Improving water use for dry season agriculture by marginal and tenant farmers in the Eastern Gangetic Plains

A Compilation of Case Studies Volume 3

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1. Documenting community engagement

1.1 Introduction

For any large and complex project introducing new and innovative technologies and institutional changes, it is important to continuously self-reflect on the process of project implementation, in particular, the process through which the team has been engaging with communities, what has went well, what was more challenging, and what was done to address these challenges. This section documents the process of engagement in each of the six study communities in West Bengal, Bihar and Nepal. It reviews the background to each community, how institutions were strengthened and interventions successfully rolled out. It also reviews how the project ensured maximum participation from community members, what it did to promote leadership, and how it engaged with stakeholders.

2. Household or individual case studies

2.1 Introduction

A core aim of the project DSI4MTF is to transform the livelihoods of marginal and tenant farmers, who often are sidelined by large scale agricultural development programmes through a radical new approach to managing land, combined with innovations in water management. As one would expect however with any new approach, there will be certain households or individuals who excel but other who struggle to realise the same benefits. The purpose of this section is to review some of the positive stories, trying to understand the roots of success, as well as some of the less positive household experiences. Both are critically important as the project refines its models of intervention. It will allow an interative process of learning from mistakes which have led to less favourable outcomes for certain people. The project team can identify what can be done to prevent households experiencing negative outcomes again, while also being aware that some problems are outside of our control, and need to be worked around. At the same time, by looking at successful households, the team can seek to replicate best practices which have perhaps enabled these households to excel.

The household unit of analysis is important, as although the group is the core unit of production and recipient of support, one cannot assume that all members of the group will benefit the same way from the interventions, given the complexity of livelihood patterns, mixed leadership and learning abilities, and pre-existing household assets.

2.2 Household case study: A case of Jitan Ram from Bhagwatipur Village

Introduction

Jitan Ram is a member of collective farming group of Village Bhagwatipur, Panchayat-Jalsain, Block- Andhrathadi. District- Madhubani of Bihar, India. There are seven members in their family.

He is the head of his family other members of his family are wife, one son, one daughter-in-law, one grandson and two granddaughters. He is a landless tenant farmer. He is cultivating 4 bigha of land on sharecropper basis. Land owner not sharing any input cost with him and take 50% of the total produce from him. Apart from farming he also working as a priest for his community, he is only one priest for more than 30-40 villages. He earns more from priest activity than from agricultural activity. In past he worked as a migrant agriculture labourer, mostly migrated to agrarian state like UP, Punjab and Haryana for 15 years. He stopped migrating after his father's death. His father was also a priest for his community. So after his father's death the responsibility of Jajemenka (priest), livestock rearing and family came to him. His son is a migrant worker and living in Delhi.

Farming and Irrigation practices before intervention:

In Kharif season he cultivate paddy on 4 bigha of land and in rabi season cultivate wheat on 1 bigha of land and lentil paira (relay) crop on 0.5 bigha of land and also sowing lentil on plough land on 0.5 bigha of land and other rabi crop like khesari (Lathyrus), pea, & mustard on 0.5 bigha of land. Paira cropping is a common practice of village, farmers used to broadcast lentil seed on standing high duration paddy crop. Due to the paira cropping practice farmers are able to sow the crop at time. Lentil, lathyrus and other rabi crops sown on standing paddy crop to use residual soil moisture. Jitan Ram used to cultivate low or no irrigation requiring crop during rabi season due to high cost of irrigation water. In wheat he used to apply one irrigations depending upon the availability of soil moisture and high cost of irrigation. If there is any rain in the month of March-April than he is able to cultivate moong crop otherwise land remain fallow during summer season. In kharif season he is not applying any irrigation to paddy crop, during dry spell he manage to apply irrigation water to few plot to save the crop for own consumption. Jitan Ram using the tubewells of landowner and hire diesel engine from the service provider for irrigation. The cost of irrigation increasing day by day due to rise in diesel cost. This leads to farmers left the land fallow during rabi and summer season in the village.

From tenant farming he got the amount of paddy, wheat and pulse crop that can feed his family for one year. He is able to generate some surplus also, sell 200-300 kg of paddy, no wheat and 20 kg lentil.

Table-1: Showing crop yield and sale before intervention

Seasons	Crops	Cultivated Area (Bigha)	Yield (Kg)	Sale (Kg)	Remarks (if any)
Kharif	Paddy	4	4000	200-300	Also paid labour as wage

Rabi	Wheat	1	700	No	Home consumption
Rabi	Lathyrus	0.5	100	No	Home consumption
Rabi	Lentil	1	240	20	
Summer	Moong	0.25	30	No	Home consumption

Joining the group and being part of intervention

He is one of the active member of a pure collective group of Bhagwatipur site-1. He played a bigger role in formation of this group. He joined the group as a member and later he holds the post of treasurer and worked as a treasurer for one year. After one year due to some internal arrangement in the group, he left the treasurer post and hand over the charge to women member of the group. He always taking lead and interest for farming activity in the collective group. He always tries to learn the new thing and demonstrate new idea to the group member as well as to the member of other group. After joining the group and he got the training on different package of practices of vegetable crop, water management of different crop, crop production and exposure visit to research farm at Ranchi and also progressive vegetable farmer of Ranchi. He along with other group member of group-1 started vegetable cultivation on the collective leased land from 2016. In collective vegetable cultivation he experienced that managing pooling of labour, timing of work in the field and attitude of group member is bit cumbersome. He feels that vegetable cultivation require continuous labour work in the field and this is additional work for the group member. Each and every group member already engage in their own tenant farming activity, so they having less time to do this additional work. He also feels that in spite of they are neighbour and relatives but not trusting each other. He used his wisdom and leadership skill to keep the group member intact, building trust among group member, and convince group member for working for collective farming. He is able to solve the issue of labour pooling as well as timeliness of work by calling meeting of group internally.

Figure 1 Jitan Ram Planting Pointed Gourd

In summer 2017 group made huge loss due to price down of vegetable produce and no proper marketing of vegetable produce. He tries his level best to sale the vegetable produce in summer 2017 by contacting the local vegetable vendor as well as wholesaler in the local market. But unfortunately he failed in his endeavour.

After joining the group, he learns the water management of various crop, irrigation scheduling, selection of crop based on market demand and seasonality and package of practices of various crop including vegetable crop. Now he is so confident in vegetable cultivation that he taken risk of high duration vegetable crop like pointed gourd. He planted pointed gourd on 0.25 bigha of land.

He also learns about the marketing skill of vegetable produce through peer farmers in the village and also by interacting with the vendor and trader. He is now interested to sale his vegetable produce directly to the consumers in the nearby villages, on haat (weekly market), and nearby local market.

After joining collective group change in cropping pattern of Jitan Ram is as follows

Table-2: Showing new crop adopted as well as yield and sale

Seasons	Crops	Cultivated area (Bigha)	Yield (Kg)	Sale (Kg)	Remarks

		Project Land Area	Tenant land area	Project	Tenant		
Kharif	Paddy	0.35	4	440	4960	500	
Rabi	Wheat	0.15	2	120	1680	300	
Rabi	Lentil	0	0.5	0	40	No	Last year he planted on 1 bigha, this reduce area under this crop due to less yield
Rabi	Chick pea	0.15	0	---	0	No	No threshing so yield data is awaiting
Rabi (Vegetable)	Potato	0.4	0.1	800	200	400	
Summer	Moong	0.45	0.7	48	80		His share was 6kg
Summer (Vegetable)	Okra	0.4	0	288	0	230	
	Bitter gourd	0.3	0	139	0	130	
	Pointed gourd	0.25	0	No yield yet	0	No selling yet	High duration crop with high profitability

After proper analysis of above two table I found that Jitan Ram benefited by joining our project in terms of generating marketable surplus of many crop.

Perceived economic and livelihood benefit

After joining collective group expectation of each and every member of the was very high. The reason of high expectation was due to adoption of vegetable crop (high value agriculture) in their cropping system. In first year of cultivation, group cultivated wheat, lentil, and potato crop during rabi season. They paid wheat to landlord as land rent, 8 quintal of potato sold and use that money for next summer season vegetable crop cultivation and each group member got 50 kg of potato for household consumption. Jitan Ram also got 50 kg potato in first year in monetary terms its value comes around Rs. 500. During first summer season group cultivated vegetable on 1 bigha of land and group earn Rs. 36000/- and group also distribute some of fresh vegetable to each member for household consumption. In Kharif season group cultivated paddy on entire group land (5 bigha) and apart from collective farming Jitan Ram also cultivated their own leased (tenant) land in all the three season. Project also introduce pointed gourd in the collective group-1 of Bhagwatipur on small plot measuring 304 sq. m. but crop failed due to poor crop stand. Due to high duration and high risk associated with the crop majority of the farmers not accepted to cultivate this crop. But Jitan Ram agreed to cultivate pointed gourd on the leased land due to high duration and also high profitability. In second year of cultivation group follows the same cropping pattern on the collective leased land but second year was not as productive as first year.

Perceived social benefit

Jitan Ram told that earlier villager and another village people recognised me as a priest for Ram community not as a farmer. But after joining the collective and started cultivation of vegetable crop people now considering me as a farmer also. Jitan Ram told that during summer season (this is also season of marriage) people calling me for Puja (worship) and also enquire about the availability of vegetable produce in the village. Jitan Ram told that he is respected person in his community because of priest but other community also give respect and honour to me in village as well as in other village.

2.3 Household case study: A case of Bishundeo Mukhiya from Bhagwatipur Village

Background of family

Bishundeo Mukhiya was a member of collective farming farmers group of Village Bhagwatipur, Panchayat-Jalsain, Block- Andhrathadi. Madhubani district of Bihar, India. There are 8 members in their family. He is the head of his family. In his family his wife, 3 sons and 3 daughters. He having 3 katha of their own land and also cultivating as a sharecropper. This year he cultivated 15 Katha of land on sharecropper basis. Earlier he used to cultivate 40 katha of land on sharecropper basis but last year that landowner rent out on varna (taken money against land) 25

katha of land and given land to person who given him money. Now he is searching some more land from other landlord for cultivation on sharecropper basis. Land owner not sharing any input cost with him and take 50% of the total produce from him. Before 2008, he also migrated to different state like UP, Delhi, Rajsthan, Ahmadabad & MP and worked as an unskilled labourer. He worked as migrant worker for 11 years and stopped migration after 2008.

2.4 Farming and Irrigation practices before intervention

In Kharif season he cultivated only paddy and in rabi small area under wheat and more area under lentil crop. They cultivated lentil by two way depending on the paddy variety duration, in long duration paddy crop he used to broadcast lentil on the standing crop of paddy and in short and medium duration paddy lentil sown after ploughing the plot. This is due to high irrigation cost. Lentil crop sown on standing paddy crop and on ploughed land to use residual moisture of the soil. In wheat he manages to apply two irrigations. If there is any rain in the month of March-April than they are able to cultivate moong crop otherwise land remain fallow during summer season.

From the sharecropping he got the amount of paddy and wheat that can feed his family for whole year. They are not getting any surplus amount of food grain that he can sell.

Joining the group and being part of intervention

He was the member of a pure collective group of Bhagwatipur site-1. He worked with group for one year and left the group due to some issues with group member on working time management and dispute in sale proceed of vegetable produce. During summer vegetable planting time (year 2016) Bishundeo Mukhiya express his desire to sell the vegetable produce of the group. Group member agreed to provide the produce to the Bishundeo Mukhiya for selling of their vegetable produce. But neither he nor the group member finalise the criteria for selling of vegetable produce by Bishundeo Mukhiya. He started vegetable produce selling and after one week he stopped selling. The reason for stopping the selling of vegetable produce was that group given him the vegetable produce without finalising the price of produce, group understand that he sold entire amount in same price, group calculated the total sale proceed on one price into total amount of vegetable produce and Bishundeo pay different amount of sale proceed. This crop-up mistrust between Bishundeo Mukhiya and other group member. According to Bishundeo Mukhiya that some sold on higher price and some on lower price and even some vegetable wasted if not sold on the same day. But none of the group member agree with the argument of Bishundeo Mukhiya. Finally, Bishundeo decided to stop selling of vegetable produce as well as leave the group because of mistrust environment.

After leaving the collective farming group, he along with another person from the village joined the farming activity with one of the bigger landlord of the same village. They started vegetable cultivation on the land provided by the landlord. Initial informal agreement was that landlord

provide the land, investment amount for input and these two farmer provide their own labour for the cultivation of vegetable crop. Another part of agreement was that these two farmer would first return the amount invested by the landlord and then pay the land rent at the rate of 8 kg wheat and 10 kg paddy per katha per annum as per our collective land rent agreement but amount is lower than our collective group land tenure. Both farmers started vegetable cultivation in 2017, planted tomato on 4 katha of land, Chilli on 8 katha of land, Okra (Bhindi) on 22 katha of land, Bitter gourd on 2 katha of land, Cucumber on 2 katha of land, Sponge gourd and ridge gourd on 10 katha of land and along the boundary they planted bottle gourd. As per initial agreement, landlord provided all the input seed, fertilizer, irrigation facility and pesticide to these two farmers. They harvested 2500 Kg of tomato, 3000-4000 Kg of Okra, 100-150 Kg of Chilli, 250-300 pieces of bottle gourd etc.

Here also Bishundeo started the selling of vegetable produce in the nearby village as well as in local periodic market place. Selling of vegetable produce by Bishundeo and his interest in marketing cropped-up suspicion in the mind of landlord that he is harvesting some more amount and showing me less amount of sale proceed. Later, landlord contacted mandi in Jhanjharpur, Khutona and Darbhanga and also contacted some local vegetable vendor. He sends tomato to Darbhanga mandi but due to lack of proper packaging knowledge there was damage of tomato in transit and sale tomato at lower price than expected. Than he started selling the produce to local vendor. This act of landlord discourages both the farmers. Landlord not stopped here now they change their earlier decision of land tenure and they told that now they will first take the investment amount than from the remaining income he will take 50% and remaining 50% will be distributed between both the farmers. Both farmers decided to discontinue the vegetable cultivation on the landlord land. One farmer (Suraj Mukhiya) started the work of vegetable vendor in the nearby village and Bishundeo Mukhiya after two-three month started the tea and snacks stall in their own village. Later Suraj migrated to Gujrat due to not getting expected income from the business. Bishundeo continuing with the tea and snacks stall and he earn Rs.300-400 per day from this business. His wife and eldest son helping him in his business.

Perceived economic and livelihood benefit

Bishundeo Mukhiya told that he got only 50 kg potato and green vegetable for home consumption. There was no monetary gain from group. In first year of collective farming all wheat and paddy paid to landlord against land rent. In next year cropping season I left the group so not in a position to tell about the gain or loss.

Bishundeo Mukhiya views towards collective farming is a loss proposition because decision making for each and every activity is difficult. He told that he incurred loss of Rs.3000/- in terms of selling the vegetable produce of the group. His view is that in vegetable cultivation and selling frequent and fast decision making is required. He feels that decision making in collective group

is difficult and time taking exercise. For each and every activity there is need of taking consent from all the member. Group is not so mature to make the proper guideline for each and every activity.

Bushundeo said that he was benefitted by joining the project collective in terms of gaining knowledge about vegetable cultivation through different training provided by project. Now I am confident to cultivate vegetable crop and secure my livelihood it. I also gained experience of vegetable selling that I never did it before. Due to this gained skill, big landlord called me for cultivating vegetable crop on their land.

Perceived social benefit

Bishundeo Mukhiya told that after gaining knowledge and skill of vegetable cultivation. Farmer from my village and nearby village ask about the procedure of cultivating vegetable crop and I am confidently telling them the how to raise nursery of vegetable crop as well as other aspect of vegetable cultivation. Bishundeo understand that this was a big gain after joining the collective farming group.

2.5 Household case study of Pramila Devi Mandal:
Is empowerment a process or end in itself?

Background

How can one say a woman is empowered? Is empowerment a process or end goal in itself? And if we set to empower a women and lead her toward the path of equality, can bringing in play mere structural changes empower them? These and many more questions were raised when we started working with farmer groups comprising of male and female members in one of the groups under DSI4MTF in Saptari.

Parmila Devi Mandal is the chairperson of group 2. While the group was formed, the executive committee was formed and through discussion among the members, Pramila became the chairperson. She is 50 years old and has 8 household members. She owns 2 khatta of

land and rents 1 bigga of land from the landlord. Prior to the project intervention, Pramila cultivated paddy and wheat in some land parcel. After the project intervention, Pramila started with cultivating some vegetables in continuation with paddy and wheat. The primary reason to be part of the group was similar to that of other group members i.e, the provision of irrigation facility and agronomic skill transfer.

"*Can women be leaders*?" from the lenses of others:

The opportunity to be part of a group was new to her especially sharing space with male counterparts to discuss on agricultural aspects. Usually agriculture would be a household matter. Discussing on what to cultivate, how to cultivate, what and how much inputs to apply are the matters discussed among the household members. The purchase related work for example for inputs was done by the husband. While the group was formed, there were discussions on the labour division for input procurement and irrigation activities. To carry out discussions on various matters, the group met monthly. Pramila felt her point of view was not taken in a number of instances by the group members. She thinks she this has to do with the fact that she is a women. A couple of months back, there were delays on collecting fund by the group. She told the fellow members to collect the fund in a number of occasion. However not much was done on this regard. In Order to reinforce the chairperson of the group feels the group members should take her call for meetings seriously.

"Women as leaders"- from myth to reality

There have been capacity building activities about group management. However, given the period of engagement of three years, there has not been a significant behavioral change. The fact that activities such as irrigation equipment operation and mobility for procuring inputs are still largely domain of men, perceiving women in the roles of chairperson is difficult for the members to comprehend. Although there have been occasion when other members have turned up in the meeting in the pre confirmed time. However, there have been events when the other members have not without much information on why they could not. Investigating the reasons to why people behave the way they do requires deeper assessments. Although, the observation and discussions show that the decisions taken by women farmers are less likely accepted in comparison to male counterparts. There have also been events when the collection of fees for land preparation from tractor was difficult when regulated by the secretary of the group who is a man. However, the hesitation of women farmers to operate irrigation equipment and take up external roles hints the societal gender roles. Such roles tend to affect the way such groups function. In this case, the dissatisfaction of Pramila of taking up position of chairperson and powerlessness to reinforce the responsibilities shows just the same.

Other challenges

Ma Durga Krisak Samuha has been facing a number of problems since the group formation primarily with the landlord. The landlord has been demanding and imposing new higher rental rates to the land. Given the lack of cohesion among the group due to low turn up in meetings called by Pramila in recent months, the motivation of the members has been withering. The end of three year land agreement is not extended by the landlord. In such a crisis, the group however has come together and is planning to rent another plot of land to continue farming. On the brighter side, the group has worked collectively to address the crisis. Nevertheless, to remain strong in the future, the group has to be more accepting of the leadership of Pramila.

Key learnings

Certainly, Pramila has grown as a leader over the span of two years of group formation from limited mobility to participation and leading the group activities. This alone will not ensure the sustainability of the group. The group members have to equally internalize and accept Pramila as a chairperson. A lot of times, the lack of cooperation comes from the age old gender stereotypes and may be unconscious bias. In such a situation, the training and community engagement activities have to back up towards transformative change and gender equity. Of course, transformative change takes time but woman like Pramila who come from patriarchal rural farming community, leading the group is one step towards achieving this.

2.6 Youth farmer Sonu Paswan

Background

Mauahi village come under Dhamora panchayat of Babubarhi block of Madhubani district of Bihar state in India. This village just 5 km away from Block headquater (Babubarhi) and 45 km away from district head quarter Madhubani. Total 580 family residing in the village. Community wise or population wise Brahmin (General), followed by Muslim, Paswan(SC), Ram(SC), Yadav(OBC), Teli(OBC), and Mallah(OBC).

Majority of land holding belongs to Brahmin rest community either marginal or landless. Villager's main source of livelihood is agriculture and labourer. Migration rate is too high in the village. Most of the youth migrate to big cities in search of job so that they could earn & support their family

Process

From the village one youth Sonu Paswan who regularly used to listen the meetings of farmers group ask our team that how he could start agriculture activity and is it profitable. Then we have good conversation with Sonu as he has lot many questions. He wants to start the agriculture activity himself because the other choice for earning his livelihood is migration and he doesn't want to leave the village. Then our team members told him that you have to form the group and

then start collective farming. We told him the benefits and losses of the collective farming that how collective farming help him to address labour problem, capital arrangement and also help him in reducing the loss. He then arranged three boys from the village namely Gagan, chandan & kamlesh. They started farming of potato +maize, Okra in some land & wheat in rest of land. After the season is over they go for moongbean crop and they earned good profit. After two season two person namely Chandan & kamlesh left the group as they are not in a habit of doing hard labour & agriculture activity. Then Sonu motivated two youth namely Chandan Kumar & Rohit paswan and continued the activity. At present Gangan also left the group but he continued farming individually. Now Sonu Paswan continued farming and his group size is of 3 members.

Impact

The activity started by Sonu Paswan in the village has great impact among youth of village. He continued his farming in group and never left village. He has entrepreneurship quality as he tried vegetable in dry & low nutrient content soil of Mauahi village. The presence of Sonu as farmer in village is now motivating other youth of village to take up agriculture as one of the livelihood option.

Critical factors that contributed to impact

The most important thing that motivated Sonu is meetings of the farmers group in which they used to share their crop status, profit/ loss, new copping options. Source of livelihood for the youth of the village are labour and other is migration.the initiation by Sonu made Agriculture could be one of the livelihood option.

Constraints encountered and resolved

The group formed by Sonu has four members out of which one member is supporting the group with capital because earlier members assumed that they require huge money as capital but the issue is resolved as they need very less money what they assume. The other constrain encountered is loss in okra cultivation and also conflict among members the issue is resolved as two less needy members left the group and loss amount is low due to division of loss among members.

Key learnings

We have to support the individual who want to form collectives in identification of possible members as well as much time should be given on members capacity building as they could be possible ambassador.

3. Collective action case studies

3.1 Introduction

As well as understanding positive and negative stories relating to particular households or individuals, there are also important learnings concerning the groups themselves, and how they function. Important questions and learnings relate to decision making, conflict resolution, and innovative ways of working together. This set of questions is critical as the collectives, particularly the pure collectives, operate themselves as the core unit of production, and thus group failure can translate directly into lower productivity.

Case-1

Collective case study

Bhagwatipur site-1

Context

Bhagwatipur village is situated 50 Km from district headquarter of Madhubani and 7 Km from block headquarter. Agriculture is one of the major sources of livelihood of inhabitant of village. The village is inhabited by SC, OBC & 1 family from general category. Land holding pattern off the village is very unequal. Major landholding is in the hand of few families from general & OBC category, most of the SC community is either landless or marginal farmers. This is the irony of agriculture of village that most of person engaged in agriculture is from SC community. Tenant/ share cropping is prevalent in the village, now some farmers started taking land on fixed rent basis from the landlord. The case study selected is of collective farming of SC community group taken land on lease from OBC landlord. Total member in group is 8 out of which 3 members are male & 5 are female. This is mixed group formed without disturbing the earlier tenancy keeping in view, not to disturb their livelihood.

Process

After series of village meeting one landlord from OBC community agreed to give their land on lease to the farmers. With the support of the project Sakhi without disturbing the earlier tenant, formed group of farmers keeping in mind the group norms (same caste, equal social & economic status). During first summer season group started vegetable cultivation in whole leased plot (1.6 hectare). All went well farmers got good harvest of some vegetables and in some vegetables they failed partially due to less knowledge of pest & fertilizer management.

Group problems

Then problem started in the group because of the unavailability of all members in field on same time. The farmers are in habit of cultivating the land on share cropping basis only for two seasons (rabi & Kharif). For farming during these two seasons require some days at the time of sowing, some day for irrigation and some days for harvesting. But when they started vegetable farming that require time on regular basis for crop management, pest management, irrigation, weeding, plucking fruits as well as selling of vegetables. So it becomes difficult for all farmers to be on field every day as they have to look after other household & livelihood works also. Then group discussed the issue in their monthly meeting and it was finalized that members were divided into small groups and they look after the crop & marketing of entire field on assigned days of week. This raise second issue of mistrust among members as vegetable is sold on regular basis and they don't trust each other and secondly they have the issue that other small group didn't managed the field properly. The issues raised in meetings and then they appointed one person Jitan Ram who will manage the accounts of group. After few weeks some members raised question on Jitan honesty and changed accountant & appointed Malhu Ram. Malhu is week in writing so after few weeks laldai devi appointed as new accountant of group. The core of the problem is availability of time so farmers started neglecting farming activity which leads to loss of group and in the meeting farmers started talking about leaving the group. At present group members are cultivating their field as partial collective group. All members divided the area of leased land and cultivating the crops. Now the condition of the field is better but all members starts feeling problem of labour.

Impact

Group meeting was organized and all the problems was discussed in the meeting and group came to solution that members distributes plot among themselves and do farming activity individually. Irrigation, field preparation & procurement of inputs will be done jointly.

During last Kharif season farmers got good result and there is no conflict among members. They are supporting each other at the time of sowing & harvesting and all farmers were cultivating their field for all 3 season.

One thing members starts feeling is problem of labour at the time of sowing & harvesting of crops.

Critical factors that affected impact

Regular meetings, discussion among members and joint decision helps in stopping turnover of the group memebrs and coming to the solution of doing the farming activity as partial collective.

Strategy to build through the learning from the case:-

The major learning from this case is that before initiating any new models we have to understand and value their traditional practices of their main source of livelihood and before diversifying

their traditional farming practice we have to build their capacity to take up new activity as well as their time availability.

3.2 Collective action and women's leadership in Mahuyahi

Background

Mauahi village come under Dhamora panchayat of Babubarhi block of Madhubani district of Bihar state in India. This village just 5 km away from Block headquater (Babubarhi) and 45 km away from district head quarter Madhubani. Total 580 family residing in the village. Community wise or population wise Brahmin (General), followed by Muslim, Paswan(SC), Ram(SC), Yadav(OBC), Teli(OBC), and Mallah(OBC).

Majority of land holding belongs to Brahmin rest community either marginal or landless. Villager's main source of livelihood is agriculture and labourer. The village is dominated by Brahmins as most of the land holding is in their hand. Most of the share cropper selected by Brahmins is from OBC & Muslim community and SC don't have access to land for farming as sharecropper. With the support of project one young boys group formed and they started collective farming that encourages women's from the SC community to come forward. These women group got land on lease of one of the landlord shambhu Jha and they started agriculture in that land.

Process and impact

The group formed by the request of the members. These members want to cultivate the field so collectively meet our field coordinator & asked her to form their group. The group formed is of small size, only 5 women farmers namely Vina Devi, Asha Devi, Ramrati Devi, Kausalya devi are members of this group. All belongs to the same caste and their economic & social background is same. None of the male members are part of this group and all the matters of group are solved by members only without interference of male members of their family.

In the first season they cultivated lady finger 1 acre & Moongbean in 2 acre. They earn some profit which encourages them and during Kharif season they cultivated paddy in all the plots collectively & they got good harvest now wheat crop is in their field and that to also in good condition. They paid their rent after the harvest of paddy and half of the payment will be paid after the harvest of wheat. This establishes trust of landlord in SC community and now they started talking to give their land on lease to good farmers from SC community.

Critical factors that contributed to impact

Small size of the group, only women members & cultivation of crops they are doing traditionally are the critical factors that contributed to the impact. The hard work of women members & timely payment of rent to landlord build trust which influenced landlord to accept them as their sharecropper.

Constraints encountered and resolved

Women has to face water crisis situation due to few bore well and low water table in that location and is managed with the support of project supported bore well and other group support. The other constrain is availability of good quality seed and fertilizer management knowledge is addressed with the support of the DSI4MTF team.

Key learnings

For collective farming group should be small and field size should be of that much area which could be easily managed by members. Second important thing we learnt that we have to identify the members who are in need. Third important thing is that let farmer decide what they want to cultivate and we have to support them by building their capacity in doing same thing by using modern method of cultivation.

3.3 Collective Action case study: How do landless and tenants farmers farm? A tale of farmers in Koiladi

Background

One doesn't necessarily need a land to be a farmer. One may think it is pretty simple. You can lease land from someone and get started with the farming business. Or is it easier said than done? The experiences from farmer group in a feudal community Koiladi suggest there are greater realities and interlink ages among a number of when we talk about farmers, how and where they farm. This narrative comes from a journey of over two years working with farmer group which started out from 8 members and its continuation till 4 members at last.

The project title, "Improving Dry Season Agriculture for Marginal and Tenant Farmers in Eastern Gangetic Plains" captures three aspects. The physical context of the area rich in ground water but dry in winter and summer due to irrigation infrastructure access challenges. Marginal and tenant farmers, the farmers who constitute the majority of farming community in the reason with limited land and investment capacity in agriculture and irrigation infrastructure. The vision to improve the existing situation in hand is inclusive too. The assessment of physical and socio-cultural scenario at hand gives a head start to make a road map. Following through the same, DSI4MTF intervention started with the farmers in site 2 Koiladi.

Group 2 named Ma Durga Krishak Samuha was formed in October 2015 under DSI4MTF. Through community engagement process, agronomic, irrigation and group mobilization process started and continued. After selection of the farmers who came forward to be part of the group, land was selected for the intervention. The group started with 8 members. The agreement was made with the landlord with rental arrangement of 42 Khatta of land with 35 maan of paddy per bigga rental arrangement on annual basis. The rental arrangement was done for a period of 2 years. On 30th Dec, 2015, irrigation equipment was installed.

The Issue

On March 2016, the landlord said he wanted to lease the land to farmers who are obedient to him. There was an argument between the landlord and the farmers. Following the discussion, the landlord decided to lease only 15 khatta of land and started farming in rest of the plots. The farmers who continued to lease land were the ones the landlord thought "obeyed him" and assisted with the domestic chores. Farmers continued to farm in the land till the contract period which ended in Poush 2074 i.e, January 2018.

Negotiation for continuing the contract

In order to extend the contract, the chairman of the group Ram Manga Mandal, IDE officer, Jilla Krisak Samuha chairperson Ram Nanda Chaudari and the chairperson of group 1 Shiv Kumar Mandal had a meeting with the landlord Murari Prasad Singh on 20th March 2018. However, the landlord said he is not willing to extend the contract despite the discussion. He gave following reasons for not extending.

- The land lease as in the farmers do not assist in other work except for the work in the intervention plot. Usually, the farmers in the village work beyond the farm related activities in the landlord's house and farm. The work is done without any monetary exchange. The practice of farmers "just working on the intervention farms" was unacceptable to him. This suggests the change in status quo in a feudalistic society in not comfortably perceived.
- Farmers pay visit to landlord only when they pay the rent not other times. This suggests non-involvement of farmers in other chores.
- If the landlord handpicks the farmers to lease the land, they help him to do domestic chores such as washing utensils, animal care and so on.
- The organized groups and written land agreement was perceived as a threat by the landlord. In case any new policies come into play and presence of written land agreement was perceived to put the landlord in disadvantage. Having the conventional land rent practice without any formal agreement is considered as a good approach by the landlord.

What next for the group now?

Formal and informal discussion were happening and the message of non-extension of the land agreement started to become clear. The team along with the farmers started seeking alternatives on what can be done next.

Four members of Koiladi group 2 have decided to continue farming together. Additional 6 farmers are interested to do the farming joining this group. Among the new interested farmers, Inar Jeet Prasad Singh owns 10 khatta of land and Jeebcha Prasad Singh owns 5 khatta of land. Apart from these land parcel, the some farmers have been farming in these land plot from the past. The farmers are set to lease this new land.

Alternative to irrigation for the group members

The groups from Saptari filled in form to request for the boring installations scheme responding to the notice of Nakta jhijha, Dhanusha Ground Water Office in October 2017 through DADO. The application was accepted and 4 boring installation for Saptari, two in Kanakpatti and two in Koiladi was approved on February 2018. Two boring will be installed in Koiladi and rest in Kanakpatti. Under the scheme, the boring, material and labor cost will be provided by 20th March 2018. The scheme does not include electric meter and the pump set. The pump and the electric meter will be brought from the older site. This has been discussed with the landlord.

Key learnings

This case is a good learning opportunity and highlights the strong role of societal dynamics in the progression of interventions. We need to spend substantial time in the community engagement period to identify the motivation of stakeholders to be part of the project. In this case, the landlord's and farmer's motivation in the beginning seemed positive. However, after the installation of the infrastructures, the motivation started fading. Despite the innovative approaches, the adoption and replication are affected and hindered by the social, economic, cultural and political characteristics. In villages like Koiladi, landless and tenant farmers constitute of major population, their decision making and adoption of new agricultural techniques is affected by the power relations among the landless farmers and the landlord. From this experience, for interventions to be sustainable, along with technical innovation, devising innovative ways to adopt technology in a contextualized manner is essential.

3.4 Collective Action case study: What does feudalism mean?: A comparative case of two landlords from Kanakpatti and Koiladi villages

Introduction

One of the interesting question on collective farming is examining why farmers work together. A number of external factors such as monetary benefits as well as efficient management of time and costs; internal factors such as farmer's behaviour and attitude as well as social norms are considered key to shape the collectivization process. Among these factors, landlords are a key

stakeholders affecting farming environment for marginal and tenant farmers. In the two study villages, Kanakpatti and Koiladi, the farmers are leasing land from two landlords. The experience since the start of the collective groups has brought varied experiences bringing light to the traditional feudalism system and shifts on landlord's attitude in face of the changing socio-economic context in these villages.

Management of common pool resources is affected by a number of factors. In agricultural context, the collective action is affected by a number of factors: External, internal and social factors. Along with the perception of benefits from involvement in the collective action/management of resources, the social norms is a strong factor affecting farmer behavior. As laid out by the framework adapted by OECD on social factors, feudalism strongly shapes where tenants and landlords are positioned in the social hierarchy. This determines how and why the farmers behave in certain way depicting the existing power play. When it comes to owning and managing resources collectively, such power play determines, how and why the decisions are made to access and utilize such resources (OECD, 2013).

The upcoming case study presents a case exploring whether there is an equal footing among the landless and tenants farmers to collectivize. Further, it delves to highlight if the power hierarchy among under feudal system incentive them cooperate.

Community Context:

Saptari district of Nepal is characterized as the land of "*unequal land distribution*". In a country where agriculture is the major source of livelihood for 68% of the population, unequal access to land brings in a lot of challenges especially for the marginal and tenant farmers. The access to unequal resources brings in power hierarchy placing landlords at the assertive and tenants at submissive positions. The experience of working with group 2 comprising of marginal and tenant farmers from Koiladi village at Saptari depicts a similar tale.

In Koiladi, a few landlords own large plots of land, while there are many tenant and marginal farmers who have no or small land holdings. These marginal and tenant farmers lease in land from the landlords under different rental arrangements. In Kanakpatti and Koiladi village, the two main kinds of rental arrangements are *thekka* and *bataiya*. Thekka is the one time rent paid to the landlord in a year and *batiya* is sharecropping whereby 50% of the crop yield is distributed among the landlord and the tenant.

In Kanakpatti, the landlord has leased out his land and the pond to all three farmer collectives. The landlord of Kanakpatti has been supportive in comparison to the landlord of Koiladi. Mr. Gupta has extended support to the group members in various occasions such as providing the bamboo to make farm fence for free. The rental arrangement for the land and pond leasing is relatively relaxed. The farmers pay 17 maan per bigga for the land. The pond has been rented at Rs 17000 per annum for 3 years. Initially the rental charge set by the landlord was higher i.e, Rs 1,00,000 per year after a negotiation. As opposed to the traditional landlord tenant dialogue

where tenant could barely speak up against the rental charges levied, the Kanakpatti landlord is willing to be part of such negotiation.

How it began?

As the intervention was in the process of rolling out in Koiladi group 2 comprising of 6 members, a formal land agreement was made between the landlord and the group members. The rental arrangement was fixed through *adhiya* system. However, soon after the electric pump was installed in the leased intervention land, the landlord Mr. Murari SIngh started demanding for more rent from the group. He wanted to go for sharecropping. The project team and farmers negotiated with the landlord a new agreement whereby a portion of land was decided on thekka (leasing) and another portion on adiya (share cropping). This resulted in a reduced intervention area and delays in implementation of planned activities. Despite the initial hurdles, the group members started cropping all three season as opposed to traditional cropping pattern on monsoon, partially on winter and fallow on summer season. The farmers stated commercially cultivating vegetables in summer and winter season by learning new agronomic skills.

As for Kanakpatti, there have been instances when the landlord has taken the vegetables grown from the farmers's collective plot for personal consumption continuously without any payments. Although the Kanakpatti landlord seems supportive, some of such incidents show the resemblance of the deep rooted feudalism and the culture of dominance of landlord over the tenants. Although the act of taking vegetables by the landlord is unethical, the power hierarchy leaves the tenants voiceless continuing to live with the oppression. However, the tenants have spoken against this at various occasions. However, the landlord continues to take vegetables from the collective plot.

Kanakpatti landlord visiting the leased out pond

Recent Development in Kanakpatti and Koiladi

While in Koiladi, the question of continuation of land leasing itself is becoming a challenge, for Kanakpatti farmers, the issue vegetable procurement by landlord without any information or payments is strengthening feudal status quo. In Koiladi during the recent months, during the meetings with landlord and his son, they expressed the lack of interest to continue leasing out the land to the farmer groups after the contract term. He considered this decision in response to the federal structure of government Nepal is moving into. The constitution of 2015 has provisioned federal and local system of government for Nepal. As of yet, the local body election has been held and the provincial election is underway. The possibility of land reform to be brought in through the new system has creeped in the reluctance to go for formal land lease agreement. Land reform in Nepal has not been progressive in the past but some of the steps taken while formulating Land Reform Act has shaped the landlord's perception in this manner.

The landlord's son mentioned, "*yo samuhako manchhe haru le jamin uniharu naam ma huncha aba vancha re*" (meaning this group members are heard saying our land will be transferred in their name). Through the negotiation led by iDE officers and farmers, it was assured that the farmer group will not capture his land. For the assurance, the farmers are willing to sign a formal document stating the same. After the intervention, although the landlord was somewhat positive towards continuing with the group, the situation is something to think about seriously.

In the case of Kanakpatti, the landlord is willing to lease additional land if new groups are formed or the existing groups want to expand the farms. Moreover, the landlord is co funding if ponds would be dug by the project or the farmers.

Power hierarchy and land reform history

The power hierarchy established among the landlord and the tenants gives the latter less confidence to negotiate the unsatisfactory land leasing terms. Likewise in this case of Koiladi group 2, the farmers were less likely to communicate the dissatisfaction over the landlord's stance.

Increasing discourse on land reform led to the promulgation of Land Reform Act on 1964 in Nepal. This act put land ceiling on the ownership of land in the terai (plain) and hilly regions of Nepal. The land ownership ceiling provisioned 25 Bigga land holding in the Terai plains and inner Terai. As for the hilly and mountain regions, the land holding ceiling was 80 ropani. The limit for Kathmandu was 50 ropani. Likewise the fourth amendment of to 1964 Land Act provisioned the tenants to have ownership over 50% of land in the land they leased. Although materializing this policy required a formal agreement between the landlord and the tenant, this move was enough to withdraw land leasing to same tenant for a long time period. Either the land was leased in to different tenants or left fallow. The general practice of having a land leasing document is

uncommon in Nepal. Likewise, working with the landlord in Saptari is a challenging venture in these terms.

Key learnings

One of the main reason why landlord cooperate in developmental projects is the perception of benefits they will get. The benefits can be monetary as well as social. In this case, the Koiladi landlord perceived the provision of pumps in his land as a benefit. Although this was a guiding factor to cooperate for Kanakpatti landlord, he wanted to cooperate to "create goodwill for political career he is interested in" in near future. For Kanakpati farmer, the benefit lies in the fact that the land currently leased was fallow and gave no economical return. The income made from the previously uncultivated land is an incentive for the landlord to support them in some sense.

The perception on the likelihood of land reform and the new form of government arrangement Nepal is moving into has heightened the fear among the landlord that the land will be redistributed. As a result, the landlord are trying measures to remain immune to such changes. On the losing end are the marginal and tenant farmers like Koiladi group 2 farmers.

In the project level, having already made the investment on infrastructures at landlord's land, this situation threatens the sustainability of intervention. The access to the water pump is still a challenge despite the availability. Although, the landlord Murari Singh has agreed to continue with the intervention, after the land agreement term ended, he decided otherwise. Now farmers have leased another land plot.

Different level of oppression can be observed among the two landlords. While, landlord from Kanakpatti seems comparatively less oppressive, the fact that he takes vegetables from the farmers field depicts feudalistic hegemony over the powerless. Although, looking at the landlord from Koiladi who has now discontinued leasing out land because the farmers "would not help with his domestic chores" puts him at the center stage of how landlord act in an oppressive feudalistic society. Although it is unfortunate on part of farmers, the incidents in both the villages show change is a gradual process. While at Kanakpatti, farmers have started voicing concerns over "free vegetable procurement" by the landlord, it will take some time in Koiladi.

To maintain anonymity, pictures of the landlord is not put in the case study article.

4. Technology case studies

4.1 Introduction

It is important that the analysis of the group functioning and the economic benefits of the project interventions do not overlook the human-technology interface. This interface is a key link which

must be bridged if the project is to successfully integrate its technological and institutional innovations. This section outlines some of the technologies which have been introduced and explores how their success or failure has been mediated by social factors.

4.2 Their mustard must have wilted, their spirit kept flowering! UC's farmers' response to impending vulnerabilities

Background

Should misfortune, such as crop failure, befall poor communities, what possibly could happen? If this is a collective experimental initiative how the response would be different? These and related others may be possible questions. In a normal Indian social milieu the immediate post failure scenario may begin and end with 'blame' –finding for some scapegoats and explanations –it was all due to factors I am not responsible for –'they' did not do it, they should have done it' –are the usual refrain'. Scientists would mine more data and pie-diagrams, social activists some more consultations and administrators would pass some orders suggesting not to repeat such mistakes. The matter would end with farmers ruing their fate and government officers closing their files till such catastrophe befall again.

In Uttar Chakuakheti, a tribal village of Alipurduar, West Bengal nothing of the above sort happened. When their mustard failed to germinate this year, which had a better performance last year, the farmers lost no time. Immediately contacted the social and bio-physical scientists, who in turn, rather than waiting for an explanation ran to the field, stood behind them , listened to them, shared their insights and agreed to do something urgently. As the term of events unfolded there was an environment of pro-action and an alternative possibility emerged. Rather than waiting for cost sharing arrangements the collaborators readily worked out something which was agreeable to all. The visit of an international scientist, during the period, helped confidence building and within a manageable time the plots of land which had turned sour got agog with activities. Mustard has been replaced with maize and summer paddy. The scientists and the farmers are hopeful of a better crop.

The story from UC is important to listen to and considered. The story suggests that technological failures can be compensated not with financial and physical compensation, lot of data mining and analysis. The situation has to be dealt with empathy and solidarity. Failures do not make farmers redundant. At times of crisis they need to be more intensely listened to and their views more deftly understood. This failure may help better solution next.

A very thought provoking perspective on livelihoods, the sustainable livelihoods framework (SLF), considers social capital as an important endowment to depend upon and institutional and policy support essential to help the poor negotiate with and come out of the multiple stifling vulnerabilities. While the social capital is gradually dwindling institutional and policy support proving elusive and all too incongruent and incompatible to the needs of the poor-thanks to the ever growing pace of globalization and global economic order! Challenging such vulnerabilities and addressing policy and institutional inadequacies, however, are the only options poor are left

with if they have to come out of the poverty trap by asserting their entitlement , developing and strengthening resilience and restoring their well being and dignity.

The tribal communities of Uttar Chakuakheti (UC), Alipurduwar (West Bengal) have been taking on their existing vulnerabilities of livelihoods with resolve. Supported under the twin international research initiatives-DSI4MTF and SIAGI (sponsored by the Australian Centre for International Agriculture Research-ACIAR), the community- is collaborating in the research initiatives to promote socially inclusive sustainable agriculture intensification especially involving the small, marginal and tenant farmers during adverse climatic conditions –dry season.

Beginning of innovations

Over period the tribal communities of UC witnessed a number of innovations in the village. Shallow tube wells, solar pumps and protected farming attracted them which they soon saw as something offering green potentials. Last couple of cropping seasons brought new and diverse vegetables and crops. The family savoured new vegetables and also earned some savings out of cultivation of mustard and wheat. The community realized the power of being together-social capital- and being proactive for a better market.

While the writings on the wall were clear it also helped the communities add additional wings to help them unleash their aspirations. The facilitating organizations –UBKV and CDHI-with team of scientists and social scientists hand held the community and walked with them on their new providing the necessary support where ever and whenever needed. Reflective interactions, exposure visits and imparting of scientific knowledge by the scientists from the University and government departments helped the community with the necessary technical and managerial expertise and skills.

To be able to move systematically, last season witnessed added emphasis over and effort at planning. The community was able to plan a yearly calendar of detailed activities with sequence of activities, responsibilities and possible linkages. End of September, 2017 could see a clear plan to be unveiled soon after the end of Kharif season. The planning process reflected experience of the last year and confidence gained.

Planting of a dream- the technology crop mix

Not to miss on the season the community, under the guidance of the scientists and specialists, made no delay in sowing mustard using zero tillage technology. Last season mustard worked better using traditional methods while the wheat and maize performed better using zero tillage. The building on the last season's success scientists and the community decided to try zero tillage for both the crops. UC witnessed a never before feat of planting these two crops just on time-not a day delay. The confidence of working closely with the scientists and based on their own experience the community was all enthusiastic with new hope of a bumper harvest!

When Biplab Mitra[1] and his scientific fraternity from UBKV invited the fellow scientists and participants to the annual meeting of the project (DSI4MTF) to witness the new crop and technology they must have had a feeling of pride –a farmer friendly approach has worked -let it spread! The community felt equally agog –they could showcase their achievement! Zero-tillage in mustard remained talk of rest of the conference –it was a major agronomic breakthrough! For Erik[2] and Ram[3] this must not have been a surprise for they attended the planning sessions in the village earlier (May, 2017,) and were aware of how things were evolving.

Wilting of mustard: A hope gets disrupted

Two weeks after the zero-tillage (for mustard and wheat) was tried had opportunity to exchange notes with Tapan[4] . Hoping of the great enthusiastic response I asked him –' how the crops were doing'? He was polite but subdued –' sir the mustard in the neighbouring plot is doing better than the zero-tillage'. Was surprised and, in a consoling tone, asked if he has contacted the UBKV scientists to which he informed -Biplab Babu did visit and had asked to wait few more days. I was rattled –immediately contacted Joy and Subrata[5] who subsequently contacted Biplab and Rupak[6] with a next morning plan of visit to UC. Called back Tapan and Souren[7] . Subsequent, calls and discussions with them seemed to have created some smoothening impact. They would observe in unison –' scientists are with us and have been visiting us. No worry –they can suggest better. Life is experiment –things can go wrong but that should not stop us from experimenting! These were quite reassuring and positive to begin with further.

The visit of scientists from UBKV and CDHI, the next morning, had a warm healing touch. Plot to plot visits were organized, rows and depths were examined and questions discussed. The germination was different for the different plots and also within the same plot. The density of plants differed as well. The field level examination and analysis worked better as the farmers and the scientists were able to make appropriate judgements. Incidentally, Christian Roth, CSIRO,

[1] Biplab Mitra and the team –Rupak Sarkar, Ranjeet Chatterjee, Soumendra and others are part of the scientific team from UBKV offering professional support in agronomy, agriculture technology and water management.
[2] Erik is the team leader of the DSI4MTF, University of South Queensland (USQ),Toowumba, Australia. Erik has been quite persistent in the annual crop planning, working closely with the UBKV-CDHI team. Earlier last year (2017) Erik spent quite good time immersing with the UC, community and understanding the engagement process.
[3] Ram is the economist with IWMI who spent time in UC together with Erik understanding the engagement process. Both Erik and Ram attended planning sessions .
[4] Tapan is one of the key farmers from UC and a great enthusiast so far new experiments are going on. He is also the de-facto link between the community and the outside world.
[5] Subrata Majumdar and Dhanajay Ray are the coordinators for SIAGI and DSI4MTF,respectively, with CDHI. These two are key players in community mobilization and pleasant link between UBKV, the community and the outside service providers. But for their dedicated involvement much of the goals would not have been accomplished. They are technology persons, they are community mobilizers and 'ready to act any moment souls' acceptable to all.
[6] Rupak is a hydrologist with UBKV and leads the project. His leadership has galvanized the team of scientists willing to work and deliver something concrete.
[7] Souren , another farmer whose plot had suffered the most. There was virtually no germination of mustard in his plot who was sounded too morosed to be consoled. A long discussion about the consequences of experiments seemed to work better who agreed to have further discussion with the visiting scientists the next day.

Australia has been on an immersion visit to the village who, being a soil scientist, made some on the spot examination and analysis. The UBKV scientists and Christian exchanged their insights and agreed on certain examinations and analysis. Having analyzed the situation, however, there was an agreement to replace the plots with the cultivation of maize and summer paddy.

The farmers had contributed, out of their last years' saving, to the sowing of mustard and there was economic difficulty to make fresh investment. This, however, was not an easy decision to make. After a series of discussions cost sharing arrangement was agreed upon which the farmers and the project agreed upon and respected.

The flowering of the spirit

During a field visit Biplab proposed the final arrangements for the summer paddy. According to the arrangement the farmers had to attend a training program anchored by UBKV and hand held by a local farmers club. Tapan and Joy/Subrata coordinated the visit of the farmers and finally the training was organized. This was return of 'celebration time' in UC. Farmers started preparing for the visit and farmer to farmer contacts made to ensure that no famer is left behind and there is timeliness in reaching the venue.

As one can feel the festive mood of the farmers in the field, during the training, this was an opportunity for the UBKV scientists to prove that they meant business which necessarily meant that they wished to restore the confidence that the farmers were about to lose. For CDHI it was a reconfirmation of their conviction that the farmers could make all the difference with their confidence and elan.

Back from the training the farmers did not lose time to transplant. The project team was there in the field to celebrate the sowing of summer paddy. This time the local government official (ADA)[8] made it to the field to personally see and read the new script that the tribal farmers were writing. For him this was an occasion to saviour and celebrate. The story could be inspiring for others with the ADA and the UBKV scientists acting story tellers.

Lessons for the project

Where does this story lead us to? Does it look like driving euphoria emphasizing impossible conditions –solidarity, empathy, network... Are we undermining and discounting the inevitable role of technology in ensuring livelihoods and in dealing with vulnerabilities? We cannot be naive enough to ignore technology and scientific formulations . Neither can we be too simplistic to consider a formulation for empathy and solidarity as sine qua non. Science and scientific facts need to be considered in a given time and space. The science and scientific data must begin and end with the community as originator and interpreter of scientific realities. This is what empathy

[8] Additional Director of Agriculture, Alipurduar. Our effort at having network with the Government Officers has always been positive. Earlier the District Magistrate and the Sub-Divisional officer proved instrumental in arranging for the caste certificate of the tribal communities. Subsequently, irrigation pumps are being arranged under another government program. Visit of the ADA signifies a major shift toward out-scaling.

is all about so far as science and scientific knowledge is concerned. Considering scientists and common people as two distinct categories –one who possess the scientific knowledge and the other as recipient

Our understanding is that human have the indomitable potential to deal with their miseries and crises. These virtues need to be acknowledged and made sincere use of. There is a tendency to hierarchically arrange and see those virtues –poor considered as some body at the lower echelon incapable of carrying out feats that is possible by specially endowed individuals. This perspective is fallacious and goes against the ethos of human development which suggests that humans are reflective, proactive and self-efficacious –they can restructure their environment and change their world and adversities surrounding them. We need to, proactively, work around to create conditions in which humans can have level playing games. Our work with the tribal communities in UC and exposure to similar situations lead us to reemphasize our conviction in the self-efficacy of the poor and they ways this can be created.

4.3 Farmer's perspectives on Drip irrigation technology in Kanakpatti

There are couples of technologies demonstrated in the Kanakpatti of Saptari. Majority of the technologies provide crop protection services and irrigation facilities including drip kits. Prior to the project, most of the farmers were unknown about the drip kits and its benefits for vegetable production. In the beginning of the project, iDE provided micro-irrigation training to the farmer groups. The trainings were complemented by the demonstration of drip kits in the farmer's plots suitable for vegetable. These efforts enabled the farmers to use technology for irrigating vegetables. We also trained them to couple the drip with the sunflower pump to improve the water use efficiency.

Figure 2. Budhai Ram's daughter in field (November 2017)

In an interaction with Sundari Devi Chaudhary, member of the Rajajee farmers group about her experiences using drip kits, she said, "I was not familiar about the drip system. I used to irrigate crops from cannel. After I attended training on drip, I knew about it. It was the first time I heard about the technology in the training. A drip video shown in the training attracted my attention and I immediately got interested to see how it works in my field. In the mean time, I was thinking if it might just be a waste of money to invest in as I saw it as a complicated system with several pipes and fittings. When I used the drip kit, it worked well. The soil was already moist enough up to the root zone".

Initially, the project installed 6 small drip kits in different plots of the farmer's fields as a demonstration. Each system has four lateral lines with 80 emitters (i.e 80 plants) irrigating 50 m^2 area of land, and water supplied by 50 liters tank. We conducted a quick survey with 23 users to understand their perception on the performance of drip technologies. An assessment (Pie-chart : Figure 2) shows that a vast majority of the farmers were happy on the drip performance, however they still hesitated to use the technology for mainly two reasons: I) extra cost needed for the drip kit (that replaced the furrow irrigation in the selected area) and II) small systems that irrigate only 50 sq. m. To overcome the limitations, project provided 40% funds to buy systems up to 500 sq.m. Now, out of twenty three farmers of the Kanakpatti, nine farmers are using different sized drip kits (100 - 500 $m^{2)}$ irrigating a total of 1400 m^2 land in the area.

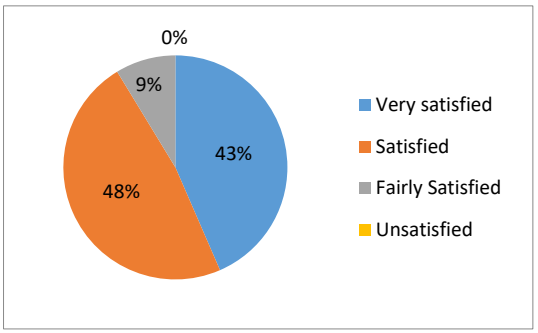

Figure 3 farmer satisfaction chart

We spoke to Janaki Devi Chaudary, one of the farmers in Kanakpatti. She was exited to talk about her experiences using the drip. She reported, "Initially, I purchased small drip with 50 Liter tank that required frequent filling up of the tank just to irrigate 50 sq.m of land. Now, I have a large drip kit (500 m^2 with 1000 ltr tank) that irrigates my field in less than 30 minutes with a full 1000 liters tank. It is a tremendous benefit that I can irrigate more lands with less water. Similarly, Shusila Devi Chaudahry and Budhai Ram appreciated that the technology is easy to operate and is instrumental to control weeds and apply fertilizers. An estimate based on the data from the project area shows that the technology saves nearly 63 % of water as compared to furrow system.

We also interacted with other three farmers, who are not in the group, but have closely observed the use of the technology. "I saw that the technology offers multiple benefits. It irrigates large number of plants in less time and drops water in plant root zone without any losses", said Pulkit Chaudhary, a neighbor farmer of Kanakpatti.

Lessons for project

We found that farmers have become aware of this technology and gradually understand its benefits. To enable them to take a full advantage of the technology, we have trained them to use plastic/straw mulching, improved seeds and fertilizers, IPM and Trichoderma in the plot. Our experiences working in the areas shows that the technology is potential for the water scare area like Kanakpati where access of surface water and availability of groundwater are limited as compared to other areas of Terai. Positive responses from the farmers indicate that the technology has a potential to scale up. However, it requires more research to understand an appropriate model for the wider promotion and scale up of the technology for the tenet and marginal farmers.

4.4 Improved vegetable production through adoption of seedling trays, plastic mulch and ridge and furrow system of planting in Madhubani

Context

Rice-wheat is the major cropping system in the Bhagwatipur and Mahuai villages of Madhubani district. High dependence of farmers on one or two major cereals crops like wheat and rice makes the farming community vulnerable to vagaries of the climate. This type of systems is also susceptible to the fluctuations in the market price. Under such circumstances, diversifying the cropping system with vegetable crops can better option that can tolerate variability in climate as well as market prices. But vegetable production requires a lot of care like proper insect pest management, weed management and better irrigation practices. Various factors affecting the yield and quality of vegetable are water stress, weeds, insect pest and diseases. Since, both the villages depend upon surface tube wells for irrigating rabi crops which is not enough for vegetable production as vegetables are high water requiring crops. Water deficit is one of the most environmental stresses affecting vegetable productivity which may result in considerable growth and yield reductions. Under such conditions, conservation of soil moisture and ensuring its availability to vegetable crops is of vital importance. It was also observed that most of the male members of the family migrate out for their livelihood hence, there is a labour scarcity for carrying out intercultural operations like weeding which is also one of the major problem in vegetable production. Hence, plastic mulching plays a major role in combating both the problems.

Kharif season paddy takes longer time to harvest because the longer duration of the paddy varieties grown by the farmers are of long duration. The paddy is generally harvested during second fortnight of the November. Since, farmers are occupied by the paddy, raising nursery for rabi season vegetables gets delayed. Such delays may have adverse impact on the crop yields. Moreover, due to excess soil water in the field after harvest paddy makes it difficult for the farmers to conduct nursery raising operations in the field. Even if farmers succeeds in pacing the vegetable seed in the wetter soil conditions, it encounters difficulty in germination and causes more mortality of the seedlings due to damping off. To overcome these issues in nursery raising the project team planned to demonstrate the use of improved nursery raising technique that uses seedling trays.

The potato cultivation in the Bhagwatipur village was solely for the household consumption and not for the commercial purpose. They used to use flat bed system of planting for potato without applying irrigation as they have the conception that if they irrigate the field it will result in early rotting during storage and low shelf life of the tubers after harvest. Farmers think that the residual moisture in the field after paddy cultivation was enough for the potato production but it was not sufficient for producing higher yield as the yield obtained by them using flatbed system of planting was less than 6 t/ha. Problem of rotting of potatoes was a serious concern to the farmers. A better alternative to the flat bed system is the ridge and furrow systems of plantation. This method precludes the direct contact of water with the tubers and prevents the rotting. Also,

the ridges do not get compacted that leads to increased size of the tubers. This intervention was required in the villages to improve the potato production which will add to the income of the farmers.

The major objectives of taking up these interventions were:

1. To demonstrate the farmers about potential benefits of the plastic mulching. The aim was that the farmers should understand the potential benefits of plastic mulching like soil water conservation, weed control and increased yield etc.
2. To achieve timely planting of vegetables and production of healthy and disease free seedlings for improving vegetable yields.
3. To introduce ridge and furrow method in the village was to increase the yield of potato by utilizing the irrigation water effectively.

Process

A sensitization workshop was conducted at the beginning of the Rabi 2015-16 to make the farmers aware about these technologies. Farmers were made aware about the types of plastic mulches and the potential benefits it can offer. The practical field training was conducted to have an hands-on-experience to the farmers. Use of seedling trays was demonstrated to the farmers through interactive sessions. The process of forming ridge and furrows for vegetable cultivation was also demonstrated in the fields. Farmers raised several questions during the interactive sessions and the field practical, which were answered to their best satisfying levels. Farmers agreed to take up the polythene mulching in vegetables from rabi 2016. Raising of nursery in the polythene trays was also agreed upon. Growing of potato on ridge and furrow system of plantation was also agreed by many famers of the four different collective groups in the Bhagwatipur. In our intervention we have used black polythene mulch of 25µ thickness for cultivating vegetables during rabi season 2015-16. In site no 1, 18 katha area was under mulch while in site no 4, 8 Katha was under the mulch. The vegetables crop grown was brinjal, tomato, pointed gourd during rabi season and okra during summer. The use of plastic mulch in the village was new and was introduced for the first time by ICAR.

Plug tray nursery trays was used in two sites i.e. Site no 1 and Site No 2 of Bhagwatipur village. According to the respondents, they had no idea regarding the plastic trays and were very new technology to them.

Impact

According to the farmers, use of plastic mulch resulted in good vegetative growth and early maturity. It saved labor as there was no weed problem. They said that there was full of weeds in the open area and no weed at all in the area where plastic mulch was used. Hence, weeding was not required. They also mentioned that the soil under the mulch conserved moisture for longer time and may be that was the reason for good yield because crop was getting water continuously. One of the major impacts of the technology was awareness. They could see themselves that it

really does conserve water, controls weeds which ultimately saves labor and give higher yield. More than 50 farmers also visited the field and as per their opinion, they are ready to adopt the same technology if provided to them by the government.

Farmers are happy to use the trays as the mortality of the seedlings reduced to great extent. They even said that they can easily see in each cell that whether the seed has been germinated or not and if suppose one or two seed did not germinate then they could easily notice it and re-sow the seed immediately in the empty cell. Transportation of seedlings is easy as they could easily carry the whole tray in the field itself and transplant the required seedling. As for this technology is concerned there was no problems identified.

Ridge and furrow system also showed very positive impact on potato production. At first, farmers were hesitating to adopt the new planting system because they thought that this system will not give good yield as most of the land remained unutilized and moreover the plant population also reduced. But finally, when the crop was harvested they could see the good harvest (yield upto 11t/ha). Even those farmers who were against the technology have accepted the fact that the yield can be higher with this type of planting system and with good irrigation.

Critical factors that contributed to impact

1. Effective capacity building of the farmers led to large scale adoption of mulching in vegetables and ridge and furrow system for potato cultivation.
2. Earliness of growing seedlings and health of the seedling were the two characteristics of the seedling rays that appealed the farmers a lot.

Constraints faced

- Laying and removing of plastic was labor intensive
- Residuals of plastic in the field after the cropping season
- Plastic film is prone to wear and tear
- At present there is no facility of mechanical ridge and furrow making and also of laying of the polythene film on beds. Also, the rotting of potato tubers during storage was higher.
- There were no constraints for plug tray nursery raising technology but the trays can be made easily available in the local market for adoption by the farmers of larger group. It can be done by discussing with the local traders or organizing stakeholders meetings.
- Social constraints (harvesting of tomato and brinjal was delayed due to some problem in the collectives of farmers which has resulted in yield loss to some extent)

Learnings for project

Farmers are ready to accept or adopt new technologies provided the new technology gives good return than traditional method. With the adoption of plastic mulching higher yield was obtained but the major problem with the farmers was its laying of mulch, easy wear and tear and removal after the crop period. So instead of using 25 micron thickness plastic we can use 50 micron which

last longer and is also easy to remove or organic mulches like paddy straw can be adopted which is easily available and biodegradable. However, for laying of the mulch, as there is no infrastructure facilities available like tractors for laying of mulch so one have to go with manual method which is labour intensive.

Similarly, for the ridge and furrow method of planting, though labour intensive higher yield was obtained but rotting of tuber during storage was also higher than the traditional variety. As such farmers do not store the potatoes because they sell it immediately after the harvest but some of the farmers store their produce. So, to reduce the rotting of tubers, storage can be improved with proper ventilation and proper room temperature suitable for the tuber storage. Also, good variety with better storage life can be adopted.

Demonstration of mulch laying

Laying of mulch by the farmers

Sowing of vegetable seeds in plug trays

4.5 Role of irrigation system in adoption of new crops in the cropping systems in Madhubani

The context

Governments, NGOs, aid agencies and extension workers have long known that the success of any project depends, in part, on whether farmers adopt the offered technologies. In agriculture, adoption of a particular technology often leads to many other meaningful changes in the farming practices. When the benefits emanated from the adopted technology outweigh the expected benefit from it, farmers tend to adopt more and more better technologies that can earn profit to them. Although better technologies leads to adoption of new technologies, there are certain technologies (say Tech A) that needs adoption of some other technologies (say Tech B) for its functioning. These additional technologies are not at the farmers will and farmers may not adopt the Tech 'A' itself. Under such circumstances it is a challenge for the project workers to convince the farmer that Tech 'B' is also going to give additional benefit. This case study particularly highlights the later scenario of the technology adoption. It explains how replacement of traditional irrigation systems with advanced ones called for modified cropping sequence and how farmers reacted to it. The objective of this case study is to demonstrate that if offered technology is good, farmers can adopt other related changes in to the farming system.

Prevalent crop options and cropping sequences

Paddy is the only kharif crop in both the villages. During rabi season farmers opt for wheat nd lentil as rabi season crops. Moong was the major sumer crop in both the villages. In Mauahi and also in Bhagwatipur farmers used to grow lentil during rabi season on residual soil moisture. There is common practice in both the village that farmers broadcast lentil seed in standing paddy crop just 15 days before harvest. This practice is called 'utera' cropping. The lentil crop does not require irrigation. Some farmers also grow linseed on residual soil moisture in both the village during rabi season.

In summer season farmers grow moong on a very small scale in both the village. This crop not require irrigation but prior to sowing require good soil moisture. For sowing of moong crop farmer dependent on rain, in Mar-Apr month if there is rain than farmers start sowing moong crop in both the village. During this season, large area remains fallow and serve as grazing ground for animal till paddy transplanting start.

Traditional irrigation practices

Irrigation is a major concern during the for wheat crop during rabi season (dry season). During summer season farmer leave most of their land fallow due to lack of water as the water table drops below the suction head of the surface operated diesel pumps. Those who have access to irrigation water and can afford one or two irrigations grow moong crop on a very limited area. In kharif season (Monsoon season) farmers depends on stream water (canal) and rain water. None of the farmer applies irrigation to paddy crop. During summer season farmers grow only moong crop, which is either grown on residual soil moisture or rain water. No irrigation water is applied to moong crop.

Irrigation during the dry season (rabi and summer) is mainly from the use of diesel engine for extracting shallow ground water. No other source of energy is used to extract ground water. Groundwater is the major source of irrigation irrigating almost 95% of the irrigated area during dry season, only few pockets of land are irrigated from pond water irrigation.

Most of the farmers apply one irrigation to wheat crop at the crown root initiation (CRI) stage, by default they know that irrigation water should be applied to wheat crop after 21 days after sowing. Some farmers even two irrigations to wheat crop based on their own judgement. Most of the farmers fear of applying second irrigation because at this time wind speed increase so their might be lodging problem. Second reason of not applying more irrigation water to wheat crop is due to higher cost of irrigation water. Mostly farmers follow check basin method of irrigation to irrigate the wheat crop. The size of the check basins range from 200 sq m to 900 sq m. The watering is done using flexible pipes that convey water from pump to the point of application.

Conventional irrigation equipment

Diesel engine and a tube well is the main irrigation infrastructure of the village. Earlier, diesel engines of capacity 5-8hp with high fuel consumption and heavy weight were used by the farmers. Major drawback of this engine was transportation or movement of engine from one site to another site and high fuel consumption rate. Nowadays, farmers used small size and higher fuel efficient diesel engine. Many farmers prefer china made diesel pumps mainly because of its low cost.

Mostly irrigation infrastructure like bore well, diesel engine, water delivery pipe and any other irrigation equipment is available with big and medium farmers. Small, marginal and tenant farmers were not able to buy and install the irrigation equipment due to higher cost involved in it. More than 85% of the tube wells and about 70% of the pumps in the villages are with small and big farmers. Earlier, big farmers did not allow other farmers to use their borewell or diesel pump on custom hiring basis. Later small farmers also installed the borewell and purchased diesel engine and delivery pipe for irrigation purpose. Small farmers act as a service provider of marginal and tenant farmers.

Water conveyance was another aspect that required attention. Farmers used earthen channel for conveyance of irrigation water to field. Big farmer kept this earthen channel permanently in their field while small land holder made temporary earthen channel in their plot. Digging earthen channel is labour intensive and cumbersome so big farmer allocates some land permanently for the earthen channel. Conveyance efficiency of earthen channel was very less but no option was available at that time so farmers used this earthen channel for conveyance of irrigation water. Now farmers have option for conveyance of irrigation water i.e. plastic delivery pipe available in the market. Farmers start using the plastic delivery pipe for conveyance of irrigation water.

Irrigation water market

While looking at the distribution pattern of irrigation equipment and the social aspect prevailing in the village the irrigation water market seems to be a monopolistic. There is great impact of irrigation water market on crop production in both the study village. In Mauahi village the there are only two water sellers and number of buyer are more. The sellers charge Rs.120-150 per hour for diesel engine. During peak irrigation water demand time these two water seller serve the farmers on first come first serve basis. During rabi season area under wheat crop is less as compared with Bhagwatipur because of limited water availability. Whereas, in Bhagwatipur village 7-8 farmers sell irrigation water. Water availability is significantly high in comparison to Mauahi village. So the area under wheat crop during rabi season is high in comparison to Mauahi village. The rate of irrigation charged by service provider range from Rs. 120-150 per hour.

Increasing diesel price and cost of irrigation water have a greater impact on crop production in general in Bihar. Another problem that existing in the water market is that service provider run the pump at low rpm to save diesel and increase the run time to make disproportionate profit from pump custom hiring.

Process

During the biophysical surveys in the villages it was observed that dry season irrigation is mainly limited due to access to irrigation water. Therefore, the project team though of implementing some interventions that can provide year round water availability to the famers. The major problem was in tapping the deeper aquifer layers which are the good natural source and are presently being underutilized.

Improved irrigation system and equipment introduced

In view of the pathetic situation of the irrigation in the project villages, the DSI4MTF team decided to introduce improved irrigation equipment to the farmers. Several sensitization sessions were held with the farmers and their proper management among the farmers of these two village. First, project personnel brought up the institutional arrangement for proper management of irrigation infrastructure and equipment. Under institutional arrangement, farmers groups were formed with 5 to 10 number of farmers. These groups were entrusted the responsibility of management of irrigation equipment. They were trained on the management of irrigation equipment by ICAR scientist. The following irrigation equipment introduced to the group.

1. **Diesel engine group wise:** After formation of groups, 4 group in Bhagwatipur and 2 group in Mauahi 3 diesel engine given to these six group. For two group one diesel engine. For maintenance of diesel engine group member collect Rs 10 per hour of machine run. This amount covered the cost of operator as well as the cost of small repairing. If any heavy repairing required than group either collect from each member or use the corpus money for repairing of diesel engine. The motive behind diesel engine to save the farmers from exorbitant rising price of irrigation water.

2. **Solar Pump:** Two solar pump of 3 hp capacity introduced in Bhagwatipur village. Solar pump is used to directly irrigate the field and also used to pump water through drip and sprinkler system. Both pump during peak sunshine hour through 5.5 litre water per second. Farmers sharing their experience with us that for diesel engine they need to either purchase diesel or pay Rs120-150 per hour. Now this amount is saved through solar pump. Second no need to pull handle to start it so now even women come to field and start the pump and irrigate the field.
3. **Drip Irrigation system:** In Bhagwatipur village drip system was introduced at two intervention site. Total 9 plot covered under drip irrigation system. During summer-17 farmers grow Brinjal, Okra and Tomato on drip with plastic mulch. Farmers compared the plant growth as well as yield of crop with without drip and mulch. They share their experience with us that with the adoption of drip and plastic mulch yield is increased significantly.
4. **Sprinkler System:** In Bhagwatipur village two plot covered under the sprinkler irrigation system. During rabi 2016-17 farmers grow wheat and potato under sprinkler irrigation. Farmers compared the yield of both the crop with basin irrigation in wheat and ridge and furrow based potato and found that the even applying less water there is no impact on the yield.
5. **Drum Kit irrigation system:** Drum irrigation system installed in both village Mauahi and Bhagwatipur. But the problem of filling the water in tank leads to the no use by farmers. Farmer is sceptical of using this irrigation system.

Impact of improved irrigation system on adoption of new crop

After installation of improved irrigation system in the village and training given to farmer on various techniques of crop production and water management led to adoption of summer season vegetable crop in their cropping system. After two seasons of cultivation of vegetable crop farmers realise that vegetable crop requires frequent irrigation but less water as compared to other crop. Farmers also experienced that the vegetable yield also increased with the adoption of better water management equipment. This realisation of fact become a motivating factor for adoption of entire new crop in the cropping system. The following vegetable crop adopted by farmers of both the village.

1. **Brinjal:** In Bhagwatipur village farmers of intervention site-1 and intervention site-4 planted brinjal in two season. Farmers of both interventions site earn a modest income from Summer season 2016 brinjal crop. In the season one non beneficiary farmers Katimlal Yadav also planted brinjal on 2 katha (0.0364 ha) of land and earn around Rs.36000/-. They also adopted the same technique with our help. Katimlal land is elevated than our intervention site land that was an added advantage for him that's why they earn higher than our intervention site farmer. Another non beneficiary farmers Pramod Yadav also cultivated brinjal crop in the same season, he also earns modest amount from this intervention. But rabi season (2016-17) brinjal crop experience was not good due to low price. Brinjal crop is not tried in Mauahi village due to their low land area and water logging problem.

2. **Okra:** This crop is highly adopted by both project beneficiary and non-beneficiary farmers of Bhagwatipur village during summer season only. During Summer-17 farmers of Mauahi also adopted this crop. In summer-16 farmers earn modest income from this income but in summer-17 due to low price income level goes down in both the village.
3. **Cucumber:** The cucumber crop is also adopted by and new crop on commercial scale in two intervention site in Bhagwatipur village. Two-three non-beneficiary also adopted this crop. Earnings from this crop was modest in 2016 as compared to summer 2017.
4. **Bitter gourd:** This crop also cultivated by both beneficiary and non-beneficiary's farmers of Bhagwatipur village for last two years. In summer 2016 farmers earn modest income from this crop.
5. **Sponge & Ridge gourd:** Farmers also started cultivation of this crop for last two years and also earn a modest amount from this crop.
6. **Potato:** This crop is widely grown by farmers of Bhagwatipur but here project bring change in the irrigation practices of this crop by ridge and furrow method.
7. **Pea:** This crop introduced in the village during rabi 2016-17, the yield and market of this crop is very good. This factor motivates farmers for large scale adoption of this crop.
8. **Pointed gourd:** Pointed gourd introduced during rabi 2016-17 but plant not survive. This year again farmer bring pointed gourd planting materials from the farmers of Pagadih of Muzaffarpur district. This shows the farmers interest in adoption of new crop.

Critical Factors that contributed to impact

1. Farmers realised the system is useful for irrigation of vegetable crops as per the crops water needs and that it requires less water
2. The water saving achieved under the technologies impressed the farmers
3. Ease of operation of the system was important factor that led to change the present cropping system
4. Increased profit with adoption of new cropping systems (inclusion of vegetables)
5. Proper knowledge and training about the adopted technology led to the adoption of better crop options

Constraints encountered and resolved

Farmers were not aware on cultivation practices of several vegetables. To overcome this constraint a range of trainings were required to be conducted. In view of this the project team conducted several trainings on operation of drip, sprinkler and solar systems. The trainings were also conducted on the aspects of improve nursery production, application of polythene mulching and water management. With these trainings farmers got the confidence that they can grow vegetables on their own. This confidence build-up led to adoption of other remunerable vegetable crops like Okra, cucumber, bitter gourd and pointed gourd.

Other major constraint was faced in management of pest and disease of the solanaceous crops like tomato and brinjal. To resolve this issue the project staff at the site sent the photographs of

the affected parts of the plants to experts at Ranchi through Whatsapp and the experts replied with the control measures to control that pest or disease. This approach was very quick and satisfying to the farmers.

Another major constraint was marketing of the newly adopted vegetables by the farmers. This problem was taken care by the collective farming approach. As one person has been identified for the sale of produce in each group, he took the responsibility of the sale of the produce in the local market. This solved the marketing issue of the produce.

Learnings for project

Adoption of new technology was viewed by the farmers as an opportunity to learn new and better techniques of vegetable cultivation. With the improved knowledge on irrigation practices they are now in position to cultivate and sale vegetables. Earlier, where only three crops were there in their cropping systems, now the scenario has been changed. Farmers are cultivating several other vegetable crops which is providing and additional income to the farmers. The development of proper irrigation technique has a greater impact on adoption of new crop. Important learning from this case study was that for wider acceptability and adoption of any technology proper training and confidence building in the farmers is the activity of prime importance. Once this is achieved the farmers will willingly adopt other changes or technologies that support the earlier adopted technologies. In our case change in cropping system was adopted as a consequence of better irrigation equipment in the field.

4.6 Perception of the farmers about the drip and sprinkler irrigation systems

Context

Rice-wheat cropping system dominates the agriculture in the Gangetic Plains of the North Bihar. Rice is cultivated during the *kharif* (monsoon) season with transplanting dates matching with onset of monsoon. Sufficient monsoon rainfall generally precludes the need of irrigation for this crop, except in the event of dry spell. Wheat, which is the main *rabi* (winter) crop of the region, requires at least three irrigations during the critical stages of the plant growth to make wheat cultivation profitable. The cultivated area under wheat is relatively very less and considerable part of the land remained fallow during the dry season. There was needs to provide the round the year access to irrigation water and use the accessed water efficiently. Solar operated deep submersible pumps was the only solution in the electricity deprived areas to tap the unutilized groundwater. Also, to improve the water use efficiency in the fields there was need to have some efficient water application systems that can save water. To this effect, the technologies on drip and sprinkler irrigation were demonstrated in the farmer's field. All these technologies were new and previously unseen by the farmers. Prior to demonstration in the farmers' fields, several trainings and field visits to other farms having drip systems were conducted to make the farmers aware about these technologies. The drip, sprinkler and solar systems were installed in the farmers' fields with participation from the farmers to make them aware about the handling of these systems. These systems were installed in the field during the rabi season of 2015-16. Farmers have used the system for the three consecutive cropping seasons and it the time to get the feedback of the farmers about these technologies. This will help the project team in assessing the future plans on training and capacity building.

Process

Interviews of the farmers were conducted to assess the feedback of the farmers about drip and sprinkler irrigation systems. A questionnaire was designed to record the farmers' feedback about the social and technical aspects of the technologies. Response of ten farmers was recorded for each of the technology. The information was analysed and presented in this case study.

Impact

The drip and sprinkler systems have led to many positive impacts on the farmers and farming systems. It has reduced the drudgery involved in irrigation to the greatest extent. There was overall increase in the yields of vegetables by the adoption of drip irrigation with polythene mulch. Sprinkler irrigation systems reduced the water use for wheat and potato significantly but produced the wheat yields at par with the surface flooding. These systems have also motivated farmers to adopt better crop options in their cropping systems. Overall there had been positive perceptions of the farmers about these two improved water application methods.

Farmers perceptions

Feedback of the farmers as collected during the interviews through the pre-designed questionnaire are analysed and presented below.

What was good about these systems?
When asked about 'what was good about the system?' all the farmers said that the systems are really very good as it saves time and labour involved in irrigation. This has led to save the cost on irrigation to greater extent.

Which operation is more difficult to do?

Different operations like cleaning of emitters and filters, folding of pipes, fertigation with ventury were listed in the questionnaire. All the farmers (100%) said that none of the tasks listed here are difficult to undertake.

Can you operate the systems on your own? (Without assistance of project team)

This was little tough to them. Only 80 % of the farmers replied that they can start the system on their own. Starting of the drip and sprinkler system required to monitor the flow and pressure in the irrigation pipes, which was bit difficult for the farmers. Operation of the valves to maintain proper pressure was the major concern raised by the farmers. Many farmers said they cannot read the pressure gauge. This was the major issue in starting the system on their own.

Is it difficult to fold pipes during rainy season?

The task of folding the pipes in proper loop was not at all a difficulty for the farmers. They responded that the lateral pipes are light in weight one can easily fold them in to circular loops.

What was the major maintenance related problem?

Farmers said that there is no any maintenance related problem till date. But it would be good have an interactive session on cleaning of filters and joining of laterals in the event of leakage.

Does the system applied water uniformly over the field?

Regarding uniformity of water application farmers claimed that the do not have the knowledge about what is uniformity. When explained in details, they said wheat crop looked fairly uniform as compared to the basin system of water application. Growth of other vegetable crops was also uniform throughout the field.

Does these systems reduced weed problem?

All farmers agreed that weed problem was reduced significantly when drip irrigation was applied in polythene mulched plots. They believed that there was no difference in the weed intensity observed in sprinkler irrigated plots and flood irrigated plots.

Is it difficulty to do inter-cultivation when these irrigation system exists?

Undertaking inter-culturing operations was not a problem with drip or sprinkler irrigation system. But they said that they have to be extra careful while operating the tools in the field so that the lateral don't get damaged. At the time of land preparation, they said, laterals needs to be folded and kept on one side of the field. But that is not a difficult task.

Is it labour intensive as compared to traditional furrow system?

Hundred percent of the respondents believed that this system is not at all labour intensive. In fact it reduced the irrigation time to great extent consequently reducing the abour requirement on irrigation.

Does the operation of system requires skilled man power?

All the farmers agreed in one voice that only skilled man power can run these system. But they further added that if training given, even a less educated person can operate these systems.

Drip/sprinkler irrigation saves time, when compared to surface irrigation methods?

All the farmers agreed that the drip irrigation system reduce the irrigation time as compared to furrow irrigation. They do not have stay in the field with the spade for the entire duration of the irrigation. Application of fertilizer took just 20 minutes saving time and labour to the tune of 50 %.

Was irrigation easy with the adoption of the systems?

"Irrigation is just at a button push" said a farmer when asked this question. All the farmers of the opinion that irrigation of the vegetable and wheat crops is very easy with these systems.

Do you know from where to buy the components of drip/sprinkler in the market?

Drip or sprinkler irrigation vendors are very rare in the Madhubani district. Farmers have not seen any vendor till date who can supply these systems. They don't have any idea about the suppliers of these systems. Farmers are also not aware about the after sales service providers for these systems. The spare parts are also not available even in district headquarters.

What is the major problem in its adoption?

For this particular question there were following options provided to the farmers.

- ☐ Lack of technical knowledge
- ☐ High initial cost
- ☐ Not suitable for my crops
- ☐ Difficult to operate
- ☐ Labour intensive

High initial cost of the system was reported as major problem in its adoption by 100 % of the farmers. Lack of technical knowledge as another major constraint was reported by 60% of the interviewed farmers. Difficulty to operate or labour intensiveness was not cited as major problem its adoption.

What would you like to know/learn about the system?

Farmers are willing to learn about the fertigation aspects of various crops and operation of the ventury system. Although clogging of emitters has not been reported from any of the sites, the farmers expressed their interest in getting trained on topic of 'emitter cleaning'. Farmers also expressed the desire the project staff should tell them when the system is to be started and for how much duration it should be run. This was really a matter of concern for the project srtaff as well.

Will you recommend this to other farmers? Why?

All the farmers said that these systems are really beneficial and that they are recommending it to the other farmers whoever is enquiring about the system. Farmers of other villages are also being advised to take-up the sprinkler system for wheat irrigation.

In future, will you install it on landlords' piece of land that you have rented from him?

There was a big NO to this question. None of the farmer wanted to install these systems on the landlords land. When asked about why they can't do that, they replied that their tenancy with a particular landlord is not permanent. If they install a system on a piece of land and their tenancy is terminated then they may have to bear huge monitory loss.

Critical factors that contributed to impact

There were many factors that contributed to the upbringing of positive attitude about these systems in the farmers. As reported by many farmers labour saving in fertigation and irrigation was the major advantage of the system. Apart from that the improved yields and water saving were also the driving factors that developed liking of the farmers towards these systems. Effective training programs on operation and maintenance of the drip systems was critical to build the confidence among the farmers about these systems.

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<tr><td>Sprinkler irrigation in the wheat crop</td><td>Training farmers on operation and maintenance of drip and sprinkler system</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Brinjal ccultivated on drip irrigation</td><td>System installation with farmers participation</td></tr>
</table>

Constraints encountered and resolved

Complete absence of knowledge about these systems to the farmers was a major challenge. All of the farmers saw these systems for the first time in their life. Building the confidence that these systems are really useful for them was really challengeable. On-farm training and involvement of the farmers in installation of these system was the effective step that could convince the farmers about the utility of these systems. Initially, farmers believed that the drip irrigation system may not apply water in sufficient quantity and the plants may remain wilted. But as the cropping season progressed farmers started realizing the benefits of the technology, water saving and better crop growth. Maintenance of these systems was another important constraint that

farmers had to face. To overcome this issue an on-farm training on the maintenance of the drip laterals, sub-mains, filters and sprinkler heads was conducted. This kind of practical experience led to proper maintenance of the systems during the off-season.

Strategy to build through the learning from the case

This case study was mainly aimed at the assessing the farmers perceptions about drip and sprinkler irrigation systems. The responses recorded by the farmers have highlighted certain very important issues. Learning from this case study was that farmers need further training on the aspects of fertigation and cleaning practices for emitters. A training event on these aspects needs to be conducted. Since the farmers raised a question that they do not know when to start the systems and for how much time it should run, there is dire need to develop farmer friendly irrigation practices for drip as well as sprinkler irrigation systems.

The first issue was regarding their knowledge about the vendors who could install the drip or sprinkler system and can provide them the after sales service. Actually there are no service providers for drip or sprinkler systems in the villages or even at the district headquarters. Unless some companies come forward and establish their sales in these regions it's practically impossible to have a large scale adoption of these systems. Also there are limited advertisements about these systems on television or any other public media. There is an urgent need to have large scale program to create mass awareness about these technologies. This calls for a policy change.

4.7 Introduction of vegetable crops for cop diversification, profitability and stability in agricultural production in Dhaloguri village

Introduction

The terai agro climatic zone of West Bengal is blessed with favourable climate for cultivation of wide range of agricultural crops. High rainfall (above 3000 mm), moderate temperature, prolong winter are the unique features of terai zone that encourages cultivation of different types of crops throughout the year. Agriculture is the primary source of livelihood for the village people and rice is the major crop cultivated during rainy/*kharif* season. In the project site of Dhaulagiri village the average size of land holding is low and mainly dominated by high proportion of marginal and tenant farmers. Irrigation infrastructure was almost negligible. Direct pumping from a nearby river was the only source of irrigation to grow potato during dry winter season. As a result most of the land remains unutilized and farmers forced to work as labour in the non agriculture sector and sometimes migrated to other states in search of livelihood. Access to year-round water for irrigation particularly during dry season was the primary need to bring more area under cultivation and to improve the productivity and profitability of the production system. Intervention of the ACIAR funded project (Australian Centre for International Agricultural Research) in collaboration with project partners (UBKV, CDHI and IWMI) helped to install one shallow tube well and provided with one 4 HP diesel pump. The farmers were motivated and

given technical exposure for cultivation of different vegetable crops during dry season. A collective farming group was formed by the joint effort of the project partners.

Village

The village Dhologuri is located in the Ambari GP, Block II of the Cooch Behar district of West Bengal, India. The village is located in the sub-himalayan *terai* region of West Bengal. The region is characterized by high monsoonal rainfall and comparatively dry winter months. The village community is mainly dominated by the lower caste population. The average size of land holding is low and comprising of marginal and tenant farmers. Agriculture is the main source of livelihood for the village people. Most of the tenant farmers work as agricultural labourer. The migration of youth to other states in search of alternate livelihoods has left many families to be led by women. The village is rich in both surface and subsurface water resources. There is one perennial river called Ghargharia flowing through the village. However, most of the ponds are seasonal and only 20-25 ponds retain water throughout the year. The groundwater table is available at about 1.5 to 4.5 m below ground level. The quality of groundwater resources is good.

Project intervention: Introduction of vegetable cultivation

In the project site, apart from rice in the monsoon season, traditionally potato was grown in some pockets during dry winter months. Traditional practice of cultivation of potato during winter months was associated with lot of risk factors such as high initial investments for seed, manures and fertilizers as well as pesticide which enhanced the total production cost. Again, sudden attack of disease like late blight in the crop maturity stage sometimes damaged the entire production; and fluctuations of price drastically reduced the profit margin. Introduction of vegetable crops brought diversity in the cropping system. Assured irrigation facility encouraged cultivation of multiple crops round the year. In the initial phase, vegetable crops which are easy to cultivate and have good demand in the local markets were purposely selected to create long term interest in vegetable cultivation. Accordingly Elephant foot yam, colocasia, chilli, cabbage, cauliflower, radish and some leafy vegetable were encouraged for cultivation. After getting success and better remuneration, farmers showed interest for cultivation of high value crops and off-season vegetables for higher profitability and better economic return. Subsequently crops like capsicum, french bean, broccoli were promoted for cultivation. Emphasis were also given for off-season crops like pumpkin and bitter gourd cultivation during winter months and palak and radish leaves production during rainy season. The uncultivated and unutilized lands were converted into a lush green field.

Impact

Promotion of vegetable crops in place of potato increased the choice of crops that subsequently reduced the risk of market glut and assured better return from crop. Adoption of vegetable cultivation helps them developing cultivation skill through hands on learning. Scope of consultation with the subject matter specialist helped them to grow more interest in crop production, proper crop planning, better judgement of disease and pest attack as well as their

management and market intelligence. As a result the family income from farm activities increased subsequently. Women farmers are also showing interest in vegetable cultivation and effectively utilizing their leisure time in some purposeful work. The assured supply of irrigation water has also reduced the risk of crop failure. With the increase in the irrigated area, the cropping intensity of the project area has increased subsequently. The migration of farmers from the project site to other state in search of job reduced considerably.

(a) Cabbage field (b) Hoeing in Colocasia (c) Tomato with straw mulch

Figure 4(a-c) Different crop scenarios at Dhaloguri village

Lessons for project

Future emphasis will be given on awareness generation for larger area coverage under vegetable crops. More farmers groups will be formed to strengthen the collective farming. More skill development training will be organised for better management of the crops, development of suitable crop calendar considering the available resources. Local youth and women will be encouraged to undertake protected cultivation for large scale production of high value vegetables and off-season vegetables. More emphasis will be given on improvement of irrigation system and better management of irrigation water to ensure more harvest per drop of water.

(a) Radish in the field (b) Seed sowing in nursery bed (c) Nursery bed covered with polythene sheet

Figure 5(a-c) Field view of different vegetable crop scenarios at Dhaloguri village

4.8 Farmer's perspectives on Drip irrigation technology in Kankapatti

Introduction of drip technology

There are couples of technologies demonstrated in the Kanakpatti of Saptari. Majority of the technologies provide crop protection services and irrigation facilities including drip kits. Prior to the project, most of the farmers were unknown about the drip kits and its benefits for vegetable production. In the beginning of the project, iDE provided micro-irrigation training to the farmer groups. The trainings were complemented by the demonstration of drip kits in the farmer's plots suitable for vegetable. These efforts enabled the farmers to use technology for irrigating vegetables. We also trained them to couple the drip with the sunflower pump to improve the water use efficiency.

Figure 6. Budhai Ram's daughter in field (November 2017)

In an interaction with Sundari Devi Chaudhary, member of the Rajajee farmers group about her experiences using drip kits, she said, "I was not familiar about the drip system. I used to irrigate crops from cannel. After I attended training on drip, I knew about it. It was the first time I heard about the technology in the training. A drip video shown in the training attracted my attention and I immediately got interested to see how it works in my field. In the mean time, I was thinking if it might just be a waste of money to invest in as I saw it as a complicated system with several pipes and fittings. When I used the drip kit, it worked well. The soil was already moist enough up to the root zone".

Initially, the project installed 6 small drip kits in different plots of the farmer's fields as a demonstration. Each system has four lateral lines with 80 emitters (i.e 80 plants) irrigating 50 m^2 area of land, and water supplied by 50 liters tank. We conducted a quick survey with 23 users to understand their perception on the performance of drip technologies. An assessment (Pie-chart : Figure 2) shows that a vast majority of the farmers were happy on the drip performance, however they still hesitated to use the technology for mainly two reasons: I) extra cost needed for the drip kit (that replaced the furrow irrigation in the selected area) and II) small systems that irrigate only 50 sq. m. To overcome the limitations, project provided 40% funds to buy systems up to 500 sq.m. Now, out of twenty three farmers of the Kanakpatti, nine farmers are using different sized drip kits (100 - 500 $m^{2)}$ irrigating a total of 1400 m^2 land in the area.

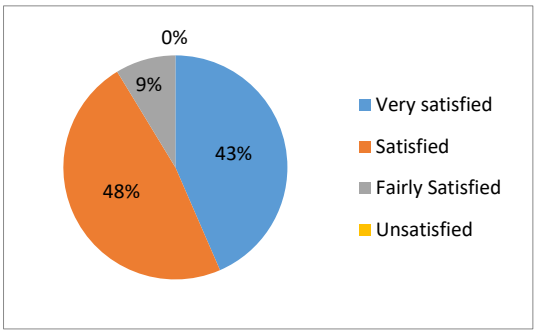

Figure 7 farmer satisfaction chart

We spoke to Janaki Devi Chaudary, one of the farmers in Kanakpatti. She was exited to talk about her experiences using the drip. She reported, "Initially, I purchased small drip with 50 Liter tank that required frequent filling up of the tank just to irrigate 50 sq.m of land. Now, I have a large drip kit (500 m^2 with 1000 ltr tank) that irrigates my field in less than 30 minutes with a full 1000 liters tank. It is a tremendous benefit that I can irrigate more lands with less water. Similarly, Shusila Devi Chaudahry and Budhai Ram appreciated that the technology is easy to operate and is instrumental to control weeds and apply fertilizers. An estimate based on the data from the project area shows that the technology saves nearly 63 % of water as compared to furrow system.

We also interacted with other three farmers, who are not in the group, but have closely observed the use of the technology. "I saw that the technology offers multiple benefits. It irrigates large number of plants in less time and drops water in plant root zone without any losses", said Pulkit Chaudhary, a neighbor farmer of Kanakpatti.

Lessons for the project

We found that farmers have become aware of this technology and gradually understand its benefits. To enable them to take a full advantage of the technology, we have trained them to use plastic/straw mulching, improved seeds and fertilizers, IPM and Trichoderma in the plot. Our experiences working in the areas shows that the technology is potential for the water scare area like Kanakpati where access of surface water and availability of groundwater are limited as compared to other areas of Terai. Positive responses from the farmers indicate that the technology has a potential to scale up. However, it requires more research to understand an appropriate model for the wider promotion and scale up of the technology for the tenet and marginal farmers.

4.9 Introduction of Dry Season Crops in Uttar Chakowakheti: A Story of Positive Changes in Farming Practice

Background

Uttar Chakoakheti is a village which is dominated by small and marginal tribal farmers. Though farming is the major sources of livelihoods for the villagers, the agricultural scenario of this village is very poor as most of the lands remain fallow during dry season due to lack of irrigation facilities and farmers' lack of awareness about the dry season crops. The average size of land holding is low with a high proportion of marginal and tenant farmers. During the dry seasons, a significant proportion of the tenant farmers work as labour. The farmers and farm women are engaged in collecting forest produce and a good number is also engaged in sand mining during dry months. The migration of youth to other states in search of alternate livelihoods has left many families to be led by women.

Paddy is the only crop which is grown during monsoon season; again due to use of traditional long duration varieties with casual agro-techniques the productivity of the crop is very poor. Some of the farmers are growing potato or maize in a very limited scale. But the productivity of these crops is also very poor due to late sowing, use of local varieties, inadequate nutritional management, etc. Except ploughing, most of the agricultural operations are performed by the farm women.

The introduction of ACIAR funded DSI4MTF project is proving to be a timely step in the right direction. The project envisages testing the efficacy of bio-physical, technological and institutional aspects in augmenting the farm productivity of small and marginal farmers in a dry season scenario. Initially, collective farming group was formed by the collaborative efforts of the project partners (UBKV, CDHI and IWMI) and as a part of the project activities social mobilization was done at the sites through a series of community meetings, focus group discussions, community engagement programmes and gender awareness meetings.

Considering this situation, UBKV scientists took initiative under the DSI4MTF project to introduce rapeseed-mustard, wheat and maize cultivation in Uttar Chakoakheti during *rabi*, 2016-17 season as the basic irrigation infrastructure in the form of shallow tubewells (STWs) with diesel pumps in all three intervention sites of the village along with a solar pumping unit were already established under this project. During *rabi* 2016-17, altogether 5, 13 and 18 demonstrations covering an area of 12459, 5666 and 7189 square metre of rapeseed-mustard, wheat and maize, respectively were carried out to show the potentiality of these crops in this village. A number of training programmes on various aspects of crop production emphasizing sowing attributes, seed treatment, fertilizer management, water management, weed management, etc of these three crops were organized at the village. Based on land situation, these crops were sown after harvesting of monsoon paddy. Each and every step in the packages was monitored by the scientists.

Results and impact

Firstly, the farmers were excited to see a good stand of these crops in their own field. It was unbelievable for them that the lands which used to remain fallow every year during the winter months were put under great stand of dry season crops (Figs. a to d). Due to high residual moisture in the soil even after harvesting of paddy, most of the crops were planted late in season after conventional land preparation. Even though some crops were sown late, the yields of the crops were encouraging. This injected great enthusiasm in the farmers' mindset that by practicing timely agricultural operations they can further increase crop yield and thus agriculture can be a remunerative livelihood option for them as well. Simultaneously, assured supply of irrigation water has reduced the chances of crop failure and farmers are confident enough to grow these crops in the existing crop rotation. Through social mobilization and strengthening of the collective farming group the farmers have started to realize the benefits of collective farming. The results indicated the feasibility of the piloted technologies in farmers' field (Table 1). Moreover, the crops were raised with appropriate water management strategies for which the irrigation water requirement was also lower for all the crops. This year the farmers are keen to further expand the intervention area under different crops. Moreover, they have been provided with more crop options for better crop planning. This year new technology on zero tillage wheat and mustard sowing has been introduced and the farmers are able to avoid late sowing of crops instead of late departure of monsoon. The cost of conventional land preparation could also be avoided.

Table 1: Performance of the crops in Uttar Chakoakheti village in the year 2016-17

Crop	Variety	Yield(kg/ ha)	Irrigation water use(mm)	Market value of the crop (INR/ha)	B:C ratio
Rapeseed-mustard	B 9	933	46.2 to 117.7	32655.00	1.17
Wheat	HD 2967	2498	103.6 to 156.9	34972.00	1.18
Maize	Allrounder	8813	59.5 to 63.6	61691.00	1.94

(a) Maize grown under ridge-furrow

(b) Excellent stand of maize crop

(c) Wheat crop ready for harvest

(d) Mustard at pod development stage

Figure 8: Dry season crop in Uttar Chakhoakheti