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Horticultural Interventions in Improving Livelihood of Tribal Farm Women in Bihar

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ABSTRACT

A case study was undertaken between 2015–2017 in Tharu tribal-dominated Bakwa Chandraul and Parsauni villages in the West Champaran district of Bihar, India. After initially understanding the socio-economic status and major role of tribal farm women in the home and farm decision-making process, horticulture-based interventions were introduced in homestead gardens managed by the women. Interventions included the introduction of high-yielding hybrids and varieties of vegetables (Bottle gourd, pumpkin, okra, cowpea, cauliflower, cabbage, pea and radish) and fruit (mango, litchi, guava and lime), and training and skill development in vermicomposting, mushroom cultivation, and fruit and vegetable processing. During the study period, the farm women were not only able to produce more for their own family consumption but could also sell the produce in the local market. Horti-based interventions improved productivity and increased farm income by more than 20% among the tribal women selected in this study; thereby providing farm women greater leverage to make purchases for the family. Our study shows how existing farming systems can be refined and fine-tuned through horti-based micro-interventions to increase farm and family income among tribal women, and bring about positive changes in the socio-economic and nutritional condition of tribal farm families.

KEYWORDS: Horticulture, livelihood, farm women, fruit, vegetables, skill development

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1. INTRODUCTION

Agriculture in Bihar has been bedevilled by a trend of falling productivity over the last few years. In particular, rice and wheat, which are the two major crops of the state together accounting for more than 75% of total cropped area have recorded a substantive fall in their productivity in recent years. There is an increased realisation that farmers have valuable knowledge, wisdom and experience to bring to the process of agricultural research, and as the end users of technology, they should be active participants in all stages of this process (Chambers, 1986). This has led to a gradual shift away from the linear transfer of technology model, towards 'innovation systems' approaches (Roling, 1988), which view innovation as an interactive process involving a range of actors with different knowledge and skills. At the same time, the understanding of innovation has broadened from a sole focus on technologies, to include socio-economic, cultural and institutional changes – with the understanding that the technical aspects of innovation are also social (Anonymous, 2012).

Sustainable agriculture is one of the cornerstones of livelihood security and income generation in tribal communities (Patidar et al., 2018, Kumar et al., 2016). There is a huge gap between the technology available in the institutions and those in the field. This is particularly true in the tribal-dominated villages of West Champaran district of the state. Most of the tribal farmers are small and marginal in nature with farm size less than 2 ha and family labour cannot be employed round the year due to monocropping (Patel et al., 2020). The reliance upon a few crops in combination with a high risk of crop failure due to a range of factors (i.e. disease, drought) exposes farmers to a high degree of variability with respect to yields and income and therefore risk (Reijntjes et al., 1992, Ashby, 2001; Laishram and Dey, 2014). On-farm trials in which farmers' incomes form the basis of research have found that the incorporation of fruits and vegetables crops is highly lucrative (Dillon and McConnell, 1997, Ashby, 2001). In this study, data obtained during the preliminary survey revealed poor socio-economic conditions of the tribal farm women which also included a cereal-based diet low in protein consumption.

The horticulture sector has become a key driver for the economic development of the country and it contributes 30.4 % to the GDP of agriculture, which calls for technology-led development (Anonymous, 2015). Research over a period of time has proved that farmers especially resource-poor farmers, continually experiment, adapt and innovate technology (Rhoades, 1987, Chambers, 1986, Gupta, 1996). A World Bank report (Anonymous, 2005) indicated that agriculture plays a key role in the economic development of rural poor and poverty reduction (Irz and Roe, 2000) with evidence indicating that every 1% increase in agricultural yields translates to 0.6 to 1.2% decrease in the percentage of absolute poor (Thirtle et al., 2002). Also, women play a vital role in different facets of tribal communities in terms of their participation in economic activities, income generation, and decision-making. Women empowerment, therefore, becomes an important process where they become conscious of their situations, organize themselves, learn skills, set goals, solve problems and develop self-reliance (Das, 2014; Isapeule et al., 2018). Economic empowerment through the provision of steady income and access to resources widens the ambit of women's empowerment (Malhotra et al, 2002; Mayoux 2000). In order to make agri-based livelihood among tribal farmers stronger and more sustainable, there is a need to improve and accelerate the contributor variables of livelihood (Islam, 2014, Kumar et al., 2015).

With this background, an effort was made to transfer appropriate Horti-led interventions to the tribal women farmers in the field to empower the tribal farm women of West Champaran district of Bihar by improving their socio-economic conditions and quality of life through the adoption of improved livelihood practices.

2. MATERIALS AND METHODS

Visit and survey were conducted in Harnatand, Mohdewa, Bakwa Chandraul and Parsauni villages in West Champaran district of Bihar during 2015–2017 to identify two villages that had a predominant population of scheduled tribes. Subsequently, Bakwa Chandraul and Parsauni tribal villages were selected for the study. A demographic survey in these two villages revealed the predominance of the Tharu tribal community. Tribal women farmers were selected as stakeholders of the programme through whom women–friendly horticultural technologies were demonstrated and introduced.

West Champaran district lies in the North–West part of Bihar. The district shares a border with Nepal in the Northern and North Eastern parts, with Uttar Pradesh in the South-West and Gopalganj and East Champaran districts to the South and East, respectively. The western border of the district is divided by the Gandak river. The district is situated between North latitude 26°16'–27°31' N and East longitude 83°50'– 85°18' E. The selected village Bakwa Chandraul is situated between 27.255070 N latitude and 84.328278 E longitude, while Parsauni Village is situated between 27.267377 N latitude and 84.332719 E longitude.

West Champaran gets heavy rains from the month of July to September. The normal annual rainfall is about 1400 mm. Soil is sandy loam and rice–wheat and rice–sugarcane-based

cropping systems prevail in the district. Agriculture is the main source of income for the people in West Champaran. Some agro-based industries have flourished here and are being run successfully. The major crops of the district are paddy, maize, sugarcane, potato, wheat, barley, arhar etc.

Before the implementation of the programme, a survey of the village profile and socio-economic condition of the tribal farmers was done through interaction and personal interviews of 43 women farmers randomly selected from both villages (26 from Bakwa Chandraul and 17 from Parsauni village). This was achieved through the use of a standard extension-based questionnaire. In the village profile survey, data on the number of households, sex composition of male and female, literacy rate, the average size of household, occupation, infrastructure facilities, marketing channel for selling horticultural crops and specific needs of tribal women in horticulture–based production system were collected and analysed. Similarly, data on socio-economic condition of the selected tribal women farmers of the villages included female literacy, family type, occupation, annual income, land holding, decision making etc (Table 1). Data was collected on the role of genders in performing the agronomical cultural practices in the field, selection and cultivation of crops, harvesting, storage, home scale processing and their consumption, marketing for purchase of vegetables etc. Study was also done on the nutritional status and food consumption patterns of the tribal farmers. Data were collected through personal interviews of the tribal women farmers.

Table 1: Socio-economic status of selected tribal women in the two villages

Parameter		Bakwa Chandraul	Parsauni
Female literacy		27%	23.5%
Family type	Joint	53.8%	41.2%
	Nuclear	46.2%	58.8%
Decision making	Female	46.2%	51.3%
	Male	41.2%	35.1%
	Joint	12.6%	13.6%
Electrification		50%	70%
Toilet		0%	12%
Type of house	Concrete	7.6%	41%
	Tiled	77%	59%
	Thatched	15.4%	0 %

All the technological interventions like distribution of vegetables seeds, fruit planting material, vermicompost units, and various training and demonstration programmes on vegetable nursery raising and cultivation, planting of fruits and aftercare, vermicomposting, mushroom cultivation, processing and value addition of fruits and vegetables, and kitchen gardening were undertaken in a participatory mode with the women farmers. XLSTAT software was used for analysis of data. All the selected women farmers of the villages actively participated in the programme.

3. RESULTS AND DISCUSSION

3.1. *Decision-making and gender roles in domestic and farm activities*

Gender role in performing different works at home and farm level was studied in both villages. The study found that women in these villages were tasked with important decision-making and undertaking different works at both home and farm. Data revealed that while the majority of the work was collectively accomplished by both men and women, major manual work that normally requires hard labour such as land preparation, ploughing, pit/basin/channel and bed preparation was done by men. Activities such as storage of harvested produce, home-scale processing and their consumption were women`s domain. Most of the decisions were taken by the women at home and farm level, thereby indicating their status and importance in the social strata. Selection and cultivation of crops, and intercrops decision were taken by both men and women whereas, harvesting, storage, home-scale processing and their consumption work was done especially by the women (Table 2). It was also observed that tribal women in both villages were tasked with the decision-making and role to make purchases of food and other home essentials from the market. Overall women were found to be involved in 46.3% and 51.3% of decision-making in Bakwa Chandraul and Parsauni, respectively, while the male counterparts took 41.2% and 35.1%, respectively in the two villages. Both men and women took collective decisions in the remaining 12.6% and 13.6%.

3.2. *Food consumption pattern*

In terms of food preference, the study found a high preference for non–vegetarian food, although the frequency of consuming high-protein food such as chicken, fish, and egg was low. About 93% of respondents of Bakwa Chandraul village were non-vegetarians while only 7 % were vegetarians. Whereas, 83% of respondents of Parsauni village were found to be non-vegetarians and 17% were vegetarians. Common items of daily food included roti, rice, milk, leafy and seasonal vegetables. Alarmingly, pulses were consumed only 2-3 days a week in both villages despite the recommended dietary allowances (RDA) for adult males and females being 60 g and 55 g, respectively (Gurusamy et al., 2022). The consumption of off-season

Table 2: Gender role in performing the different activities of horticultural crop production

Sl. No.	Activities	Bakwa Chandraul		Parsauni	
		Participation	Responsibility / Decision making	Participation	Responsibility / Decision making
1.	Land preparation	Both (M+F)	Male	Both (M+F)	Male
2.	Manure application	Both (M+F)	Both (M+F)	Both (M+F)	Both (M+F)
3.	Lifting of plants	Both (M+F)	Both (M+F)	Both (M+F)	Both (M+F)
4.	Selection of crop	Both (M+F)	Both (M+F)	Both (M+F)	Both (M+F)
5.	Planting	Both (M+F)	Male (fruit) Vegetable–F	Both (M+F)	Male (fruit) Vegetable–F
6.	Weeding	Both (M+F)	Both (M+F)	Both (M+F)	Both (M+F)
7.	Intercultural operation	Both (M+F)	Both (M+F)	Both (M+F)	Both (M+F)
8.	Harvesting	Both (M+F)	Male	Both (M+F)	Male
9.	Marketing of fresh produce	Male	Both (M+F)	Male	Both (M+F)
10.	Processing at household level	Female	Female	Female	Female
11.	Retention of seed	Female	Female	Female	Female
12.	Storage	Female	Female	Female	Female

M: Male, F: Female

fruits and vegetables was very less although seasonal fruits were consumed significantly by most of the respondents. Considerably higher–priced and high protein food such as paneer (cottage cheese), mushroom, egg, fish, chicken, and meat were only occasionally consumed owing to their high cost in the market and in most cases beyond the purchase ability which otherwise were items of preference. The food consumption pattern, therefore, reflected a relatively poor diet amongst the tribal women comprising mostly cereals, with low intake of proteins, pulses, fruits and vegetables. It was therefore assumed that with food consumption far from the requirements of a balanced diet, the health and nutritional level of the tribal population in the villages under study would be poor (data not shown).

3.3. Introduction of high-yielding vegetables

Demonstrations on improved production technologies of vegetables especially quality seeds of improved varieties and modern production methods including suitable plant protection measures at farmers' fields will contribute to enhancement in the productivity of vegetables which would further improve the nutritional and livelihood security of the farming community. The majority of the tribal women farmers of the villages were using local seeds and following the traditional method of vegetable cultivation. High–yielding varieties and hybrids of vegetables were introduced in villages. Bottle gourd (Kashi Ganga), pumpkin (Kashi Harit), Okra (Kashi Pragati) and cowpea (Kashi Kanchan and Kashi Nidhi) were introduced among 145 women farmers of Bakwa Chandraul and 105 of Parsauni village for cultivation in kitchen garden during summer and rainy season. Whereas, cauliflower (Hybrid White Heart) and cabbage (Hybrid Alisha),pea (Azad Pea–3) and radish (Shweta) were introduced among 26 women farmers of Bakwa Chandraul and 18 farmers of Parsauni village for cultivation during winter season.

Yield performance and net income obtained from different crops grown in kitchen garden areas of tribal women in Bakwa Chandraul and Parsauni villagehave been presented in Table 3 and 4. In general, the performance of different vegetables grown in Parsauni village outperformed that of Bakwa village. The yield of bottle gourd was found to be 170–240.7 to185.0–250.5 q/ha followed by pumpkin (163.0 – 250.0 to 173.0–265.0 q ha^{-1}), okra (yield 90.0–110.0 to 95.0–115.0q ha^{-1}) and cowpea (yield 80.5–96.5to 85.5–102.5 q ha^{-1}) in Bakwa Chandraul and Parsauni villages respectively. The net income obtained from different vegetables grown in a small plot of backyard area by the women farmers was also worked out. The highest net return among beneficiaries was (₹ 1250–4000/- to ₹ 2550–4200/-) obtained in bottle gourd followed by pumpkin (₹ 600–1740/- to ₹ 1600–2400/-), okra (₹ 650–1325/- to ₹ 975–1125/-) and cowpea (₹ 450–925/- to ₹ 750–1250/-) in Bakwa Chandraul and Parsauni village, respectively.

Yield performance and net income of various vegetables cultivated in Bakawa Chandraul and Parsauni village revealed that the highest yield of 270 to 400 q $ha^{-1}$and 280 to 380 q ha^{-1} was observed in cauliflower cultivation followed by 250 to 400 q ha^{-1} and 230 to 350 q ha^{-1} in cabbage, 100

Table 3: Yield performance and net income of different vegetables in Bakwa Chandrauland Parsauni villages

Village	Bakwa Chandraul			Parsauni		
Crop	Plot size (m^2)	Yield (q ha^{-1})	Net income (₹ $farmer^{-1}$)	Plot size (m^2)	Yield (q ha^{-1})	Net income (₹ $farmer^{-1}$)
Bottle gourd	150–275	170–240.7	1250–4000	250–350	185–250	2550–4200
Pumpkin	150–250	163.0–250.0	600–1740	200–300	173–265	1600–2400
Okra	100–250	90.0–110.0	650–1325	175–250	95–115	975–1125
Cowpea	150–300	80.5–96.5	450–925	300–500	86–103	750–1250

1US$ = ₹ 82.35 (February, 2023)

Table 4: Yield performance and net income of different vegetables in Bakwa Chandrauland Parsauni village

Village	Bakwa Chandraul			Parsauni		
Crop	Plot size (m^2)	Yield (q ha^{-1})	Net income (₹ $farmer^{-1}$)	Plot size (m^2)	Yield (q ha^{-1})	Net income (₹ $farmer^{-1}$)
Cauliflower	25–60	270–400	1450–3500	22–70	280–380	1500–3450
Cabbage	10–30	250–400	1250–2850	10–45	230–350	1150–2600
Pea	15–25	35–55	750–1125	15–20	25–48	675–1050
Radish	10–16	100–135	650–950	10–15	90–120	625–850

to 135 q ha^{-1} and 90–120 q ha^{-1} in radish and 35 to 55 q ha^{-1} and 15–20 q ha^{-1} in pea cultivation grown at Bakwa Chandraul and Parsauni village, respectively. Similarly, net return realized among the tribal farmers from the cultivation of cauliflower was ₹ 1450 to 3500/- and ₹ 1500 to 3450/- followed by ₹ 1250 to 2850/- and 1150 to 2600/- in cabbage, ₹ 750 to 1125/- and ₹ 675 to1050/- in pea and ₹ 650 to 950/- and 625 to 850/- in radish cultivated under Bakwa Chandraul and Parsauni village, respectively.Farmers were also imparted training on improved nursery management, seed treatment, and pest and disease management of vegetables. The difference in yield, monetary return in selected villages may be due to the timely adoption of management practices of vegetable cultivation by the women farmers.These results are in line with the study conducted by Deshmukh et al. (2013) on turmeric demonstration in the field of Meghalaya tribal farmers. They reported that the difference in monetary return among the selected SHGs may be due to varied agro-climatic conditions that prevailed in a particular location and the timely adoption of management practices by the SHGs. An increase in income among tribals of Mizoram through the adoption of integrated farming System over *Jhum* system has also been reported by Sangpuii and Malhotra (2016).

3.4. Fruits cultivation

Mango, guava and lime fruits of local cultivars grown by the tribal people in both the villages in their backyard were found low yielding and poor in quality. Improved varieties of fruits like mango cv. Malda, litchi cvs. Shahiand China, guava cv. Lalit and lime cv. Kagzi lime were introduced in the villages and distributed among 75 tribal women families. Three plants each of mango, litchi and guava and one plant of lime were planted in backyard of farmers' homes for ensuring household nutritional security. Feedback indicated that some women farmers earned up to ₹ 350–500/- $plant^{-1}$ from the selling of lime and guava fruits. Early return from lime and guava trees was achieved by the farmers because of the early bearing habit of these fruits as compared to mango and litchi fruits which took more time (more than 5 years after planting) to come into bearing stage. Initial data recorded on the establishment of different fruits showed that guava, lime and mango plants survived cent per cent while the survival of litchi plants was less. On-farm training to women farmers was also imparted on pit preparation, planting, training and pruning and disease & pest management of fruits. These findings are also in accordance earlier report (Das et al., 2014) that some tribal farmers earned up to ₹ 500 $plant^{-1}$ from selling of peach fruits introduced in farmers field of Meghalaya.

3.5. Vermi-compost production

During the visit to villages and interaction with tribal farmers, there was plenty of solid waste of crop residues and cattle dung available in the village and thrown on the side of the road. Therefore, the need for the establishment of vermicomposting unit was felt to manage the solid waste which can provide organic fertilizer to enhance crop productivity. Solid waste including agricultural waste, animal excreta and kitchen waste was utilized for the production of vermicompost in the villages. Eighteen women farmers were provided vermi-bed and vermi-compost production

technology was demonstrated to them through which they could utilise the solid waste, domestic waste and cattle dung. Vermicompost produced from the unit was used by the tribal women for use in growing vegetables and fruits in their backyard of the home.

3.6. Capacity building

Stakeholders meet involving experts in vegetables, fruit, mushroom, and vermicompost production were arranged to interact with the tribal women farmers on various aspects of agriculture. Several training programmes on "Entrepreneurship development in horticulture and mushroom production and value addition" were also arranged for the women farmers of both villages to improve their skills in horticulture production and value addition.

3.7. Ensuring people's participation

The significant aspect of the programme was the active involvement and participation of the village tribal women at all stages of the programme. Most of farming problems require the participatory approach of those practising farmers closely involved in technology development, testing and dissemination (Das et al., 2014).

The Bakwa Chandraul and Parsauni villages have become successful model villages for horticultural development in the most backward district of Bihar. As a part of disseminating the improved technology, the villagers are selling the vegetables, mushroom and fruit etc at prices 15–20% lower than the market rate to the neighbouring farmers. The productivity and consumption of vegetables especially cabbage, cauliflower, okra and cowpea increased substantially and family income has gone up by at least20% in the adopted villages. The villagers are now aware of the new agricultural technologies and their self–confidence has gone up as well. For the overall development of the tribal villages, a greater number of such activities need to be replicated in the various identified pockets of the states.

4. CONCLUSION

Introducing high-yielding and hybrid varieties of fruits and vegetables, and skill development in vermicomposting, mushroom cultivation, fruit and vegetable processing in remote villages of Bihar resulted in farm women not only being able to produce more for their own family consumption but also to sell the produce in the local market. Horti-based interventions improved productivity and increased farm income by more than 20% among the tribal women selected in this study, thereby bringing about women empowerment.

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