, fish and poultry come from Andhra Pradesh (South India).

Important food system activities of the district are food production, distribution, exchange and consumption. Food production is carried out by 0.44 million farmers of the district of which 92.53 per cent have less than 1 ha land (marginal farmers) and 5.1 percent have 1- 2 ha land (small farmers). Only 2.37 per cent of holdings have land more than 2 ha. All these small and marginal farmers have very little resource base. Nearly half of the district is flood prone in which two main food crops paddy and maize are severely affected. Climate affects both food production and consumption activities of these farm families as most of them are dependent on agriculture for their livelihood. Yearly income of land less households is Rs.19365 and households having land <1 ha is Rs. 25,498. Average income of house holds having land more than 1 ha is Rs 34851. Major source of income of land less households is wage earnings followed by agriculture and livestock. Agriculture is major source of income for other categories of households followed by livestock. Majority of labourers are very poor and dependent on agricultural work. When monsoon fails they migrate for their livelihood. Average annual per capita expenditure of rural population is Rs. 4975 of which 61 per cent is made towards food items and remaining 39 per cent is made towards non-food items. Average per capita expenditure of urban population is Rs. 8094 of which 50 per cent is food expenditure and the remaining 50 per cent is non-food expenditure. Percentage of population below poverty line in Vaishali district is 63. All these indicate that the farmers of district are vulnerable to environmental change.

7.3.2 : Participatory impact assessment of agricultural technologies on farmers livelihood in eastern region

(Abhay Kumar, A.R.Reddy, A.K.Singh, R.D.Singh, D.K.Kaushal, Ranbir Singh, U.S.Gautam and A.K.Sikka)

The project was undertaken with the objective to study the adoption of the technologies developed by the Institute and its possible impact on bio-physical and socio-economic aspects. From the analysis of data collected from the survey related to optimization of rice transplanting technology (ORT), it was found that more than 80 per cent farmers were adopting ORT. Due to adoption of ORT, the rice could be harvested from maximum number of fields by last week of November. Earlier, it used to be harvested by the end of December. The transplanting pattern before and after adoption of this technology is presented in Table 23.

Table 23: Change in rice transplanting pattern due to adoption of ORT

Date	Percentage transplantation		Variety	Yield
	Before adoption	After adoption		
25 June - 15 July	5 – 10	25 – 30	MTU 7029	4.8 – 6.4 t/ha
16 July - 30 July	60 – 65	60 – 65	MTU 7029, BPT 5204, Sita, Sonam	3.2 – 4.8 t/ha
31 July & after	25 – 30	5 – 10	–	< 3.2 t/ha

The farmers also informed that they are now spending more on health, education and clothing. During the period under report, two types of schedules were also developed: (i) Survey schedule for impact assessment of multi-tier cropping system, and (ii) Survey schedule for impact assessment of cultivation of tomato in rainy season

7.4 : Socio-economic, institutions and policy guidelines for governance of resource management

7.4.1. : Understanding makhana production system

(P. K. Thakur, Janardhan jee, Ujjwal Kumar, Abhay Kumar, A. R. Reddy, B. K. Jha, Sanjeev Kumar and Naresh Chandra)

Out of four selected districts (Darbhanga and Madhubani in north-west zone and Katihar and Purnia in north-east zone), the pre-tested interview schedule was applied and data was collected from 400 makhana growers from Madhubani and Katihar districts. Information regarding price and marketing of makhana was also collected from 30 stakeholders involved in marketing of makhana. The information was collected on social profile of makhana growers which included cast, education, sex, occupation etc. The present cost of cultivation including labour, fertilizers and manure, irrigation and

land rent were also studied for both pond and field situation of makhana cultivation. The process of price determination and marketing channels was also studied.

While studying the makhana processing and marketing, the research team found that huge quantity of makhana bran, a by-product of processing of makhana pop, is thrown along the road side and wasted. To explore the possibility of use of makhana bran as animal feed and other purposes, the team collected the sample and got its nutritive value determined and compared it with other types of bran as presented in Table 24.

Table-24 : Comparative study of makhana bran with some other bran/by products

Nutrient content	Makhana bran	Rice bran	Wheat bran	Corn Gluten Feed (CCG)	Sorghum bran	Pearl millet bran	Soy-hull	Gram husk	Peanut bran
1. Moisture (%)	8.6-10	9.0-11.0	8.0	12.0	10.0	10.0	11.0	10.0	10.0
2. Dry matter (%)	91.0	91.0	89.0	90.0	89.0	90.0	89.0	90.0	90.0
3. Total Ash (%)	7.6	8.3	6.9	9.0	2.0	3.2	5.2	5.3	10.9
4. CP (%)	8.2	13.0	17.0	14.2	6.7	17.1	13.0	17.4	8.1
5. Carbohydrate (%)	49.4	49.0	61.6	56.0	34.6	52.2	42.8	66.0	28.8
6. CF (%)	249.0	11.4	10.9	8.4	27.0	-	39.7	11.4	40.6
7. Calorific value (Kcal/ 100g)	244.0	360.0	205	229	236	354	185	-	210
8. Iron mg/100g)	98.7	35.0	19.0	16.2	5.0	-	49.6	-	16.4
9. Zn (mg/100g)	3.8	4.0	9.6	7.3	6.8	-	3.8	-	3.1
10. Ca (mg/100g)	228.0	80.0	130	70	250	16.8	490	-	17.0
11. P (mg/100g)	234	1410	1290	150	340	-	180	-	-
12. K (mg/100g)	137	1900	1400	270	600	-	1400	-	-
13. Mg (mg/100g)	143	900	60	450	18	-	27.0	-	35
14. E.E./Fat(%)	1.6	16.0	4.4	3.2	8.5	5.0	2.6	1.0	3.3
15. TDN (%)	-	72	78	80	65	-	77	-	48.9

Note : CP: Crude protein, CF: crude fibre, E.E. : Ether extract, TDN: Total Digestible nitrogen

7.4.1(a): Socio-institutional parameters affecting makhana production and livelihood system of makhana

(Ujjwal Kumar, Abhay Kumar, A. R. Reddy, B. K. Jha and P. K. Thakur)

Two hundred makhana growers each from Madhubani and Katihar were surveyed in order to understand their socio-economic profile. It was found that cent per cent makhana cultivation is done by *Sahni* community as main occupation in Madhubani. Only 54 per cent of them were taking fishery also as secondary occupation. In Katihar, only 18 per cent cultivation of makhana is done by *Sahni community*. The percentage of makhana farmers having nuclear family was higher in both the districts i.e. Madhubani (84 per cent) and Katihar (97 per cent).

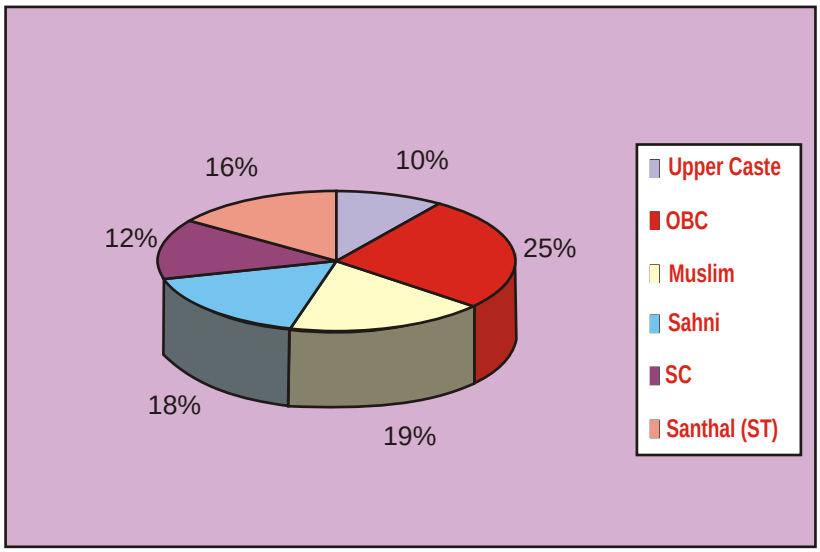

Fig. 32. Social status of makhana grower in Katihar district (N = 200)

7.4.1. (b) Cost of production and input output relationship in makhana production

(A. R. Reddy, P. K. Thakur, Ujjwal Kumar, Sanjeev Kumar and B. K. Jha)

Data was collected from two districts, Katihar and Madhubani. Data from Katihar was analyzed and the results are presented. Total cost of cultivation of makhana was found to be Rs. 31498/ha in pond situation and Rs. 36809/ha in field situation (Table 25). Cost of production was more in field situation due to the use of more inputs. Human labour, being the major cost item in both the situations, accounted for 84.98 per cent of total cost in pond situation and 52.04 per cent of total cost in field situation. Harvesting was the major activity, which consumes 75 to 80 per cent of total human labour. Machine/bullock labour accounted for 13 per cent of total cost in field situation. Cost of fertilizers and compost was Rs.4129 and Rs.3248 /ha respectively in field situation. Irrigation cost per/ha to maintain desired water level in pond situation and field situation was Rs. 1336 and Rs. 5813 respectively. Cost of pesticides was also more in field situation than in pond situation. There is no seed cost in makhana production. In pond situation left-out seeds germinate in-situ and in field situation farmers collect seedlings from nearby ponds without involving any extra cost. Gross income from makhana production was found to be Rs. 64503/ha in pond situation and Rs. 90035/ha in field situation. Due to better management, yield of makhana is more in field situation. Net income in pond situation was Rs. 31498/ha as compared to Rs. 36809/ha in field situation.

Table-25 : Costs and returns in makhana production

Particulars	Pond situation		Field situation	
	Cost (Rs./ha)	Percentage to total	Cost (Rs./ha)	Percentage to total
Fertilizers	0	0.00	4129	7.76
Compost	0	0.00	3248	6.10
Pesticides	671	2.03	1417	2.66
Machine/bullock labour	0	0.00	6917	13.00
Human Labour	28048	84.98	27701	52.04
1. Transplanting	0		2113	
2. Weeding/cleaning	4174		2833	
3. Gap filling	904		581	
4. Chemicals application	356		780	
5. Irrigation	320		650	
6. Harvesting	22294		20744	
Irrigation cost	1336	4.05	5813	10.92
Land rent	2950	8.94	4000	7.52
Total	33005	100.00	53226	100.00
Gross income	64503		90035	
Net income	31498		36809	

7.4.1. (C) Price and marketing of makhana

(Abhay Kumar, A. R. Reddy, Ujjwal Kumar, Janardan Jee and P. K. Thakur)

A study was undertaken in order to identify the present system of marketing in the state and its specific problems and constraints in various areas of agricultural marketing. Out of the four randomly selected districts, a survey was concluded in two districts, namely, Katihar and Madhubani with a sample size of randomly selected 200 makhana growers, 30 processors and wholesalers, commission agents, pre-harvest contractors and retailers in each district. Altogether 10 retailers, 5 middlemen & 10 big traders from Katihar and 10 retailers, 5 middlemen & 3 big traders from Madhubani were surveyed. From the information collected from 10 retailers of Katihar, it was found that the businessmen used to purchase makhana *lawa* (makhana pop) directly from the farmers @ Rs. 50 - 70/ Kg and sell it @ Rs. 85 - 110/Kg. The variations in retail prices of Makhana in Katihar in different months of the year are depicted in (Fig. 33).

It was also found that businessmen used to purchase makhana *lawa* 80 per cent from the *Phodias* and 20 per cent from farmers. These local businessmen used to sell makhana pop to the big traders of the district. During July, sale price used to be highest, whereas, it is lowest in December. The average expenditure on transportation in marketing is Rs. 0.50/kg. There was no cost of machinery involved in marketing. Out of 100 tonnes, 70 tonnes were marketed outside Bihar. The marketing channels observed in Madhubani and Katihar are as follows;

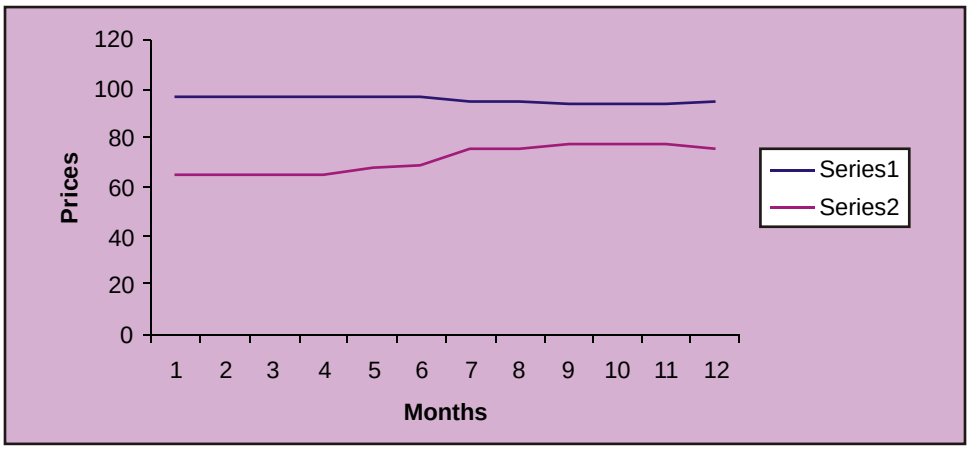

Fig. 33. Retail prices of makhana in Katihar

Madhubani

Farmers ⟶ Middlemen ⟶ Traders ⟶ Wholesale market ⟶ Retailers ⟶ Consumer

Katihar

Farmers ⟶ *Phodias* ⟶ Middlemen ⟶ Traders ⟶ Wholesale market ⟶ Retailer ⟶ Consumer

Being away from *Mandi*, high transportation cost and less consumption and restricted publicity were some of the main constraints as perceived by the retailers in makhana marketing.

7.5 : Training methodology needs assessment and capacity building

7.5.1 : Feedback assessment of agriculture training on farmers' practices

(*N. Chandra, U.S. Gautam and Abhay Kumar*)

A total of 60 trainee farmers having attended trainings on different subjects were randomly selected. Those trainee farmers were personally interviewed with the help of a structured schedule to assess their level of satisfaction with the adoption of the knowledge obtained during the training programmes. They were also interviewed about constraints in adoption and suggestions to improve the training programme. The primary data obtained through interview was analyzed.

The selected topics of training were zero tillage (wheat), nursery management in polyhouse, reduced paddy seed rate, improved cultivation of horticultural crops (Ranchi), improved vegetable cultivation (Varanasi), spraying techniques, fish cultivation, mushroom cultivation, drip irrigation in banana, bee-keeping, IPM, fruit and vegetable preservation and duck rearing. It was found that satisfaction level of farmers with almost all training programmes was high. Adoption was found to be high for the training programmes such as nursery management in polyhouse, fish cultivation, mushroom cultivation and fruit and vegetable preservation. It was found to be medium for zero tillage (wheat), reduced paddy seed rate, improved cultivation of horticultural crops (Ranchi), improved vegetable cultivation (Varanasi), spraying techniques and duck rearing. The same was observed to be low for drip irrigation in banana, bee-keeping and IPM. Lower level of adoption was because of multiple factors such as lack of capital, inputs, interest, and family labour and non-supply of critical inputs. It was found that effectiveness of trainings could be further improved as far as possible with more field visits/practicals on some of the selected topics.