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Nepal's Final Report to DFID

Reaping the Benefits: Assessing the Impact and Facilitating the Uptake of Resource Conserving Technologies in the Rice-Wheat Systems of the Indo-Gangetic Plain

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Executive summary

1. The goal of this DFID-funded project was to improve rural livelihoods through accelerated adoption of resource-conserving technologies in the Terai region of the Indo-Gangetic Plain.
2. Farmers in Belwa and Benauli were assessed according to family size and landholding in order to determine their Rice Self-Sufficiency Indices and assign them to one of four socio-economic groups, i.e. Landless, Marginal, Subsistence and Food Surplus.
3. Male farmers said that they liked the Chinese power tiller (PT) because it costs less to buy and operate than a 4-wheel tractor, it can be used to till small plots, it has many attachments which can be used for seeding, transport and irrigation and can be hired out to generate income.
4. Female farmers said they liked the PT because they don't have to dig out the corners of the field by hand, prepare food for the driver or feed it! They said that they were keen to learn how to drive the PT.
5. 68% of farming families in Belwa and Benauli are Marginal. The PT User Groups, set up by the Nepali team in Belwa and Benauli contained 70% Food Surplus and Subsistence farmers.
6. Food Surplus and Subsistence farmers formed business groups in Belwa in order to buy the PT from the project in six monthly instalments. Both PTs were later returned due to non-payment. Two Food Surplus farmers in Benauli took commercial loans to buy the PTs from the project and were able to pay back by hiring them out to other farmers.
7. Only 27% of Marginal and Landless farmers who had participated in the Users' Groups in Belwa were able to hire a PT after they were privatised. All the Marginal farmers who had participated in the Users' Group in Benauli were able to hire a PT after they had been privatised.
8. Food Surplus farmers were found to be in control of the production and marketing of new, improved varieties of rice and wheat seed in both Belwa and Benauli.
9. It was noted that the highest impacts of new technologies such as PTs and seed were on the livelihoods of the Food Surplus farmers, whereas the lowest impacts of these technologies were on the livelihoods of Marginal and Landless farmers, including women.
10. Recommendations were made on ways of making access and control of PTs and improved seed more equitable.
11. It was discovered that male Marginal and Landless farmers and women from Subsistence and Food Surplus farming families had the least access to information on new technologies.
12. The Nepali team drew up an Action Plan to unblock knowledge pathways, create an enabling environment for participatory technology development and optimise pro-poor development.
13. NARC scientists recorded and broadcast a series of programmes describing new technologies via FM radio. Feed-back from listeners was difficult to obtain as many farmers did not have access to radios.
14. Two day training sessions in vegetable production involved 47% of women from Marginal households in Belwa and 35% of women from Marginal households in Benauli. The Marginal women in Belwa obtained the highest incomes from marketing their vegetables.
15. 85% of participants selected for training in PT repair and maintenance were Food Surplus or Subsistence farmers.
16. The success of a Marginal farmer, who was not involved in the project but had used his own resources to purchase a PT on the open market, was documented.
17. A meeting with machinery suppliers resolved to request government incentives to assist in their efforts to import new machines.
18. The PVS process did not involve "baby" trials and thus excluded Marginal farmers from the pre-harvest monitoring and evaluation process. Food Surplus farmers retained control of the improved seed and sold it to neighbouring farmers.

19. By putting Food Surplus farmers in control of farmer selection, *Tharu* and *Yadav* castes were disproportionately represented in most training sessions, while in Belwa the majority Muslims were excluded from the training in vegetable production.
20. Suggestions are made for reasons why Food Surplus farmers became the main beneficiaries of this project and recommendations for capacity building are made.
21. The people of the Terai region are currently crying out for a new system of development that does not discriminate on the grounds of religion, caste or gender, (see http://news.bbc.co.uk/1/hi/world/south_asia/6353363.stm) and agricultural scientists have a crucial role to play in this.

Acronyms

AIRC = Agricultural Implement Research Centre

CABI = CABI

CIMMYT = International Maize and Wheat Improvement Centre

DFID = Department for International Development, UK

NARS = National Agricultural Research Scientists

NGO = Non Government Organisation

USD = United States dollar (USD1 = Rs.60)

NARC = Nepal Agricultural Research Council

Rs. = Nepalese Rupees (£1 = 120 Rs.)

PT = Power tiller (Chinese)

PVS = Participatory Varietal Selection

RCTs = Resource Conserving Technologies

Introduction

Project Goal:

Improved rural livelihoods through accelerated adoption of productive, appropriate and sustainable agricultural practises:

- ***Increased incomes and social benefits***
- ***Increased productivity and food needs met***
- ***Sustainable agro-ecosystems***

Project Purpose:

To maximize opportunities and options for livelihood improvement by ensuring the relevance, impact and sustainability of new production mechanisms to optimise uptake of beneficial practises to all social strata involved in agriculture.

This project was implemented by scientists from CABI-Europe and CIMMYT South Asia, in collaboration with NARS scientists and local NGOs at five sites with rice-wheat farmers inhabiting villages across the Indo-Gangetic Plain:

- Dinajpur, Bangladesh (Wheat Research Centre + DIPSHIKA)
- Basti, Faizabad, India (Narendra Deva University of Agriculture and Technology)
- Varanasi, India (Institute of Agricultural Services, Banaras Hindu University)
- Belwa, Tarai region, Nepal (Nepal Agricultural Research Council + CIMMYT Nepal)
- Sheikapura and Sailkot, Pakistan (CABI Pakistan)

The Nepal Team

In Nepal, the principal investigator was Dr Sam L J Page, Farmer Participatory/Rural Livelihoods specialist, CABI-Europe and the Regional Co-ordinator was Dr Etienne Duveiller, Cereal Pathologist, CIMMYT, South Asia. The Site Manager was Ganesh Sah, Nepal Agricultural Research Council (NARC) he was assisted by Scott Justice (CIMMYT) Chanda Gurung (CIMMYT) Najibullah Ansari (NARC) and Kailash Prasad Bhurer (NARC).

Fig. 1. Nepalese team at the planning workshop in Dhaka, December, 2004

Using a livelihoods approach to target the poorest farmers

The adoption of new technologies which impact on crop yields and/or household budgets pose a threat to the livelihoods of resource-poor farming families in terms of their food security and income, thus it is that only those farmers who have sufficient land to guarantee household food security throughout the year that can take the necessary risk. In an effort to target the poorest groups with our research, the following socio-economic categories were drawn up according to their ability to take risk:

- **Landless/ Food deplete farmer**: Must rent land or do paid labour to get food and pay for other necessities. *Cannot take any risks.*

- **Marginal/ Food deficit farmer**: Has insufficient land to achieve household food security. Regular shortage of food and cash. Must do labour in order to buy additional food, inputs and other basic necessities. Can enter a downward spiral very easily. *Cannot take any risks.*

- **Subsistence/Self-sufficient farmer**: Has sufficient land to meet basic food needs under normal conditions. May need to do labour to pay for inputs and other necessities (including school fees). Remains vulnerable to economic and environmental shocks. *Risk averse.*

- **Food surplus /Cash cropping farmer**: Has sufficient land to guarantee household food security. Able to produce surplus grain and cash crops for sale to buy inputs, send children to school and accumulate "middle class" assets, e.g. bicycle, TV, electric fan. *Able to take risk.*

According to this classification, only Subsistence and Food Surplus farmers are able to take risk and therefore it is these farmers who are most likely to adopt new technologies. However, in order to ensure that all farmers covered by this project were placed in the correct category each household was assessed according to its capacity to be food secure see Box 1.

Box 1.

Assessing household food security for rice farming households

The ability of farmers to achieve household food security is based on their landholding, number and ages of dependents and expected yield of their staple food crop. For rice growing farmers this can be expressed according to the following formula:

$$\text{Rice Self-Sufficiency Index (RSSI)} = \frac{\text{Potential paddy yield x Landholding}}{\text{Annual paddy requirement}} \times 100'\%$$

According to FAO, the recommended annual energy intake for an adult is equivalent to 365kg of (unprocessed) paddy rice, for an adolescent child over 10 years this is 274kg per year, while for a child under 10 years it is 183kg. The annual paddy rice requirement for each household can thus be calculated once the numbers of dependent adults, adolescents and children under 10 years are known.

The farmer's own yield data in terms of kg of paddy/ha is used to calculate the RSSI for each household. In cases where the farming families are sharecropping, the amount of grain that is due to the landlord must be subtracted from the potential yield.

The Rice Self Sufficiency Index (RSSI) for landless farmers will normally be zero, while the RSSI for marginal farmers will always be less than 100%. For the purposes of this research, the RSSI for Subsistence farmers was set at between 100 and 200%, while for Food surplus farmers an RSSI of more than 200% was used.

Adapted from Page & Chonyera, 1994.

Fig. 2. Marginal farmer discussing access to PTs in Belwa

Output 1: "Implications and benefits of new technologies on social well-being and system productivity and sustainability determined and key beneficial practises identified for each agro-ecosystem and social group within each community at selected benchmark sites."

1.1 Assessing the impact of improved technologies on farmers' livelihoods

1.1.1 Improved technologies investigated by the Nepalese team

The Nepalese team chose to investigate the impact of the Chinese power tiller (PT) in two villages in the rice/wheat cropping areas of the Terai (plains) in southern Nepal, namely Belwa and Benauli. Scientists from CIMMYT and NARC have been promoting PTs as part of an "equitable access/poverty reduction" strategy since 2000: The impacts of the PT were investigated amongst two groups of farmers in Belwa and one group in Benauli that had been formed in order to "try out" a CIMMYT sponsored PT, for one year[1]. Each "Users' Group" consisted of about 20 farmers distributed amongst all four socio-economic groups, viz. Food Surplus, Subsistence, Marginal and Landless. (Landless farmers leased land on a share-cropping basis). These farmers were able to get first hand experience of using the PT to prepare the land for the production of rice, wheat and vegetables. At the end of this period the PTs were sold, at a reduced cost, either to a single farmer, in the case of Benauli and to small groups of 3-5 farmers in the case of Belwa, on the assumption that all or part of the cost would be re-paid in instalments from the charges made from hiring it out to other farmers, thus ensuring continued wide accessibility to the PT.

Information was also collected in order to find out which categories of farmers were first to access the seeds of new varieties of rice and wheat. In this case the first farmer to obtain and use a particular seed variety was discovered and the other farmers asked to indicate the source and date on which they had first used this seed. Livelihood indicators were noted for all farmers involved.

1.1.2 Methodology used to determine the impact of these technologies on the different farmer types

In order to obtain data that would allow farmers to set the agenda within a framework of relevant areas and give their own unbiased views on access to the PTs, the team was provided with a template for conducting informal case studies. These focussed on specific indicators, namely socio-economic, human, natural and institutional, see Appendices 1 and 2. The teams were encouraged to interview farmers in their own homes, rather than in groups, to prevent intimidation from more powerful neighbours. Although the team set out to interview up to six farmers in each category, i.e. Landless, Marginal, Subsistence and Food Surplus, in the event a total of nine farmers were interviewed in depth in Belwa and only seven in Benauli due to the constant threat of violence in the area. Less detailed information was collected from more than 50 other farmers, relating to landholding, family size and whether or not they had been able to access the PT. Farmers from each of the villages were also asked to draw maps showing individual plots in relation to resources such as rivers, irrigation canals, boreholes and roads. It was hoped that these maps would serve as a reference for discussions on the problems associated with land fragmentation and siltation.

[1] Overall the project had seven groups formed in three separate districts.

1.2 Assessing the impact of power tillers on the livelihoods of farmers in Belwa and Benauli villages

1.2.1 Farmers' comments on the benefits of the PT

Chinese PTs are extremely popular amongst farmers in the Kathmandu and Pokhara Valleys as they can be used for land preparation, seed drilling, reaping, carrying produce and general transport, while the detachable engine can be used to power irrigation pumps, threshing machines and other small-scale farming equipment.

In Belwa, male farmers said that they also liked the PT because;
- Its purchase cost is less than that of a 4-wheel tractor.
- It is less costly to operate than a 4-wheel tractor, requiring less time, fuel and labour per ha.
- Unlike a 4-wheel tractor, it can be manoeuvred easily and can till right up to the edges, including the corners, of a small field.
- Its use leads to improved yields of rice and wheat.
- It can be hired out to neighbouring farmers to generate income.
- It is versatile and has attachments that can be used for a wide range of on and off-farm activities, including transporting guests to weddings.

Women said they liked the machine because it reduced drudgery;
- They don't have to dig the corners of the field by hand.
- They don't have to prepare food for the driver (cf 4-wheel tractors)
- They don't have to maintain it (unlike bullocks that have to be fed every day)
- Women can also drive it

Farm labourers were keen to learn how to drive the PT as they felt that it would improve their employment opportunities.

1.2.2 Impacts on farmers in Belwa village

In November 2000, scientists from the NARC/CIMMYT project had organised farmers into two PT Users' Groups in Belwa. PT Users' Group 1 contained 50% Muslims and 50% Hindus, while PT Users' Group 2 was entirely Hindu, see Tables 1 and 2. All the farmers in these groups were assessed in terms of their ability to be food secure and two or more farmers from each group were interviewed in depth to determine any benefits that they had gained from using the PT and whether or not they had been able to continue accessing one of the PTs after the machines had been privatised.

N.B. Many of the farming families in this village reported that the river was flooding their land and covering it with sand making it useless for rice production. Some farmers had had their entire landholding degraded in this way.

Users of the power tillers before and after privatisation

PT Users' Group 1

This Users' Group consisted of two Landless (with access to leased land), four Marginal, five Subsistence and nine Food Surplus farmers. Three male, Muslim farmers (two Food Surplus and one subsistence) from this Users' Group formed Business Group I in November 2002 in order to purchase the PT on credit from the project, see Table 3. Unfortunately this PT had

to be returned to the project in November 2004, because the group had failed to maintain the PT and were unable to re-pay the loan in time.

- **Landless farmers**

Two landless farmers were interviewed from the first PT Users' Group. Both of these farmers were Muslim. Aalim Ansari had been able to lease sufficient land to provide food security for his family of eleven adults, five adolescents and two younger children, while Rashid Ansari had been unable to lease enough land to guarantee food security for his family (see Table 1). Both farmers had used the PT for wheat land preparation and soil puddling for rice before it was privatised. Rashid Ansari had also received seven days' training from project staff as a PT driver. Neither farmer had been able to use the PT after it had been sold to Mustak Ansari and his partners and had thus resorted to hiring the more expensive 4-wheel tractor for land preparation.

- **Marginal farmers**

Four marginal farmers who had been in the PT users' group, had a mean RSSI of 64%. Two of these farmers had lost at least 50% of their land because it had been inundated by sand from the river, see Table 1. They reported that they had used the PT for land preparation and for sowing wheat as well as for soil puddling in preparation for rice production. Only one of these farmers reported using the PT after it was privatised. Gaya Mahato said "We cannot get the PT as the owners use it and by the time they finish the season is over". Sonarpati Devi stated that she had only used the PT once but had been invited to join the business group but was too poor to get involved. She said that women could run the PT just as well as men and intended to sell the family's 4-wheel tractor in order to buy a PT.

- **Subsistence farmers**

Four subsistence farmers (including one female farmer) participated in the original PT users' group. These subsistence farmers had an average RSSI of 143%. One of these farmers had lost 30% of his land due to flooding (see Table 1). Two of the farmers had been able to access the PT once it had been privatised. A fifth subsistence farmer, Suleman Ansari who had not been in the original PT Users' Group was invited to join Business Group I that purchased the PT in 2002, see Table 3. Makhani Devi said that the PT gave her a "good yield" and eliminated the labour requirement for digging corners and breaking clods. She explained that she had wanted to learn how to drive the PT, but the group didn't call her for training. She said "Group leaders are more influential and they do not discuss with others, especially the women, I do not know why they ignore us and no use asking them as they will not respond".

- **Food Surplus farmers**

Nine Food Surplus farmers were involved in the original PT Users' Group. These farmers had sufficient land to produce an average rice harvest that was more than three times their annual requirement (see Table 1). Mustak Ansari reported savings of Rs.2,700-3,000 per ha and increased yields of 35 to 40% for wheat and 25% for rice after using the PT. He said that he is utilising the time saved by doing other agricultural activities to increase his farm income. He added that no woman in the locality is interested to use the PT. Hriday Sah said he received training to drive the PT and stated that women cannot drive it. Five of these farmers had been able to access the PT after it was privatised, including the two who had been part of the business group that purchased the PT. Ali Ansari (who had been unable to hire the PT after privatisation) complained that the person who had been trained to drive the PT had not been included in the business group and since they had increased the hire charge to Rs.200 per hour, most farmers had taken the service on credit. He said that it was easy to hire the PT when it belonged to the project, as everyone was given a turn. But when it was

Table 1: Belwa PT Users' Group 1

Farmer type	Farmer name	Gender	Religion/ caste	Rice harvest (kg)	Family size			Land-holding (ha)	Land leased (ha)	Total paddy req (kg)	Rice self-sufficiency index %	Off-farm income?	Joined business group?	Used PT after Nov 02?
					adults	adolescents	children							
Food surplus	Ansari, Atiur Rahma	male	Muslim	8,000	2	3	4	2.8	0	2,284	503	yes	yes-I	returned 2004
	Ansari, Ali Ahamad	male	Muslim	2,400	4	0	1	2.0 (30% flood	0	1,643	349	no	no	no
	Dahait, Mahanta	male	Tharu	3,400	4	0	1	1.2	0	1,643	299	yes	no	no
	Sah, Hriday Narayan	male	Kanu	6,000	4	3	0	1.7	0	2,282	298		no	yes
	Dahait, Suryamani	male	Tharu	6,800	7	0	2	0.3	2.0	2,921	281	yes	no	no
	Mahato, Indradev	male	Kanu	6,000	3	4	2	1.7	0	2,545	274	yes	no	yes
	Sah, Ramagya	male	Kanu	6,200	4	1	2	2.0 (30% flood	0	2,100	273		no	no
	Mian, Shahid	male	Muslim	4,000	3	2	4	1.5	0	2,369	260	yes	no	yes
	Ansari, Mustak	male	Muslim	5,000	4	2	1	1.3	0	2,191	249	yes	yes-I	returned 2004
Means		**male**		**5,311**	**4**	**2**	**2**	**1.5**		**2,220**	**310**			
Subsistence	Devi, Makhani	female	Yadav	3,333/ha	6	3	0	1.3	0	3,012	181		no	no
	Ansari, Habib	male	Muslim	4,000	2	2	3	0.7	1	1,827	157	no	no	yes
	*Ansari, Suleman	male	Muslim	1,600	2	0	4	0.5	0	1,462	140	yes	yes-I	returned 2004
	Sah, Ramji	male	Teli	4,030	4	2	1	1.0 (30% flood	0	2,191	124		no	no
	Ansari, Quim-Uddin	male	Muslim	6,400	10	4	8	1.7	0	6,210	112	yes	no	yes
Means		male		3,873	5	2	3	0.98		2,940	143			
Marginal	Ansari, Samshad	male	Muslim	6,000	6	4	2	1.4	1.5	3,652	79	yes	no	yes
	Devi, Sonarpati	female	Barai	>4,000	8	1	3	0.7	2.7	3,743	77	yes	no	owns tractor
	Mahato, Uma Devi	female	plains origin	1,400	7	0	6	0.8 (50% flood	0	3,653	45	yes	no	no
	Mahato, Gaya	male	plains origin	7,000	12	3	3	2.0 (60% flood	0	5,751	57	yes	no	no
Means		**male**		**4,600**	**8**	**2**	**1**	**1.1**	**1.05**	**4,200**	**64**	**yes**		
Landless	Ansari, Aalim	male	Muslim	4,000	11	5	2	0	1.2	5,751	0	yes	no	no
	Ansari, Rashid	male	Muslim	3,000	4	2	2	0.2 (100% floo	0.5	2,374	0	yes	no	no
Means		male	Muslim	3,500	8	4	2	0	0.9	4,063	0	yes		
Labourers	Majhi, Dashai	male	Malhuri/Hindu	0	2	2	2	0	0.1	1,644	0	no	no	n/a

owned by a few people it was difficult to hire "as the owners, who have more land, use it first and by the time we get a turn the time for using it is over".

- **Farm Labourers**

It was not possible to interview any of the labourers associated with the Food Surplus farmers in Group 1 because they were afraid of loosing their employment.

PT Users' Group 2

This PT Users' Group consisted of two Landless, three Marginal, nine Subsistence and eight Food Surplus farmers. In November 2002, two business groups were formed from these farmers and each business group was allowed to purchase a PT on credit from CIMMYT/NARC. Business Group II consisted of three male, Hindu (*Tharu* or "farmer" */Yadav*) farmers, while Business Group III consisted of five male, Hindu (caste: *Tharu/Brahmin/Yadav*) farmers. The largest business group was unable to keep up re-payments and returned their PT a few months later, in 2003, see Table 2.

- **Landless farmers**

Both Landless farmers from PT Users' Group 2 were subsisting on leased land. Arjun Dahait had recently had his entire landholding destroyed by flooding, see Table 2. He had been able to join the larger business group that bought the PT from the project. The female landless farmer, Lalita Devi Sah said that the PT was good for grain crops as it does not leave big clods which can "crush the seed". She did not find it good for vegetable cultivation, however, "because it does not plough deep enough". She complained that only the men went for training and that she had not been asked whether she wanted to put money into the business group and had been unable to use the PT ever since it was privatised.

- **Marginal farmers**

Three Marginal farmers were active in the original PT Users' Group. The mean RSSI of these farmers was 81%. Two of these farmers had only recently become Marginal because flooding had destroyed part of their land. Mahadev Dahait (who formerly cultivated 1.64ha) had not had time to go for training but had been able to access a PT after it was privatised, see Table 2.

- **Subsistence farmers**

Eight male and one female Subsistence farmers were in the original PT Users' Group. These farmers had an average RSSI of 138%, see Table 2. Three of the male farmers, Mandev Prasad, Mahadev Prasad Dahait and Maheshwar Dahait had joined business groups that purchased the PTs, see Table 3. Maheshwar Dahait had leased an additional 4.7 ha and said that he was able to spend more time on vegetable production since using the PT. Four of the Subsistence farmers said that they had been unable to use the PT after it had been privatised.

- **Food Surplus**

Six male and two female farmers who had been in the PT Users' Group had rice self-sufficiencies of between 225 and 1,549%, see Table 2. Four of these farmers subsequently became involved in business groups that purchased a PT, see Table 3. Abay Das claimed to have been able to reduce his regular labour force by two thirds and increased his rice and

Table 2: Belwa PT Users' Group 2

Farmer type	Farmer name	Gender	Religion /caste	Rice harvest (kg)	Family size			Land-holding (ha)	Leased land (ha)	Total paddy req (kg)	Rice self-sufficiency index %	Off-farm income?	Joined business group?	Used PT after Nov 2002?
					adults	adolescents	children							
Food Surplus	Das, Abhay	male	Tharu	20,800	12	0	5	20.0	0	5,295	1549		yes-III	returned 2003
	Sah, Hari	male	Kanu	24,000	16	4	8	13.3		8,400	649	yes	no	yes
	Prasad, Ramji	male	Yadav	6,000	4	3	4	2.7		3,014	367	no	yes-III	returned 2003
	Sah, Mina Devi	female	Kanu	3,000	2	2	2	1.5		1,644	374	yes	no	no
	Devi, Gauri	female	Tharu	4,000	3	1	4	1.3		2,101	254		no	no
	Sah, Jagar Nath	male	Kanu	10,000	8	0	2	2.0	0.7	3,286	250	yes	no	no
	Dahait, Anirudh Pras	male	Tharu	10,000	12	5	7	4.0	0	7,031	233	yes	yes-II	yes
	Tiwari, Lal Babu	male	Brahmin	5,000	3	0	2	0.8		1,461	225		yes-III	returned 2003
Means		male		10,350	8	2	4	5.7		4,029	488			
Subsistence	Sah, Rameswar	male	Kanu	2,400	4	0	5	1.0		2,375	173	yes	no	no
	Dahait, Mahadev Pra	male	Tharu	1,800	4	0	2	0.7		1,826	150	yes	yes-II	yes
	Prasad, Rajdev	male	Yadev	3,600	6	0	3	1.0		2,739	150		no	yes
	Mishra, Kailash	male	Brahmin	1,600	4	0	0	0.5		1,460	140	no	no	no
	Chaurasia, Paraman	male	Chaurasia	2,800	7	0	3	1.0		3,104	132		no	no
	Chowdhury, Gauri D	female	Chowdhury	4,000	3	2	3	1.2(29% floode	?	2,192	132	yes	no	no
	Dahait, Maheswor	male	Tharu	8,000	7	10	10	2.2	4.7	7,125	127	yes	yes-III	returned 2003
	Prasad, Mandev	male	Yadav	4,000	2	1	2	0.4		1,370	120	no	yes-II	yes
	Sah, Ache Lal	male	Kanu	8,000	3	3	3	0.7		2,466	116	yes	no	yes
Means		male		4,022	4	2	3	0.97		2,740	138			
Marginal	Dahait, Mahadev	male	Tharu	2,132	3	0	1	1.64 (76% flooded)		1,278	96	yes	no	yes
	Prasad, Ashok	male	Chaurasia	3,400	8	2	2	1.0 (30% flood	0	3,834	75	yes	no	no
	Dev, Suk	male	Yadav	6,000	6	1	8	0.7		3,928	73	yes	no	yes
Means		male		3,844	6	1	4			3,013	81	yes		
Landless	Dahait, Arjun	male	Tharu	3,800	6	1	1	1.3 (100% floo	1.3	2,647	0	no	yes-III	returned 2003
	Sah, Lalita Devi	female	Teli	600	2	3	1	0	0.1	1,735	0		no	no
Means				2,200	4	2	1		0.7	2,191	0			
Labourers	Majhi, Rmraj	male	Malhuri/Hindu	0	7	0	3	0	0	2,190	0		no	driver

wheat yields by 1,700 and 670kg/ha respectively since using the PT. Anirudh Dahait received a week-long training in the operation of PTs and a further training in PT maintenance from the project staff. He was also invited to attend the Rice Wheat Consortium's international travelling seminar to Bihar and Bangladesh. This farmer reported retrenching all three of his regular labourers since joining the business group. He also stated that women are not interested in learning to drive the PT because of the need for cranking it with a starting handle.

Neither of the female farmers had been able to access the PT since it had been privatised: Gauri Devi said that now the PT is privately owned by three farmers there is no chance to use it. Mina Devi Sah is happy to pay for her brother's 4-wheel tractor to plough her land and admitted that her husband had only persuaded her to join the PT Users' Group to overcome her shyness.

- **Farm Labourers**

One of the labourers who was employed by Anirudh Dahait was interviewed. This labourer was landless and had a family of six adults and 3 children to support, see Table 2. He had been taught to drive the PT by his employer and was impressed by the yield increases he had observed in both rice and wheat. He lamented the fact that his wages had not increased as a result and mentioned that he will be tied to his employer until he has been able to pay off his Rs.1,000 loan.

Table 3: Comparative resources of PT owners in Belwa

Busine group	Farmer type	Famer name	Gender	Religion /caste	Land-holding (ha)	Rice self-sufficienc index (%)	Income from rice & wheat Rs/yr	Assetts	Other income Rs/month	Power Tiller costs						
										Loan provider	Purchase cost (Rs)	Repayments method	Interest charged	Client hire charge Rs	No. of hrs/yr	income /year
I	Food Surpl	Ansari, Mustak	male	Muslim	2.8	503	24,000		2,500							returned 2004
I	Food Surpl	Ansari, Rahman Atu	male	Muslim	0.4	503	700		1,500							
I	Subsistenc	Ansari, Suleman	male	Muslim	0.5	140	1,000	shop	2,000	CIMMYT	110,000	18,000/6mth	16%	250	250	62,500
Means			male	Muslim	1.2	382	8,567		2,000							
II	Food Surpl	Dahait, Anirudha Pr	male	Tharu	4.0	285	49,000		20,000							
II	Subsistenc	Dahait, Mahadev Pr	male	Tharu	0.7	150	20,000		10,000							
II	Subsistenc	Yadav, Mandev Pra	male	Yadav	0.4	120	19,200		0	CIMMYT	95,000	18,000/6mth	16%	225/hr	162	36,450
Means			male		1.7	185	29,400		10,000							
III	Food Surpl	Das, Abhay	male	Tharu	20.0	1549	49,800	4 Wtractor	4,000							returned 2003
III	Food Surpl	Yadav, Ramji Prasa	male	Yadav	2.7	367	40,000		0							
III	Food Surpl	Tiwari, Lal Babu	male	Brahmin	0.8	225	30,000		0							
III	Subsistenc	Dahait, Maheshwar	male	Tharu	2.2	127	20,000	4WTracto	0							
III	Landless	Dahait, Arjun	male	Tharu	flooded	0	0		0	CIMMYT	125,000	20,570/6mth	16%	250/hr	150	37,500
Means			male		6.4	454	27,960									
n/a	Marginal	Miyan, Manir	male	Muslim	0.7	46	0		3,500	Ag Dev Ban	99,000	4,000/mth	18%	200-300/hr	450	112,500

1.2.3 Impacts on farmers in Benauli village

Users of the power tillers before and after privatisation

Scientists from NARC/CIMMYT established only one PT Users' Group in Benauli, made up of four Marginal, eight Subsistence and five Food Surplus farmers. There were no Women or Landless farmers in this group; one of the PT Users was Muslim, the rest were Hindu belonging mainly to the Yadav ("milkman") caste. In November 2002, one of the Food Surplus farmers bought the PT from the project using funds provided by a local money-lender. While another took a loan and bought a PT on the open market, see Table 5.

All farmers in the PT User's Group were assessed in terms of landholding and family size. However, due to political instability in the area, only three farmers could be interviewed in detail, regarding any benefits they had gained from using the PT.

- **Landless farmers**

No Landless farmers were included in the PT Users' Group.

- **Marginal farmers**

Four Marginal farmers who were in the PT Users' Group had a mean RSSI of 56%. Two of these farmers had been able to increase their rice harvests by leasing additional land, see Table 5. All four farmers reported that they had been able hire a PT after the Food Surplus farmers had bought them.

- **Subsistence farmers**

Eight Subsistence farmers had been in the PT Users' Group. These farmers had a mean RSSI of 133% and two of them had increased their rice surpluses further by leasing extra land, see Table 5. Dayali Pd. Yadav said that with a PT it takes two days instead of 15 days to plough his land, he also noticed that his overall yield had increased by up to 400kg and he could reduce his labourers from five to two, since using the PT. This farmer said that he planned to sell his bullocks in order to buy a PT. Only one of the Subsistence farmers questioned said that he had been unable to use the PT since it had been privatised.

- **Food Surplus farmers**

Five Food Surplus farmers, having RSSIs ranging from 262 to 988%, had been in the PT Users' Group. The most affluent of these farmers, in terms of landholding and rice self-sufficiency, Chhote Lal Sah (caste: *Kalwar)* was one of three farmers who had been chosen for a total of three weeks' training in PT in driving, maintenance and repair by NARC. This farmer explained that previously it took 4 days to plough 1ha with bullocks at a cost of Rs.3,200. With a PT he can now plough 1ha in a day at a cost of Rs.1,000. He devotes the time saved to vegetable production. He had experienced yield increases of 25% in both rice and wheat, as well as savings in terms of time and labour costs. As a result this farmer has been able to dispense with three of his five labourers. These labourers were said to have been able to find alternative work in a local brick factory. Chhote Lal Sah previously owned two pairs of bullocks and has now sold both pairs in order to buy the project PT.

Another Food Surplus farmer, Ramjatan Yadav (caste: *Yadav)* stressed the savings made in irrigation time when using the PT, compared with traditional ploughing with bullocks (with and without the *satpahruwa*[2]) or the 4-wheel tractor: the irrigation time needed for the 4-wheel tractor is 20 hours, while that needed for traditional ploughing is 13 hours, this is reduced to 8 hours when the *satpahruwa* is used, however the irrigation time is further

[2] A *satpahruwa* is a bullock-drawn, traditional six-disc cultivator which can be used for reduced tillage.

reduced by half, i.e. to 4 hours when a PT is used to plough the land. This farmer had bought a PT on the open market, using a loan from the Agricultural Development Bank, following his training at AIRC, Ranighat that was provided by the project. He claims to have expanded his income through increasing his rice yields, obtaining savings in wheat and rice production costs and hiring the PT out to other farmers.

- **Labourers**

One of Chhote Lal Sah's remaining labourers was interviewed about the impact of the PT on his work. This man said that there is less drudgery in his work now and that his payment in rice has been increased from 2.5 to 5kg per day.

Table 4: Benauli PT Users' Group

Farmer type	Farmer name	Gender	Religion /caste	Total paddy harvest (kg)	Family size: adults	Family size: adolescen	Family size: children	Land-holding (ha)	Leased land (ha)	Total paddy req (kg)	Rice self-sufficiency index %	Off-farm income?	Bought PT?	Used PT after Nov 2002?
Food Surplus	Sah Chhotelal	male	Kalwar	6,000	2	1	2	3.3	0	1,370	988	no	yes	yes
	Yadav, Ramsw	male	Yadav	9,000	3	0	5	2.0	0	2,010	408	no	no	no
	YadavRamjata	male	Yadav	15,600	8	2	4	4.0	0	4,200	390		yes	yes
	Sah, Rambabu	male	Kalwar	8,000	4	2	0	1.8	0	2,008	368	yes	no	yes
	Yadav,Rammo	male	Yadav	4,000	4	0	4	1.7	0	2,192	318	yes	no	no
	Sah, Dinanath	male	Kalwar	4,000	3	0	0	0.7	0	1,095	262	yes	no	yes
Means		male		7,767	4	1	3	2.3	0	2,146	456			
Subsistence	Yadav, Dayali	male	Yadav	6,449	5	2	3	1.3	1.3	2,922	187	yes	no	yes
	Yadav, Sarfjit	male	Yadav	6,000	4	0	4	1.0	0	2,192	187	yes	no	yes
	Yadav, Dhrupla	male	Yadav	6,000	3	2	3	0.7	0.3	2,192	131	no	no	yes
	Sah, Raghunat	male	Kalwar	3,000	6	2	2	0.9	0	3,104	119	no	no	yes
	Yadav, Mahen	male	Kalwar	6,000	8	0	4	1.0	0	3,652	112	yes	no	yes
	Nek, Mohamm	male	Muslim	2,400	2	0	4	0.4	0	1,462	112	yes	no	yes
	Yadav, Naraya	male	Yadav	2,000	3	0	0	0.3	0	1,095	112	no	no	yes
	Yadav, Krishna	male	Yadav	8,000	10	2	2	1.1	0	4,558	102	no	no	no
Means		male		4,981	5	1	3	0.8	0.2	2,647	133		no	
Marginal	Yadav, Sukai	male	Yadav	8,000	2	1	0	0.2	0.6	1,004	82	no	no	yes
	Yadav, Narad	male	Yadav	4,500	3	0	4	0.3	0	1,827	67	no	no	yes
	Yadav, Bharat	male	Yadav	1,000	2	0	5	0.2	0	1,645	50	yes	no	yes
	Yadav, Atmara	male	Yadav	2,000	5	2	4	0.2	0.1	3,105	26	yes	no	yes
Means		male	Yadav	3,875	3	1	3	0.225	0.175	1,895	56		no	yes
no data	Yadav,Chhotu	male	Yadav											

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

Table 5: Comparative resources of PT owners in Benauli

Farmer	Famer	Gender	Religion	Land-	Rice self-	Rice-wheat	Assetts	Other	Power Tiller Costs						
type	name		/caste	holding	sufficiency	income		income	Loan	Purchase	Repayments	Interest	Client hire	No. of	Income
				(ha)	index (%)	Rs/yr		Rs/mth	provider	cost (Rs)	method	charged	charge	hrs/yr	/year
Food Surplus	Sah, Chhotelal	male	Kalwar	3.3	1,187	15,000	pumpset, tube well	no	Money lender	118,435	over 3 yrs	16%pa	Rs250/hr	300	75,000
							pr bullocks								
Food Surplus	Yadav, Ramjatan	male	Yadav	4.0	390	11,880	pumpset, tube well	no	Ag Dev Bank	89,100	over 3 yrs	16%pa	Rs200/hr	600	120,000

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007

1.3 Impacts of improved seed on farmers in Belwa and Benauli

1.3.1 Results of the seed mapping exercise in Belwa

Farmers in Belwa reported using three different varieties of rice (Pusa Basmati, NDR and BG 1442) starting in June 2003 and one variety of wheat, namely NL 297 which became available in November 1993. The Basmati rice is a commercial variety from India, while the other varieties were released by Narenda Dev Agricultural University, U. P., India and NARC respectively.

- **Rice var. Pusa Basmati**

In the case of Pusa Basmati, the *Tharu*, Food Surplus farmer, Aniruddha Dahait had been the first to obtain the seed of this variety from the Rangpur Agricultural Research Station, Parwat in June 2003. The following year he passed the seed on to another Food Surplus, *Tharu* farmer (Abhay Das) as well as a Muslim Subsistence farmer and a *Tharu* Marginal farmer, see Table 6.

- **Rice var. NDR**

Aniruddha Dahait was also the first farmer to obtain this rice variety in June 2003 from a commercial outlet in Pokhara and again he passed it on to Abhay Das, another Food Surplus, *Brahmin* farmer, a Subsistence, Muslim farmer and two Marginal farmers, one *Tharu* and one Muslim, see Table 6.

- **Rice var. BG 1442**

Aniruddha Dahait was again the first farmer to access the variety BG 1442 from NRRC, in June 2003. In this case he passed it on to three Subsistence and two Food Surplus farmers. These farmers belonged to the *Tharu, Brahmin, Yadav* and *Barai* castes, see Table 6.

- **Wheat var. NL 297**

Abhay Das was the first farmer to obtain the wheat variety NL 297 from the Agricultural Input Corporation, in November 1993. He passed the seed from this variety on to Aniruddha Dahait and two Subsistence *Tharu/Teli* and one Marginal *Brahmin* farmer, see Table 6.

This exercise indicates that in Belwa new wheat seed flowed from the Food Surplus, *Tharu* farmers to the poorer, *Tharu/Brahmin* and occasionally Muslim farmers, see Table 6.

Table 6: Seed mapping in Belwa

Seed name	Original seed source	Date of 1st use	Seed pathway	Farmer name	Farmer type	Religion /caste	Family size			Total pad requirem (kg/yr)	Land-holding (ha)	Rice self-sufficiency index %
							Adults	Adolesce	Children			
Pusa Basmati	RARS, Parwani	Jun-03	1st	Dahait, Aniruddha	Food Surplus	Tharu	12	5	7	7,031	6.0	350
rice	A P Dahait	Jun-04	2nd	Das, Abhay	Food Surplus	Tharu	12	0	5	5,295	13.3	1030
	A P Dahait	Jun-04		Ansari, Mauladin	Subsistence	Muslim	4	5	4	3,562	1.2	138
	A P Dahait	Jun-04		Dahait, Maheshwar	Marginal	Tharu	17	8	12	10,593	2.0	79
NDR rice	Agro vet, Pokha	Jun-03	1st	Dahait, Aniruddha	Food Surplus	Tharu	12	5	7	7,031	6.0	350
	A Das	Jun-03	2nd	Das, Abhay	Food Surplus	Tharu	12	0	5	5,295	13.3	1030
	A Das	Jun-04	3rd	Miyan, Seikh Islam	Subsistence	Muslim	2	3	2	1,918	0.7	150
	A Das	Jun-04		Jha, Nawal Kishor	Food Surplus	Brahmin	2	2	2	1,644	1.7	424
	A Das	Jun-04		Dahait, Maheshwar	Marginal	Tharu	17	8	12	10,593	2.0	77
	A Das	Jun-04		Dewan, Chokat	Marginal	Muslim	4	2	3	2,557	0.05	8
BG 1442 rice	NRRC, Hardinat	Jun-03	1st	Dahait, Aniruddha	Cashcropper	Tharu	12	5	7	7,031	6.0	350
	A P Dahait	Jun-04	2nd	Chaurasiya, Parman	Subsistence	Barai	7	0	3	3,104	1.0	132
	A P Dahait	Jun-04		Yadav, Rajdev	Subsistence	Yadav	3	5	3	3,014	1.0	136
	A P Dahait	Jun-04		Tiwari, Lal Babu	Food Surpus	Brahmin	3	0	2	1,461	0.8	225
	A P Dahait	Jun-04		Dahait, Arvind	Food Surplus	Tharu	3	3	2	2,283	1.4	251
	A P Dahait	Jun-04		Dahait, Satya Naraya	Subsistence	Tharu	2	2	1	1,461	0.7	196
NL 297 wheat	Agri Input Corp,	Nov-93	1st	Das, Abhay	Food Surplus	Tharu	12	0	5	5,295	13.3	1030
	A Das	Nov-95	2nd	Dahait, Aniruddha	Food Surplus	Tharu	12	5	7	7,031	6.0	350
	A Das	Nov-95		Dahait, Mahadev	Subsistence	Tharu	2	1	6	2,102	0.7	137

1.3.2 Results of the seed mapping exercise in Benauli

Farmers in Benauli reported using four rice varieties (Pusa Basmati, BG 1442, Pioneer, Sona Masuli) and one wheat variety (NL 297). Sona Masuli was said to be the most popular rice variety as "it has a higher yield, is less prone to pests and fetches a higher price".

- **Rice var. Pusa Basmati**

The *Kalwar,* Food Surplus farmer, Chhotelal Sah had been the first to obtain the seed for Pusa Basmati from an Indian relative in 2002. The following year he passed the seed on to other relatives and neighbouring Food Surplus, Subsistence and Marginal farmers in the *Kalwar* and *Yadav* castes, see Table 7.

- **Rice var. Pioneer**

Chhotelal Sah was also the first to try out Pioneer seed in 2003, which he had bought in India. This seed could not be passed on to other members of the community as it is a hybrid variety.

- **Rice var. Sona Masuli**

In 1993, another Food Surplus, *Kalwar* farmer, Ramdhari Sah was given Sona Masuli seed by his Indian relative and passed it on to Food Surplus, Subsistence and Marginal farmers in the *Kalwar* and *Yadav* castes, a year later.

- **Rice var. BG 1442**

Ramjatal Yadav who is a Food Surplus, *Yadav* farmer procured BG 1442 from the National Rice Research Programme, in June 2003. This seed was passed on to Food Surplus farmers in the *Yadav* caste and Subsistence and Marginal farmers, most of whom were Muslim.

- **Wheat var. NL 297**

Chhotelal Sah obtained seed of NL 297 from the government-controlled Agricultural Input Programme (AIC) in 1993 and in this case passed it onto mainly Marginal farmers in the *Kalwar, Yadav, Ram* and *Dhanuk* castes.

In every case in Benauli village new seed flowed from the Food Surplus farmers, belonging mainly to the *Kalwar* caste to the poorer farmers in the lower castes and rarely to Muslim farmers, see Table 7.

Table 7a: Seed mapping in Benauli (Pusa Basmati and NL 297)

Seed name	Original seed source	Date of 1st use	Seed pathway	Farmer name	Farmer type	Religion /caste	Family size			Total paddy requirement (kg/yr)	Land-holding (ha)	Rice self-sufficiency index %
							Adults	Adolesc	Children			
Pusa Basmati	Relative	2002	1st	Sah, Chhotela	Food Surplus	Kalwar	2	1	1	1,187	3.3	1140
	Sah, Chotelal	2003	2nd	Sah, Rajdev P	Subsistence	Kalwar	10	1	5	4,839	1.0	131
	Sah, Chotelal	2003		Yadev, Ddrub	Subsistence	Yadav	3	2	3	2,192	0.7	131
	Sah, Chotelal	2003		Yadev,Ramjata	Food Surplus	Yadav	8	2	4	4,200	5.0	488
	Sah, Chotelal	2003		Yadev, Ganesh	Subsistence	Yadav	6	0	4	2,922	1.0	140
	Sah, Chotelal	2003		Yadev, Rikdev	Marginal	Yadav	8	1	8	4,658	1.0	88
	Sah, Chotelal	2003		Yadev, Sukai	Food Surplus	Yadav	2	1	0	1,004	0.8	327
	Sah, Chotelal	2003		Sah Abadh	Food Surplus	Kalwar	4	0	4	2,192	2.7	505
NL297	AIC	1995	1st	Sah, Chhotela	Food Surplus	Kalwar	2	1	1	1,187	3.3	1140
	Sah Chotelal	1996	2nd	Sah, Abadh	Food Surplus	Kalwar	4	0	4	2,192	2.7	505
	Sah Chotelal	1996		Sah, Ragunath	Marginal	Kalwar	6	0	5	3,105	0.5	66
	Sah Chotelal	1996		Sah, Ramdhari	Marginal	Kalwar	6	2	1	2,921	0.7	98
	Sah Chotelal	1996		Mahara, Ganes	Marginal	Ram	8	4	3	4,565	1.0	90
	Sah Chotelal	1996		Yadav, Shiv Ba	Marginal	Yadav	6	0	6	3,288	0.3	37
	Sah Chotelal	1996		Yadav, Dhrub	Marginal	Yadav	3	2	3	2,192	0.3	56
	Sah Chotelal	1996		Mahato, Ramji	Marginal	Dhanuk	2	0	0	730	0.1	56
	Sah Chotelal	1996		Mahato, Laxmi	Landless	Dhanuk	2	0	0	730	0	0

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

Table 7b: Seed mapping in Benauli (Pioneer and Sona Masuli)

Seed name	Original seed source	Date of 1st use	Seed pathway	Farmer name	Farmer type	Religion /caste	Family size			Total paddy requirement (kg/yr)	Land-holding (ha)	Rice self-sufficiency index %
							Adults	Adolesc	Children			
Pioneer	India	2003	1st	Sah, Chhotela	Food Surplus	Kalwar	2	1	1	1,187	3.3	1140
Sona Masuli	Indian relative	1993	1st	Sah, Ramdhar	Food Surplus	Kalwar	2	0	3	1,279	12.0	3847
		1994	2nd	Sah, Chhotelal	Food Surplus	Kalwar	2	1	1	1,187	3.3	1140
		1994		Yadav, Ramjat	Food Surplus	Yadav	8	2	4	4,200	4.0	390
		1994		Yadav, Dayali	Subsistence	Yadav	5	2	3	2,922	1.3	182
		1994		Yadav, Basude	Food Surplus	Yadav	14	1	11	7,397	20	1109
		1994		Yadav, Krishna	Subsistence	Yadav	10	2	2	4,564	1.7	153
		1994		Yadav, Laxmi	Food Surplus	Yadav	6	0	3	2,793	3.3	484
		1994		Sah, Krishna	Marginal	Kalwar	10	1	5	4,839	1.0	85

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

Table 7c: Seed mapping in Benauli (BG 1442)

Seed name	Original seed source	Date of 1st use	Seed pathway	Farmer name	Farmer type	Religion /caste	Family size			Total paddy requirement (kg/yr)	Land-holding (ha)	Rice self-sufficiency index %
							Adults	Adolesc	Children			
BG 1442	RARS	1998	1st	Yadav, Ramja	Food Surplus	Yadav	8	2	4	4,200	4.0	390
	Yadav, Ramjata	1999	2nd	Miya, Mogalbi	Marginal	Muslim	6	1	3	3,013	0.2	27
	Yadav, Ramjata	1999		Mohammad, N	Subsistence	Muslim	2	0	4	1,462	0.4	112
	Yadav, Ramjata	1999		Yadav, Dhanes	Food Surplus	Yadav	9	1	7	4,840	3.0	254
	Yadav, Ramjata	1999		Yadav, Basude	Food Surplus	Yadav	14	1	11	7,397	20	1109
	Yadav, Ramjata	1999		Yadav, Laxmi	Food Surplus	Yadav	6	0	3	2,793	3.3	484
	Yadav, Ramjata	1999		Yadav, Ram S	Subsistence	Yadav	4	0	4	2,192	1.0	187
	Yadav, Ramjata	1999		Yadav, Jay Ma	Food Surplus	Yadav	5	1	6	3,197	3.0	385

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

1.4 Conclusions and recommendations

1.4.1 Impacts of the PT and improved seed on Women farmers in Belwa and Benauli

Out of a total of 42 participants in the PT Users' Groups in Belwa, only seven were women and all were Hindu: Two were from Food surplus, two were from Subsistence, two were from Marginal and one was from a Landless farming family. None of these women reported going for training in the operation and maintenance of the PT that was offered by the project team, despite the fact that several of them were keen to do so. No women were included in the 18-strong PT Users' Group in Benauli. This means that overall; just 8% of the participants who had had access to the PTs before they were privatised were women. No women reported being able to access the PTs after they were privatised.

No women were involved in the seed mapping exercise, presumably because they are not in control of the production of either rice or wheat.

Figure 3.
Impact of new technologies on the livelihoods of Risk-prone Women farmers

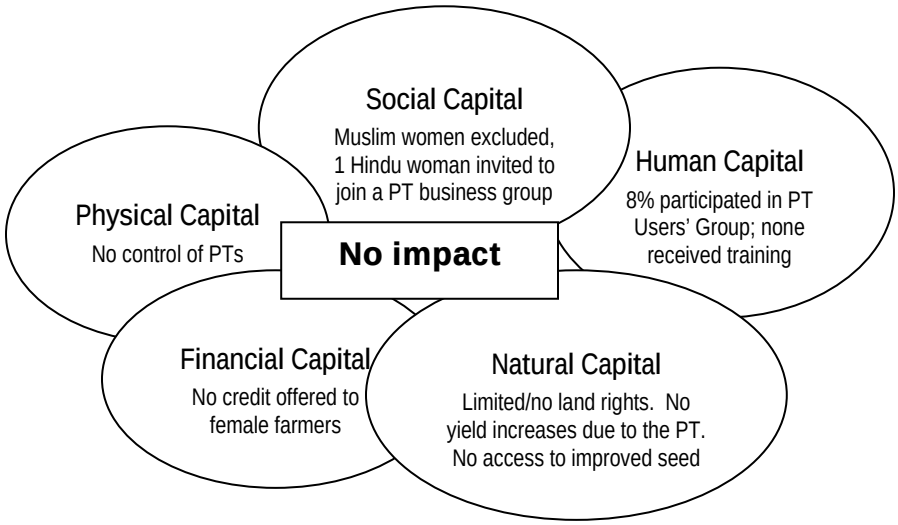


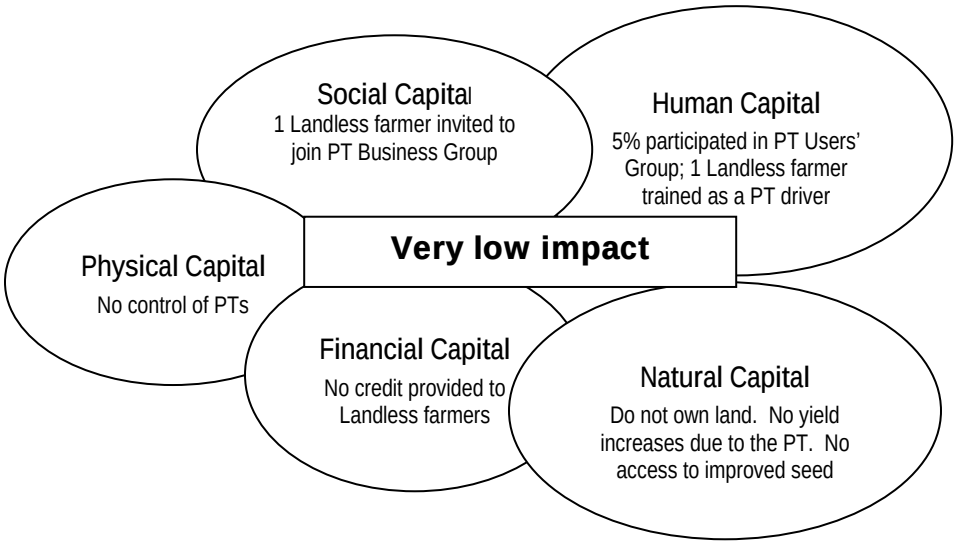
Figure 3 indicates that while there was a slight gain in *human capital* when 8% of the women participated in the Users' Group. Overall, women, particularly Muslim women, did not receive any long-term benefits from either the PT dissemination project or accessing new seed varieties, in terms of improving their livelihoods, see Fig. 3..

1.4.2 Impacts of the PT and improved seed on Landless farmers in Belwa and Benauli

Overall, just 5% of the farmers who were involved in the PT Users' Groups were Landless. However, this percentage was confined to Belwa as no Landless farmers were included in the PT Users' Group in Benauli. One of these farmers, Rashid Ansari, had been encouraged to go for training as a driver but was not included in any of the business groups. Arjun Dahait, who had only recently become Landless, had retained sufficient *social capital* to be invited to join Business Group III.

In general the impact of the PT dissemination project on Landless farmers was negligible in terms of the very low numbers involved in the project overall and the lack of long-term benefits acquired by the few that did participate. Only, one of these farmers had been able to accumulate some *human capital*, when he was trained as a driver, while another improved his *social capital* when he become involved in a business group, probably on account of his status as a member of the *Tharu* community, see Figure 4.

Figure 4.
Impact of new technologies on the livelihoods on Male, Risk-prone Landless farmers



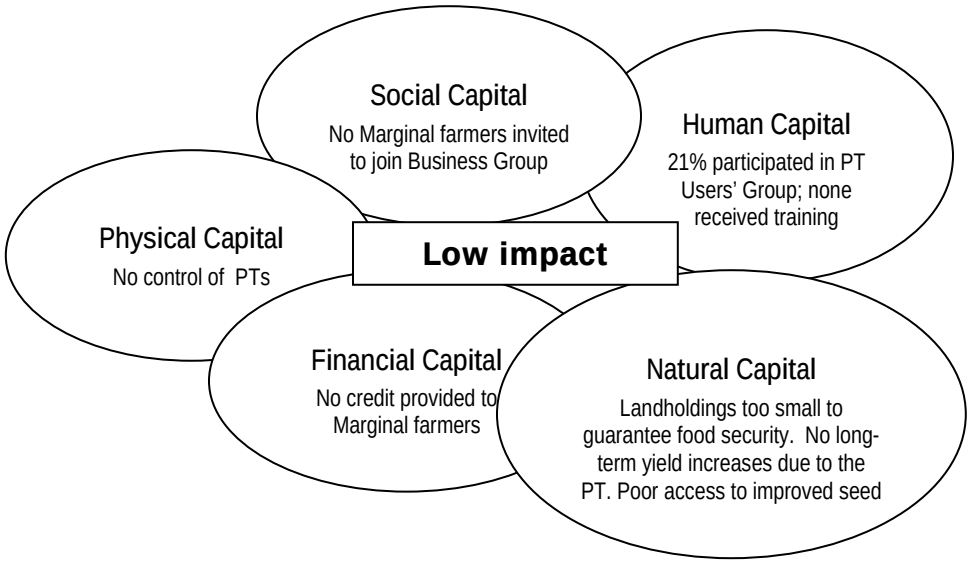
There was no improvement in either financial or natural capital with Landless farmers being unable to access the credit necessary for them to purchase a PT and having little or no access to improved seed.

1.4.3 Impacts of the PT and improved seed on Marginal farmers in Belwa and Benauli

Although 21% of the farmers who had participated in the PT Users' Groups, were Marginal none had been involved in the special training courses that had been provided by project staff. Mahdev Dahait said that he did not have time to go for training. Less than 50% of the Marginal farmers in Belwa had been able to access the PTs after they had been privatised, whereas all of the Marginal farmers in Benauli had been able to hire a PT from its owner.

This means that the impacts of the PT was low in terms of both access and control amongst Marginal farmers in Belwa; high in terms of access and zero in terms of control in Benauli, see Fig. 5.

Figure 5.
Impact of new technologies on the livelihoods on Male, Risk-prone Marginal farmers



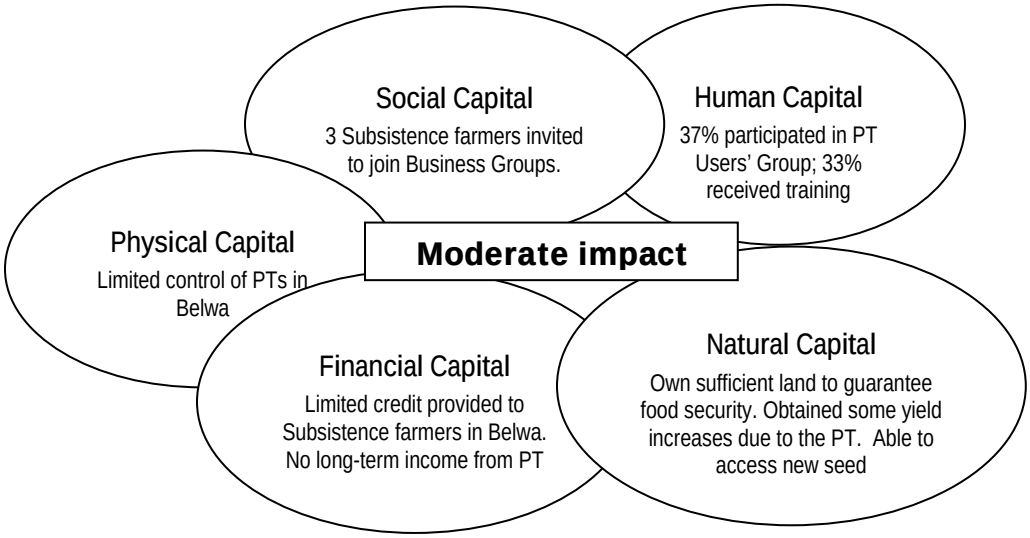
Marginal farmers did not acquire any *social* or *financial capital* from the project. They could not improve their *natural capital* because they did not benefit from any long-term, PT-related yield increases and were also found to have poor access to improved seed, particularly if they belonged to groups other than *Tharu* or *Brahmin* in Belwa or were Muslim in Benauli.

1.4.4 Impacts of the PT and improved seed on Subsistence farmers in Belwa and Benauli

Overall thirty-seven percent of the participants involved in the PT Users' Groups were Subsistence farmers and 33% of them (along with other family members) also received specialised training in driving and maintenance. In Belwa one *Tharu* or Muslim Subsistence farmer was involved in each of the three business groups. In Benauli, no Subsistence farmers were given the opportunity to purchase the project PT although one of them had expressed an intension of buying a PT on the open market, once he had sold his bullocks. More than 50% of Subsistence farmers in Belwa and all except one of these farmers in Benauli had been able to access PTs after they had been privatised.

This means that the impact of the PT dissemination project on Subsistence farmers has been high in terms of the *human capital* gained from participating in the Users' Group and from being trained in PT driving and maintenance. In Belwa a few of these farmers had sufficient *social capital* in terms of their family ties or caste to be invited to join one of the business groups and thus benefited from any credit that was available. Unfortunately the financial benefits that should have been derived from hiring out the PT were not realised, see Fig. 6.

Figure 6.
Impact of new technologies on the livelihoods on Male, Risk-averse Subsistence farmers

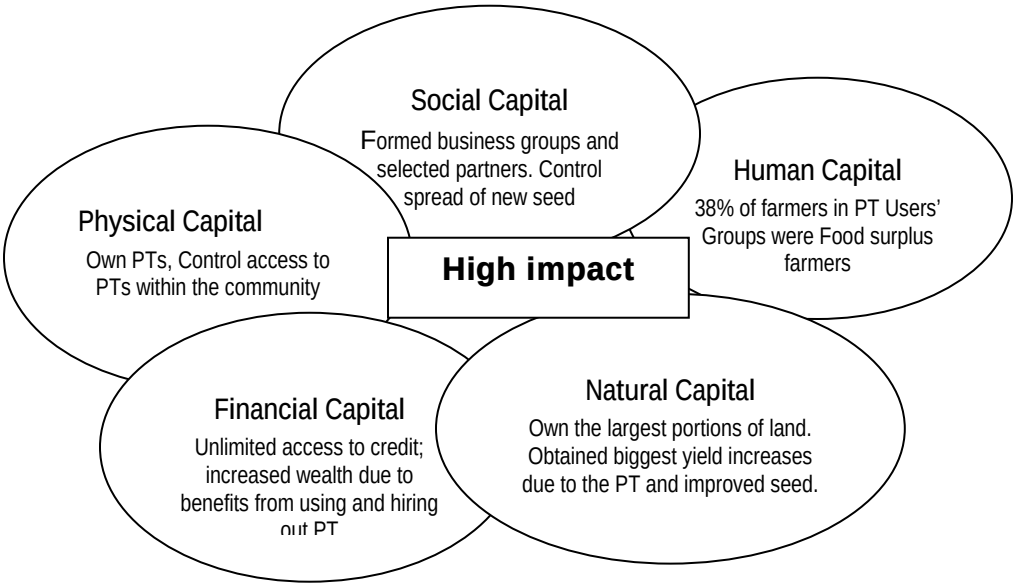


Some Subsistence farmers improved their natural capital through obtaining yield increases as a result of using the PT. They were also able to access improved seed from their Food surplus neighbours.

1.4.5 Impacts of the PT and improved seed on Food Surplus farmers in Belwa and Benauli

Thirty-eight percent of the farmers who had participated in the PT Users' Groups in Belwa and Benauli were Food surplus. Ninety-one percent of these farmers had also received training in the operation and maintenance of the PTs. Most of them reported long-term benefits from using the PT, in terms of increased food security and wealth. In Benauli the two richest farmers in the Users' Group had received specialised training and then took the opportunity to buy the PTs offered by the project using loans provided by a local money-lender/ Agricultural Development Bank. While in Belwa Muslim and *Tharu* Food surplus farmers also received this training and then controlled each of the three business groups that bought discounted PTs (including attachments) from the project. As a result 48% of the Food surplus farmers became PT owners, and a further 2% of them continued to access the PTs after they were privatised.

Figure 7.
Impact of new technologies on the livelihoods of Male, Risk-free Food Surplus farmers



Overall, the PT dissemination project had the highest impact on the livelihoods of Food Surplus farmers: Food Surplus farmers gained *human capital* through participating in the Users' Group and receiving training in the operation and maintenance of the PT. They used this improved *human capital,* together with their already abundant *financial, human* and *social capital* to buy the PT or form the business groups that purchased the machine. Their *social capital* also ensured that their land was tilled first and allowed them to control access to the PTs both within the business group and in the wider community. As a result their *financial capital* was strengthened by a reduction in labour costs, increased income from larger grain surpluses and from hiring out the PT to other farmers. The capacity of their *natural capital*, the form of large landholdings was boosted through yield increases in both rice and wheat, see Fig. 7.

Evidence showed that Food surplus farmers are also able to use their *human, social* and *financial capital* to access and control the spread of new seed within their communities.

1.4.6 The case of Md. Manir Miyan

Md. Miyan is a Marginal farmer who was unable to participate in the CIMMYT/NARC PT project. However, he told us that he had been so impressed by the benefits that other farmers were getting from the PTs that he used part of his land as collateral in order to get a loan from the Agricultural Development Bank so that he could purchase a machine, at a cost of Rs.99,000. He is being charged the commercial interest rate of 18%, see Table 3. Md. Miyan has since bought a seed drill for his PT from the project, after one of the business group-owned PTs, that included a seed drill, was returned to NARC and more recently he has bought a trailer for transporting goods. Because Md. Miyan has so little land he is able to hire out his PT almost continuously. By charging Rs.200 per hour for land preparation and Rs.300 per hour for minimum till seed sowing services for a total of 450 hours last year he was able to raise Rs.112,500 (USD1,875). This more than covered the purchase cost of the PT, see Table 3.

1.5 Conclusion

The main beneficiaries of the PT dissemination project, in terms of all five sustainable livelihood components, in both Belwa and Benauli were the minority Food surplus farmers. Subsistence farmers also benefited in terms of *human* and *social capital*, while the risk-prone Marginal and Landless farmers only partially benefited in terms of *human capital* as a result of short-term participation in the Users' Group. None of the women involved in this investigation gained any long-term benefit from the project. This means that the dissemination methods used by the project did nothing to alter the status quo in respect of access and control of resources within either of the two villages.

The most disadvantaged group were the Muslim women who did not participate in any of the Users' Groups because their culture may have prevented them from being involved in activities that were dominated by men. Although a few Hindu women were involved in the Belwa Users' Group there were no enabling factors in place which would provide an opportunity for training, allow them to gain control over the PT or even access it once it was privatised. Overall, the risk-prone Marginal and Landless farmers represented less than 25% of the User Groups: This percentage does not reflect the current situation in either Belwa or Benauli, where Marginal farming families alone represent 67 and 69% of the total farming families respectively. Not only were the Food surplus farmers disproportionately represented in PT User Groups, more than 90% of them were also offered additional training in the operation and maintenance of the PTs. Two years later, by failing to put into place enabling factors which would allow Marginal, Landless or Women farmers to buy the PTs, control of these machines was virtually handed to the Food surplus farmers. The data suggests that the farmers in Belwa were able to use their wealth and status to select friends and relatives to enter into partnerships with them for the purposes of buying the PT. Farmers belonging to the *Tharu* community were in the majority in two of the Business Groups, while the third group was entirely Muslim: Mustak and Rahman Ansari invited Suleman Ansari to join their Business Group, even though Suleman had not participated in the original Users' Group, see Table 3.

The already resource-rich, Food surplus farmers in Belwa were offered loans (@ 16% interest) without the need for collateral. Marginal and Landless farmers were not able to take advantage of these loans. The fact that a farmer with little or no land would be able to hire out his PT almost continuously, and therefore be in a better position to pay back his loan appears to have been overlooked. For example, a Landless or Marginal farmer would be able to hire out a PT

almost 100 percent of the time – more than 10 hours every day (some farmers reported tilling their land at night). At a rate of Rs.250 per hour, 6 days per week, this would provide an income of approximately Rs.60,000 per month during peak periods when rice and wheat are sown. This would allow the cost of the PT to be paid back within three years, with ease, even allowing for fuel and repair costs. A good example of this is a Marginal farmer in Belwa, Md. Manir Miyan, who despite having had neither training nor support from the project is now hiring out his machine at a rate of 37.5 hours per month, see Table 3. And with the recent addition of a trailer, will be in a position to generate income on a daily basis throughout the year.

It is significant that two out of three of the PTs were returned from Belwa, while both PTs are still being utilised by their single Food Surplus owners in Benauli. This is probably because the owners in Benauli were motivated to hire out their PTs to other farmers in order to raise the funds needed for paying back the loans that they had obtained from external sources. Mr Chhotelal hired out his PT for 100 hours during the last wheat season in Benauli, while Ramjatan Yadav generated Rs.120,000 from hiring out his PT for a total of 600 hours last year (see Table 5). In the case of the PTs in Belwa, however, the PT owners gave priority to tilling the land belonging to each member of the Business Group before hiring the machine out to other farmers. For example, Business Group II hired out their PT for only 12 out the 162 hours that were spent preparing the land for wheat and did not hire it out at all to farmers outside their group during the last rice season. As a result the three farmers in Business Group I managed to raise just Rs.62,500 in one year, while the three farmers in Business Group II and the five farmers in Business Group III only raised Rs.36,450 and Rs.37,500 respectively, during this time, see Table 3. This was insufficient to cover the cost of loan re-payments. Problems also arose when it came to the maintenance and repair of the PTs as individual farmers refused to take responsibility for this task. Some farmers thought that the project would repair their PT and as a result "treated it roughly": Business Group I were said to have damaged their PT by using it without water in the cooling system.

It is clear that Food surplus farmers do not need any assistance in accessing credit for the purchase of new technologies. These resource-rich farmers are also in a position to use their considerable *human, social* and *financial capital* to obtain information and training from the commercial sector. It is the majority, resource-poor Landless, Marginal farmers and women who require the most support in the adoption of new technologies, and technology dissemination projects should be concerned with reducing the risk associated with the adoption process for these people. Unfortunately, not only did this project fail to ensure equitable access to the benefits of the PTs, but by inadvertently favouring the dominant castes and richest farmers it actually widened the gap between rich and poor in both Belwa and Benauli. Such inequality is an underlying cause of the current social strife in Nepal and concerned scientists could use the development opportunity provided by technology dissemination projects to challenge the status quo that favours resource-rich farmers, in order improve the livelihoods of the poorest members of the community.

1.6. Making access to the PT and improved seed more equitable

1.6.1 Recommendations on improving the livelihoods of the poorest farmers and women.

This means creating a "win-win" situation in which the control of new technologies is put into the hands of the poorest farmers and women, while the benefits remain accessible to all.

How to improve *Human* and *Social Capital* for the poorest farmers and women

- Provide "whole family training" (wife and husband/eldest son) to involve women (including Muslim women).
- Set up separate User Groups for Marginal/Landless farming families.
- Organise separate (whole family) training courses for Marginal/Landless farming families.
- Hold meetings at times and in locations that suit poor farmers and their families.
- Ensure that the numbers of farmers exposed to new technologies and training reflect the numbers of farmers (men and women) in each of the livelihoods categories and religious groups/castes in the wider community, in percentage terms.
- Find innovative ways of getting information to the poorest farmers and women, e.g. through the use of radio and videos.

How to improve *Physical* and *Financial Capital* for the poorest farmers and women

- Provide enabling factors, e.g. business plan, low interest rates/longer repayment time that will allow poorer farmers and women to access loans for the purchase of PTs and other improved technologies.
- Collaborate with NGOs that provide micro-credit.
- Provide improved seed directly to poor farmers and women.
- Train (whole family) Marginal and Landless farmers in the production, storage and sale of improved seed.
- Link with organisations that provide training in income generating activities, e.g. low input, pesticide-free vegetable production, mushroom growing, vegetable seedling/fruit tree/herb production.
- Enable Marginal farmers/Landless people to set up a PT repair service.

How to improve *Natural Capital* for the poorest farmers and women

- Encourage discussion and self-help to protect land from flood damage.
- Allow poor farmers to make the best use of limited landholdings by providing training in pesticide-free vegetable production, mushroom growing, and vegetable seedling/fruit tree/herb production.

Output 2: "Agricultural knowledge systems identified in regions concerned, uptake and adoption blockages ascertained and strategies developed to overcome these and optimise pro-poor development"

2.1 Identifying agricultural knowledge systems

In order to determine the agricultural knowledge systems available to farming communities in the wheat growing areas of Nepal and to ascertain any blockages that were being experienced by farmers based on gender or socio-economic grouping, the method indicated in Box 2, below, was used in each of the project villages:

Box 2.

Knowledge mapping exercise

This exercise consists of three steps and should be conducted with three male farmers and three female farmers from each of the four socio-economic groups: Landless, Marginal, Subsistence, Food surplus. Responses should be tabulated for ease of interpretation.

Step 1: Ask male and female farmers from each socio-economic group to list the various sources of information available to them.

Step 2: Ask farmers to explain which sources of information are most accessible, and why some sources are more effective than others.

Step 3: Compare the sources of information given by the farmers between each socio-economic group and with the list of all possible sources of information that were collated in Step 1. Where some farmer groups make no use of sources of information on this list, then the farmers in this group should be asked if they know of this source and/or why they do not use it and to explain the perceived blockages in accessing it.

2.1.1 Results of a knowledge mapping exercise

- In the case of male farmers, the number of information sources declines with decreasing wealth, thus Food Surplus farmers have access to most information sources, due to their social and financial capitals, as well as more time to access these sources.
- Subsistence and Marginal women farmers have access to more sources of information than the wives of Food Surplus farmers. This is because they must get involved in farming in order to survive. Hindu women tend to access more information than Muslim women because of their increased mobility.
- The wives of Food Surplus farmers gain respect by staying at home and avoiding agricultural work, this reduces their motivation to access information.
- Landless labourers rely on their employers for information.
- All socio-economic groups of women cite family members, especially husbands as major sources of information, whereas all socio-economic groups of male farmers tend to look outside the family for information, because women's knowledge is not valued.

2.1.2 Unblocking knowledge pathways

The Nepali team were tasked with drawing up a series of activities that would unblock knowledge pathways for Marginal and Subsistence farmers, including women and these are set out in Table 8.

Table 8: Ways of unblocking knowledge pathways in Nepal

Media	NGOs	Extension	Marginal farmers	Policy-makers
• FM radio – using local language • Season/time • Appropriate technology at the right time • Strong linkage with media and institutions • Press conference • Sensitise the media about new technologies • Encourage private sector to involve media to promote new technologies • Site visits for media	• Collaborative project with local NGOs • Interactive meeting • Incentives for NGOs • Provisions to bring NGOs in local priority areas	• Collaborative projects and commitments • Sensitisation of extension personnel involved • Appreciation for contribution • Updating knowledge of extension regularly • Periodic interactive meetings	• Must be considered as important stakeholders • Full participation in PTD (planning, execution and M/E) • Training visits • Flow of information • Valuing indigenous knowledge • Women's group approach	• Site visits and demonstration of the technology as a regular programme • Brochure preparation for policy makers • Farmer-policy maker interaction in central level • Documentary to show of the successful technologies

Some of these activities were incorporated into the Action Plan which would be implemented in order to fulfil Outputs two and three, see Table 9.

Table 9: Action Plan for Outputs Two and Three

Major Activity	Sub-activities	Start date	Outputs (in terms of unblocking knowledge pathways for the poorest farmers)
1. Training	Women's Vegetable Cultivation Group		
	1) Group formation with the poorest as leaders.(Poor women have better outside access and mobility than Food Surplus women)	1) End July 2) 1st Week Sept	30 Women trained in vegetable cultivation with minimum 50% from marginal and landless women farmers
	2) Seed management training		
	3) IPM training	3) 1st Week Oct	
	4) Off season vegetables	4) 1st Sep	
	5) Marketing	5) 1st Nov	
	6) Seed fair	6) Last Feb	
	7) Link / network group with other sources of information (improve other pathways)	7) Ongoing	Sources of information for poor women farmers increased
	Men's / RCT		
	1) ID marginal and landless male farmers for PT repair training	1) End July	
	2) ID above individuals for new HMG program for PT loans	2) End July	40 people trained in PT repair with 50% chosen from marginal and landless class
	3) ID local / district level pump set mechanics for PT repair training	3) End Sept	
	4) Training	4) Aug - May	
2.a Regional Level FM Radio programs and spots Private Sector FM radio spots 16 nos. with help from NARC Public Info Division in Bhojpuri	Get 20 FM/AM Chinese radios to each women's group	1) End of July	Through Listener letters and Listener groups obtain feedback about how far we are reaching
	1) Meeting with FM station to chalk out timings	2) End July	
	2) Meeting with Umesh Manandhar about his program development and rates	3) End June	
	3) ID issues/content and experts for program development	4) End July	Information reaching a much wider audience
	4) Writing and recording	5) First Aug	
	5) Radio listening groups	6) Aug	
	6) Get other NGOs interested in forming listeners' groups. Airtime		
2.b Regional Level AM Radio	1) Meeting with Krisi kariyakram folks in Kathmandu Krisi Kariyakram (AM) radio show. Invite radio personality to come to site and interview farmers for program i. Vegetable Programs - 6 programs ii. PowerTiller machinery programs - 6 programs	End of June	Through Listener letters and Listener groups obtain feedback about how far we are reaching
	2) Begin programming process similar to FM	End of Aug	Information reaching to a much wider audience
3. Demonstrations	1) Off season vegetable production using / accessing CHT	1. Aug	50% of landless and marginal women farmer in each village will have a demonstration plot with free inputs
	2) Off season summer vegetables	2. Feb	
	3) Zero Till demonstration with PT using new wheat varieties	3. Oct	Demonstration in 3 landless and 3 marginal farmers fields with free inputs
	4) Bed planting vegetables / potatoes	4. Oct	
4. Spare Parts	1) ID one poor pump set mechanic & one tractor dealer in Parwanipur area to receive PT spare parts.	1. End of Juy	Two new suppliers of spare parts in the Birganj area
	2) Giving 20,000 NR PT/PTSD/reaper spare parts to each	2. End of Sept	
	3) Link / Visit to Kathmandu wholesale providers	3. End of Oct	
	4) Link via radio programs	4. First program	
5. M&E	1) Implement 6 monthly L&A meetings		
	2) Get feedback from farmers on radio programs (request for letters/responses via the radio program)		

2.1.3 Unblocking knowledge pathways via FM radio

In order to unblock knowledge pathways and promote awareness of improved technologies amongst farmers in the Terai region, NARC scientists negotiated with producers at the privately-owned Krisi Kariyakram local radio station for permission to broadcast a series of 30 minute programmes on topics related to the use of improved technologies at a cost of NRs3,000 (USD50) per broadcast. These programmes were written and narrated mainly by NARC scientists; some were recorded in the research station, others at the radio station in Birgunj, while yet others were recorded in farmers' homes. The programmes were recorded in the local language, *Bhojpuri*, and aired through the FM channel every Monday evening between 6.30 and 7pm, a time when most farmers are at home, beginning in March 2005. The full list of programmes is shown in Table 10. The wide range of topics covered, relate to PT use, vegetable production, wheat and rice management, livestock problems and fish culture. Local songs were included at intervals during the broadcasts to entertain the listeners. Each of these programmes targeted a different audience, including women and Marginal farmers. However, more than a third of the broadcasts focussed on the needs of resource-rich, Food Surplus male farmers while only nine out of 68 topics were concerned with the specific interests of women.

During the planning workshop the NARC team had been advised to form "listeners' groups" and provide small radios to these groups in order to ensure that the broadcasts were accessible to the poorest farmers (see Table 9.). These listeners groups were also supposed to provide a forum for discussion on the different broadcast topics and any issues raised by the farmers could then have been fed back to the scientists responsible for making the programmes. This would have enabled them to make any necessary clarifications or incorporate ideas for new programmes. Unfortunately, no radios were provided and instead a short survey was conducted in both Belwa and Benauli villages in April 2006, in order to determine the types of farmers who had been able to access the radio programmes. The results of this survey indicated that only three out of 18 farmers interviewed actually owned radios and out of the 10 farmers who had listened to the programmes at least once, eight of them had been sharing a radio with a friend or neighbour, see Table 11. Of the eight farmers who had not heard any of the programmes, seven said that they did not have access to radios and one, who owned a radio, said that she was unaware of the broadcasts, see Table 13. The farmers who had heard the programmes reported that those relating to vegetable production were the most popular and all farmers (representing all socio-economic groups) had tried out practices that they had learnt from the radio, ranging from minimum tillage, surface seeding, bed planting, intercropping and vegetable production to the use of neem to control pests, see Tables 11 and 12.

Table 10: Calendar of FM-Birganj Krisi radio programmes for farmers

Date	Program subject	Presenter	Target audience
Mar 14	Wheat Harvesting by Reaper /Harvester	G Sah	Food surplus men
21	Moongbean cultivation	K P Bhurer	Men, women, all groups
28	Direct Seeded Rice by Drum Seeder	G Sah	Men, all groups
Apr 4	Direct Seeded Rice by Power Tiller Drill	G Sah	Food surplus, Subsistence men
11	Nursery Management for Vegetables	S L Shrestha	Women
18	Insect Management in Bhindi Crop	A R Ansari	All groups
25	Sugarcane Production Technology	K P Mahato	Food surplus men
May 2	Insect Management in Rice Nursery bed	A R Ansari	Men, all groups
9	Improved Mushroom Cultivation Technology	PCP Chaurasiya	Women, men all groups
16	Poultry Production a Profitable Business	Sagar Paudel	Food surplus men
23	Insect Management in Rice Nursery bed	A R Ansari	Men, all groups
30	Early Vegetable Production in Terai	S L Shresth	Women
Jun 6	Nutrient Management in Rice Cultivation	D Adhikari	All groups
13	Utilities of Power tiller and its Maintenance	G Sah	Men, all groups
20	Mastitis problem in Cattle and its control	J P Yadav	Food surplus men
27	Agricultural Biodiversity	R B Yadav	Men, women, all groups
Jul 4	Rice Varietal Selection	T Akhtar	Men Food surplus, Subsistence
11	Rice Production Technology	T Akhtar	Food surplus men
18	Integrated Weed Management in Rice	K P Bhurer	Men, women, all groups
25	Posterior Paralytic Syndrome in Sheep and Goat	B P Kushwaha	Men, women, all groups
Aug 1	Fish Production Technology in Rice	K K Srivastav	Food surplus men
8	Rice Seed Production Technology	B P Singh	Women
15	Fruit Nursery Production and Orchard Establishment	S L Shrestha	Food surplus men
22	Irrigation Water Management in Rice	G Sah	Food surplus, Subsistence men
29	Community Seed Bank	Shrestha, NGO	Women
Sept 5	Main Rice diseases and their control	B N Mahato	Men, all groups
12	Main Diseases of Sugarcane and their control	K.P. Mahato	Food surplus, men
19	Improved cultivation practices of mustard, rapeseed	K P Bhurer	All groups
26	Need of Women Participation in Agril. Mechanisation	G.Sah	Women
Oct. 3	Rajma Cultivation for Improved Health and Income	K P Bhurer	Men, all groups
10	Improved Practices for Commercial Banana Cultivation	S L Shrestha	Food surplus men
17	Importance of Reaper-Harvester for Rice Cultivation	G Sah, NARC	Food surplus men
24	Technology for Green Onion Vegetable Production from setts	Ram Bahadur	All groups
31	True Potato Seed Production Technology	S L Shrestha	Food surplus, Subsistence men
Nov 7	Boro Rice : Blessings for farmer	K P Bhurer	Marginal men, women
14	Potato Production Technology	R L Sah	Food surplus, Subsistence men
21	On-farm Wheat Seed Production Technology	B.P Singh	Marginal women
28	Operation, Repair, Maintenance and Precautions during PT Operation	G Sah	Food surplus men
Dec. 5	Services Provided by RARS Parwanipur, Bara	RB Prasad	All groups
12	Improved Maize Cultivation Technology	RP Yadav	Food surplus men
19	Improved Wheat Cultivation Practices	JJ Tripathi	Men, all groups
26	Integrated Weed Management in Wheat	KP Bhurer	Men and women, all groups
Jan 2	Wheat Research and Development in Nepal	MR Bhatta	Men, all groups
9	Irrigation Water Management in Wheat	G Sah	Food surplus men
16	Post Harvest Losses and Control for Vegetables	SL Sherstha	Women
23	Rice Post Harvest Loss Reduction Technologies	IP Upadhyay	Women
30	Insect, Pest Control In Chick Pea	BB Achhami	Food surplus men
Feb. 6	Balanced Ration For Cattle and Buffalos	YP Yadav	Food surplus, Subsistence men
13	Major Wheat Diseases and their Control	PC Chaurasiya	Men, all groups
20	Need of Women Participation in Agril. Mechanization (Repeated)	G.Sah	Women
27	Micro-Organisms in Soil and Their Role in Improving Soil Fertility	D Adhikari	Food surplus men
Mar 6	The Point to be Noted for The Application of Herbicides	BB Achhami	Food surplus men
13	Management Technology for The Fish Seed Production	KK Shrivastav	Food surplus men
20	Advance Technology for The Production of Bhindhi in Nepal	RL Sah	Food surplus men
27	Micro Nutrient and Its Use in Vegetables	D Adhikari	All groups
April.3	Integrated Pest Management	BB Achhami	Men, all groups
10	Breeding of Chinese Carp Fish	KK Srivastav	Men, all groups
17	International and National Rice-A Review	BMS Basnet	Men, all groups
24	Improved Technols for Reducing Storage Losses in Wheat and Pulses	IP Upadhyay	Men, women, all groups
May 1	Combine Harvester for Harvesting and Threshing of Rice and Wheat	G. Sah	Male Food surplus
8	Introduction to Major Insect pests of Cucurbits and their Control	BB Aachhami	Women
15	Parasites of Goats and their Control Measures	S Poudel	Men, women, all groups
22	Direct Seeding of puddled Rice by Drum Seeders (repeat)	G. Sah	All groups
29	Direct Seeding of Rice by Chinese Seed Drill and Zero Till Seed Drill	G. Sah	Food surplus men
Jun 5	Management of Green Fodder and Forage Grass to meet livestock demand	S Poudel	Food surplus, subsistence, men
12	Direct Seeding of Rice by Chinese Seed Drill and Zero Till Seed Drill (Repeat)	G. Sah	Food surplus men
19	Direct Seeding of Rice by Drum Seeders (Repeat)	G.Sah	All groups
26	Sugarcane Production Technology	KP Mahato	Food surplus men

Table 11: Socio-economic grouping of farmers who listened to the broadcasts

Farmers' name	Religion/ Caste	Socio-economic group	Gender	Village	Radio access	Family size			Landholding ha		Reported Rice self-sufficiency	Total paddy requirement (kg)	RSSI (%)
						<10yrs	10-18yrs	>18yrs	Owned	Leased			
Basmati Dahait	Tharu	Food surplus	Female	Belwa	Owns	5	3	12	5.33	3.33	12	6,117	357
Samsad Ansari	Muslim	Food surplus	Male	Belwa	Shares	5	0	6	1.7	0.3	12	3,105	224
Gauri Devi	Tharu	Subsistence	Female	Belwa	Shares	3	2	3	1.05	0	12	2,192	196
Rameshwar Sah	Kanu	Subsistence	Male	Belwa	Owns	4	1	4	1	0	12	2,466	166
Drub Mandal	Dhanuk	Marginal	Male	Belwa	Shares	2	1	2	0.3	0	8	1,370	90
Lalita Devi Belwa	Teli	Marginal	Female	Belwa	Owns	0	3	6	0.6	0.45	6	3,012	82
Sukai Yadav	Yadav	Marginal	Male	Benauli	Shares	0	1	2	0.1	1.7	7	1,004	41
Laxman Sah	Kalwar	Marginal	Male	Benauli	Shares	4	1	5	0.15	0.33	7	2,831	22
Roz Mohammad Hawari	Muslim	Marginal	Male	Benauli	Shares	4	2	4	0.05	0.33	2	2,740	7
Kolai Mahato	Dhanuk	Landless	Male	Belwa	Shares	3	0	6	0	0.33	2	2,739	0

Table 12: Interests of farmers who listened to the broadcasts

Farmer name	Socio-economic Group	Gender	Village	Programmes listened to	Tried out new practises
Basmati Dahait	Food surplus	Female	Belwa	Vegetable. production + weed, fertiliser and pest management	Production of summer vegetables
Samsad Ansari	Food surplus	Male	Belwa	PT use	Minimum till wheat with PT
Gauri Devi	Subsistence	Female	Belwa	Soil fertility management, vegetable production	Insect control in rice, use of neem
Rameshwar Sah	Subsistence	Male	Belwa	Fertiliser use, poultry, fish farming, intercropping potato	Intercropping beans and potato
Drub Mandal	Marginal	Male	Belwa	Wheat storage technologies	None so far
Lalita Devi Belwa	Marginal	Female	Belwa	Vegetable production, pest management	Bed planting, use of neem
Sukai Yadav	Marginal	Male	Benauli	Vegetable and wheat production	Surface seeding of wheat
Laxman Sah Kalwar	Marginal	Male	Benauli	Vegetable production	Vegetable production
Roz Mohammad Hawari	Marginal	Male	Benauli	Rice, wheat, potato and vegetable production	Bed planting of cowpea, onion and chillies
Kolai Mahato	Landless	Male	Belwa	Vegetable production	Potato, onion, tomato cultivation

Table 13: Farmers who did not listen to the radio broadcasts

Farmer name	Religion/ caste	Socio-economic group	Gender	Village	Radio access ?	Family size			Landholding ha		Reported Rice self-sufficiency (months)	Total paddy requirement kg	RSSI (%)	Reason for not listening
						<10yrs	10-18yrs	>18yrs	Owned	Leased				
Rashid Ansari	Muslim	Food surplus	Male	Belwa	No	3	0	4	1.3	1.3	12	2,009	265	No radio
Mahadev Dahait	Tharu	Food surplus	Male	Belwa	No	2	0	3	0.9	0.5	10	1,461	253	No radio
Sonaparti Devi	Barai	Marginal	Female	Belwa	No	6	1	8	1	2.35	12	4,292	96	No radio
Girija Prasad Yadav	Yadav	Marginal	Male	Benauli	No	2	2	3	0.4	0	8	2,009	82	No radio
Uma Devi	Plains orig	Marginal	Female	Belwa	Owns	7	1	8	0.65	0	7	4,475	60	Unaware
Bhagat Prasad Yadav	Yadav	Marginal	Male	Benauli	No	1	1	2	0.15	0	4	1,187	52	No radio
Kunta Devi Yadav	Yadav	Marginal	Female	Benauli	No	3	1	1	0.05	0	5	1,188	17	No radio
Aisa Khatun	Muslim	Marginal	Female	Benauli	No	5	1	5	0.05	0.33	3	3,014	7	No radio

2.2 Conclusions and recommendations

The knowledge mapping exercise indicated that poor farmers have the least access to information concerning agricultural technologies, particularly that concerning the benefits of using the PT. The converse is true in the case of women, as it is those from the richest households who have least information. This is because women in the Terai region gain respect by shunning agricultural work. When the Nepali team was tasked with suggesting ways of unblocking knowledge pathways for the poorest groups they highlighted the need to use the media, work with local NGOs and extension workers, focus on the needs of Marginal farmers (including women) and influence policy-makers. They then drew up a comprehensive Action Plan for achieving Outputs two and three of this project, see Table 9.

According to this Action Plan the Nepali team intended to unblock knowledge pathways for the poorest farmers by providing 20 low cost FM/AM radios to each women's group, preparing and broadcasting a series of 30 minute radio programmes on agricultural technologies and obtaining feed-back from farmers in the listeners' groups.

Unfortunately radios were not provided to any of the farmers, but the radio broadcasts went ahead as planned. The short survey of radio listeners and non-listeners that followed these broadcasts showed that FM radio can be used as an effective tool to unblock knowledge pathways for all socio-economic groups, including women who may be confined to the homestead. By carefully selecting the topics and broadcasting the information at a time when most people are at home, the NARC scientists were able to motivate farmers to try out several new practises. Many of these programmes are now being repeated in an effort to reinforce the learning process. In future more stress could be put on topics relating to the use of technologies that are appropriate to farmers, including women, who have limited resources and the creation of a system which allows farmers to feed-back their views on the programme content.

Output 3: "New technical innovations evaluated and developed by communities at pilot sites and enabling environments (including local manufacture, micro-finance, input access and training) established for participatory technology development"

3.1 Creating an enabling environment

3.1.1. Influencing policy-makers to improve access and control of PTs for the poorest farmers

It was recognised that access to PTs ultimately depends on government policy in terms of the removal of import tariffs and the reduction of interest rates on loans. The biggest barrier to Marginal and Landless farmers taking control of these machines is the banks' need for collateral in the form of land.

In order to raise some of these issues with local policy-makers, a meeting was held with eleven of the local agricultural machinery suppliers on 23rd December 2005. The full list of participants at the meeting is shown in Table 14. The following issues were discussed at this meeting:

- The importance of agricultural machinery for Nepalese farmers
- The types of machines available
- Availability of spare parts
- The need for more information about the latest machines
- High prices of machinery compared with neighbouring states
- High custom duties on imported spare parts
- High interest charged on loans for farmers who want to purchase machines
- Possibility of local manufacture of spare parts
- Difficulty of obtaining a license to drive a PT on the road and high charges for renewal

Table 14:
Machinery supplier and researcher interaction meeting

No.	Supplier's Name	Position	Business Address
01	Mr. Umesh Manandhar	Proprietor	Havi Auto Trading Birganj
02	Mr. Pushpa Prasad amatya	Manager	,,
03	Mr. Mukul Bikram Shah	Manager	Kedia SAME PVT, Ltd
04	Mr. Mukesh Sarawagi	Proprietor	Nepal Standard Tractor, Birganj
05	Mr. Bijay Kumar Thakur	Manager	Nepal Trade and Service Link, Birganj
06	Mr. Devendra Bhakta Shrestha	Field officer	Bhajuratna Engineering and Sales Pvt Ltd
07	Mr. Hariman Shrestha	Manager	,,
08	Mr. Arvind Kumar Mandal	Field officer	Rohit Enterprises, Birganj
09	Mr. Firoj Khan	Field officer	Tulsyan Tractors, Birganj
10	Mr. Basant Raj Sharma	Field officer	MAECO International, Birganj
11	Mr. Subhash Shrestha	Branch Manager	Agni Incorporated Pvt Ltd
12	Mr. Shardananda Chaudhary	Field officer	,,
13	Mr. Bishnu Pd. Patel	Field office	,,
14	Mr. Deepak Manandhar	Field officer	,,
15	Mr. Bineshwar Panjiyar	Field officer	,,
16	Mr. Vedprakash sharma	Field officer	,,
17	Mr. Sheetal Pd. Mahato	Representative	RSS, Birganj
18	Mr. Ambikacharan Srivastav	Senior scientist	RARS, Parwanipur

The participants resolved to request incentives from the Nepali Government to assist the suppliers in their efforts to import new machines. However, it is not clear how the participants intended to address the vital issues of high interest rates on loans and the need for collateral.

3.1.2 Enabling Marginal and Landless farmers access/gain control of PTs

According to the agreed Action Plan (see Table 9.) the Nepali team planned to create an enabling environment to improve access and control of the PT and high yielding wheat varieties by conducting the following activities:

- Training women from mainly Marginal and Landless farming families to grow vegetables as an income-generating enterprise
- Training mainly Marginal and Landless farmers in PT maintenance and repair as an income-generating enterprise
- Involving Marginal farmers in varietal selection of wheat

3.1.3 Providing training for women to produce vegetables as an income generating project and improve their access to the PT

Under Output One it was noted that new technologies, i.e. PTs and improved seed, had not had any impact on women farmers in either Belwa or Benauli: Few women had been involved in the User Groups and the women had been unable to access the PTs once they were privatised because they were too poor to pay the hire charge. In order to help alleviate this poverty it was intended that a minimum of 50% of Marginal and Landless farmers should be trained in vegetable production. In addition to improving household food security and alleviating poverty, the profits from this enterprise could also be used to pay for a PT tillage service.

In the event 53% of the women selected for this training were from Food Surplus or Subsistence households in Belwa and 65% were from these socio-economic groups in Benauli (see Tables 14 and 16). In Belwa 65% of the women were from the *Tharu* caste, see Box 3, while in Benauli 65% were from the *Yadav* caste, see Box 4. No Muslim women were included in the training in either village.

Box 3: Comparative numbers of Muslim and Hindu households in Belwa village

Belwa village

No. of Muslim households: 80 (52%)

No. of Hindu households: 74 (48%)
Main castes

- *Tharu* (Farmer) households: 10 (7%)
- *Yadav* (Milkman) households: 10 (7%)
- *Kanu* (Sweetmaker) households: 8 (5%)
- *Dhanuk* (Servant) households: 8 (5%)
- *Massahar* (Landless/Labourer) households: 10 (7%)

In Belwa, the Marginal women farmers belonged to households that had RSSIs of between 46 and 92%, the Subsistence women farmers belonged to households that had RSSIs of between 112 and 180%, while the women from Food surplus households enjoyed between 218 and 646% of their annual rice requirement, see Table 15.

In Benauli, the Marginal women farmers came from households that had RSSIs ranging from 10 to 63% the Subsistence women farmers were from households which ranged from 112 to 159% while the women from Food Surplus households had an average of between 242 and 1,106% of their annual rice requirement, see Table 17.

Box 4: Comparative numbers of Muslim and Hindu households in Benauli village

Benauli village

No. of Muslim households: 10 (5%)

No. of Hindu households: 176 (95%)

Main Hindu castes

- *Kalwar* households: 82 (47%)
- *Yadav* (Milkman) households: 65 (37%)
- *Kanu* (Sweet-maker) households: 3 (2%)
- *Dusadh* households: 12 (7%)
- *Mallah* (Fisherman) households: 7 (4%)
- *Brahmin* (Priest) households: 1 (1%)
- *Hajam* households: 1 (1%)
- *Giri* households: 1 (1%)

Two-day training sessions in vegetable production were held in August 2004 and two female Food Surplus farmers: Janaki Devi Gauro in Belwa and Radhika Devi Yadav in Benauli, were able to further increase their *social capital* by being selected to host small demonstration plots on their land. In Belwa the women farmers were keen to grow brinjal, cauliflower and tomato during the winter and bottle, sponge and bitter gourds in the summer to sell in the local market. The training focused on the production of early vegetables to enable the women gain higher prices.

Fig. 8. Women assessing a brinjal crop in Benauli

Five women in Belwa and three women in Benauli retained all the vegetables that they produced over the whole season for home consumption. The rest of the women sold varying amounts of produce and gained incomes ranging from Rs.1,000 (USD17) to Rs.50,000 (USD833) in Belwa village and ranging from Rs.300 (USD5) to Rs.5,000 (USD83) in Benauli village. In Belwa the Marginal farmers who sold their vegetables gained the mean equivalent of Rs.83,571 (USD1,393) per ha, while the Subsistence and Food Surplus farmers gained an mean equivalents of Rs.8,200 (USD137) and Rs.40,833 (USD681) respectively. In Benauli all three socio-economic groups of women vegetable producers gained mean incomes of just over Rs.22,000 (USD367) per ha. The wide differences between the mean incomes for the farmers in each of the two villages can be explained by the fact that there are many more opportunities for marketing vegetables in Belwa because of its proximity to the town of Birgunj and the passing trade from factory workers. It is clear that the poorest group of women farmers in Belwa took the most advantage of these marketing opportunities and gained the highest incomes from their produce, see Table 16.

Table 15: Training women in vegetable production in Belwa: Comparative RSSI of their households

Women farmers	Religion/ caste	Socio-economic group	Family size			Reported rice self-sufficiency (months)	Annual paddy requirement	Landholding (ha)	RSSI %
			<10yrs	10-18yrs	>18yrs				
Jhagari Devi Gauro	Tharu	Marginal	1	5	8	6	4,473	0.5	46
Lalita Devi Gauro	Tharu	Marginal	3	0	3	5	1,644	0.2	50
Shanti Devi Gauro	Tharu	Marginal	1	1	2	3	1,187	0.15	52
Nagiya Devi Mahato	Koiri	Marginal	2	0	6	10	2,556	0.4	64
Lalita Devi Sah	Kanu	Marginal	0	2	4	12	2,008	0.35	71
Phula Devi Sah	Teli	Marginal	4	1	2	6	1,736	0.35	83
Lalmati Devi Das	Tharu	Marginal	3	3	5	10	3,196	0.65	83
BhagiyaDevi Mahato	Koiri	Marginal	1	0	5	10	2,008	0.45	92
	Means:	Marginal	2	2	4	7.8	2,351	0.38	68
Manamati Devci Das	Tharu	Subsistence	4	0	3	6	1,827	0.5	112
Jagiya Devi Dahait	Tharu	Subsistence	7	8	10	12	7,123	2.0	115
Gayatri Devi Gauro	Tharu	Subsistence	1	2	4	10	2,191	0.85	159
Ramrati Devi Mahato	Koiri	Subsistence	3	1	4	12	2,283	1.0	180
	Means:	Marginal	4	3	5	10	3,356	1.1	142
Shila Devi Sah	Teli	Food surplus	4	1	6	12	3,196	1.7	218
Gauri Devi Dahait	Tharu	Food surplus	4	1	3	12	2,101	1.35	263
Basmati Devi Dahait	Tharu	Food surplus	4	7	13	12	7,395	6.65	369
Janaki Devi Gauro*	Tharu	Food surplus	4	0	7	12	3,287	3.35	418
Laxmi Devi Das	Tharu	Food surplus	3	4	14	12	6,755	10.65	646
	Means:	Food surplus	3	3	9	12	4,547	4.74	309

*Hosted demonstration plot

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

Table 16: Impact of training in vegetable production on household income and ability to hire a PT in Belwa

Women farmers	Religion/ Caste	Socio-economic groups	RSSI %	Area of Vegetables Grown (ha)	Income from veg (Rs)	Income per ha (Rs)	New assets bought with profits	Tillage method 1st season	Tillage method 2nd season	Why PT not used to till vegetable plot
Jhagari Devi Gauro	Tharu	Marginal	46	0.1	4,900	49,000	Roof tiles	PT	4 wheel tractor	Not available
Lalita Devi Gauro	Tharu	Marginal	50	0.25	50,000	200,000	Daughter's wedding	PT	PT	-
Shanti Devi Gauro	Tharu	Marginal	52	0.01	1,000	100,000	Household items	PT	Ox plough	Not available
Nagiya Devi Mahato	Koiri	Marginal	64	0.15	5,500	36,667	Purchased land	Ox plough	Ox plough	Not available
Lalita Devi Sah	Kanu	Marginal	71	0.33	Not sold	-	None	4-wheel tractor	4 wheel tractor	Not available
Phula Devi Sah	Teli	Marginal	83	0.15	20,000	133,333	Paid land owner	Ox plough	Ox plough	Not available
Lalmati Devi Das	Tharu	Marginal	83	0.1	5,000	50,000	Household items	4-wheel tractor	4 wheel tractor	Not available
Bhagiya Devi Mahato	Koiri	Marginal	92	0.2	3,200	16,000	Furniture	Ox plough	Ox plough	Not available
	Means:	Marginal	68	0.16	12,800	83,571				
Manamati Devci Das	Tharu	Subsistence	112	0.25	1,350	5,400	Cosmetics	4-wheel tractor	4 wheel tractor	Not available
Jagiya Devi Dahait	Tharu	Subsistence	115	0.25	Not sold	-	None	PT	4 wheel tractor	Not available
Gayatri Devi Gauro	Tharu	Subsistence	159	0.2	Not sold	-	None	PT	Ox plough	Not available
Ramrati Devi Mahato	Koiri	Subsistence	180	0.1	1,100	11,000	Paid land owner	Ox plough	Ox plough	Owns bullock
	Means:	Subsistence	142	0.2	1,225	8,200				
Shila Devi Sah	Teli	Food surplus	218	0.1	6,575	65,750	Fertilisers	Ox plough	Ox plough	Owns bullock
Gauri Devi Dahait	Tharu	Food surplus	263	0.25	Not sold	-	None	None	Ox plough	Not available
Basmati Devi Dahait	Tharu	Food surplus	369	0.15	Not sold	-	None	None	Ox plough	Not available
Janaki Devi Gauro	Tharu	Food surplus	418	0.1	4,800	48,000	Rabbits	4-wheel tractor	4 wheel tractor	Owns tractor
Laxmi Devi Das	Tharu	Food surplus	646	0.2	1,750	8,750	Household + cosmetics	PT	4 wheel tractor	Not available
	Means:	Food surplus	383	0.16	4,375	40,833				

Table 17: Training women in vegetable production in Benauli: Comparative RSSI of their households

Women farmers	Religion/ Caste	Socio-economic group	Family size			Reported rice self-sufficiency (months)	Total paddy requirement kg	Landholding ha	RSSI %
			<10yrs	10-18yrs	>18yrs				
Lalmati Devi Hajara	Dusadh	Marginal	3	0	4	1.5	2,009	0.05	10
Aysha Khtun	Hawari	Marginal	4	0	3	2	1,827	0.05	11
Sikil Devi Sah	Kalwar	Marginal	2	1	3	1	1,735	0.05	12
Rampati Devi Sah	Kalwar	Marginal	5	0	6	2	3,105	0.4	53
Shima Devi Sah	Kalwar	Marginal	4	1	5	2	2,831	0.4	58
Saraswoti Devi Yadav	Yadav	Marginal	10	5	9	9	6,485	1.0	63
	Means:	Marginal	5	1	8	3	2,999	0.33	35
Dipani Devi Yadav	Yadav	Subsistence	3	0	4	12	2,009	0.55	112
Shanti Devi Yadav	Yadav	Subsistence	6	4	6	12	4,384	1.35	126
Maina Devi Yadav	Yadav	Subsistence	6	2	6	12	3,836	1.35	144
Radhika Devi Yadav	Yadav	Subsistence	3	0	5	12	2,374	0.85	147
Jiyami Devi Yadav	Yadav	Subsistence	3	2	3	12	2,192	0.85	159
	Means:	Subsistence	4	2	5	12	2,959	0.99	138
Shail Devi Yadav	Yadav	Food surplus	5	1	3	12	2,284	1.35	242
Phulmati Devi Airin	Yadav	Food surplus	4	1	4	12	2,466	2.0	333
Mahapati Devi Yadav	Yadav	Food surplus	3	2	2	12	1,827	1.65	370
Radhika Devi Yadav*	Yadav	Food surplus	6	1	8	12	4,292	4.0	382
Maya Devi Sah	Kalwar	Food surplus	0	2	2	12	1,278	2.0	642
Koshila Devi Yadav	Yadav	Food surplus	4	1	4	12	2,466	6.65	1106
	Means:	Food surplus	4	1	4	12	2,436	2.94	513

*Hosted demonstration plot

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

Table 18: Impact of training in vegetable production on household income and ability to hire a PT in Benauli

Farmer	Religion/ Caste	Farmer type	RSSI %	Area of Vegetables (ha)	Income from veg. Rs	Income per ha (Rs.)	New assets bought with profits	Tillage method in 1st season	Tillage method in 2nd season	Why PT not used to till vegetable plot
Lalmati Devi Hajara	Dusadh	Marginal	10	0.05	1,500	30,000	Household items	Ox plough	Ox plough	Not available
Aysha Khtun	Hawari	Marginal	11	0.2	1,000	5,000	Medical treatment	Ox plough	Ox plough	Not available
Sikil Devi Sah	Kalwar	Marginal	12	0.15	4,300	28,667	Fertilisers	4-wheel tractor	4-wheel tractor	Not available
Rampati Devi Sah	Kalwar	Marginal	53	0.1	4,750	47,500	Household items	Ox plough	Ox plough	Not available
Shima Devi Sah	Kalwar	Marginal	58	0.03	Not sold	-	None	Ox plough	Ox plough	Not available
Saraswoti Devi Yadav	Yadav	Marginal	63	0.2	500	2,500	Household items	Ox plough	Ox plough	Not available
	Means:	Marginal	35	0.12	2,410	22,733				
Dipani Devi Yadav	Yadav	Subsistence	112	0.07	4,000	57,143	Fertilisers + household items	Ox plough	Ox plough	Not available
Shanti Devi Yadav	Yadav	Subsistence	126	0.1	2,800	28,000	Stocked shop	Ox plough	Ox plough	Not available
Maina Devi Yadav	Yadav	Subsistence	144	0.2	500	2,500	Household items	Ox plough	Ox plough	Not available
Radhika Devi Yadav	Yadav	Subsistence	147	0.1	700	7,000	Household items	Ox plough	Ox plough	Not available
Jiyami Devi Yadav	Yadav	Subsistence	159	0.2	Not sold	-	None	Ox plough	Ox plough	Owns bullock
	Means:	Subsistence	138	0.13	2,000	23,661				
Shail Devi Yadav	Yadav	Food surplus	242	0.05	900	18,000	Household items	Ox plough	Ox plough	Not available
Phulmati Devi Airin	Yadav	Food surplus	333	0.1	5,000	50,000	Fertilisers + household items	Ox plough	Ox plough	Not available
Mahapati Devi Yadav	Yadav	Food surplus	370	0.07	1,500	21,429	Livestock	Ox plough	Ox plough	Not available
Radhika Devi Yadav	Yadav	Food surplus	382	0.2	300	1,500	Household items	Ox plough	Ox plough	Not available
Maya Devi Sah	Kalwar	Food surplus	642	0.03	Not sold	-	None	Ox plough	Ox plough	Not available
Koshila Devi Yadav	Yadav	Food surplus	1106	0.1	2,000	20,000	Goat	4-wheel tractor	4-wheel tractor	Owns tractor
	Means:	Food surplus	513	0.09	1,940	22,187				

Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

The women used the income from selling vegetables to purchase mainly household items, school fees, clothes, fertilisers and small-scale livestock. One woman in Belwa was able to use the Rs.50,000 that she raised from a 0.25ha plot to pay for her daughter's wedding, while a woman in Benauli was able to pay for medical treatment, see Tables 16 and 18. The training of women in vegetable production thus had a high impact on all socio-economic groups, see Fig.12.

Improving women's access to the PT

In Belwa, during the first season, six women were able to hire a PT to cultivate their land prior to planting their vegetables, at a cost of Rs.200 per hour. The other 12 women either used oxen at a cost of Rs.250 per day (Rs.3,000 per ha) or hired a 4-wheel tractor, at a cost of Rs.2,800 per ha, to plough the land. The following season, despite having regular cash incomes from vegetable production only one of the women, Lalita Devi Gauro, was able to hire a PT to cultivate her plot. This may have been due to the shortage of power tillers and the fact that, so far, these machines are all controlled by men.

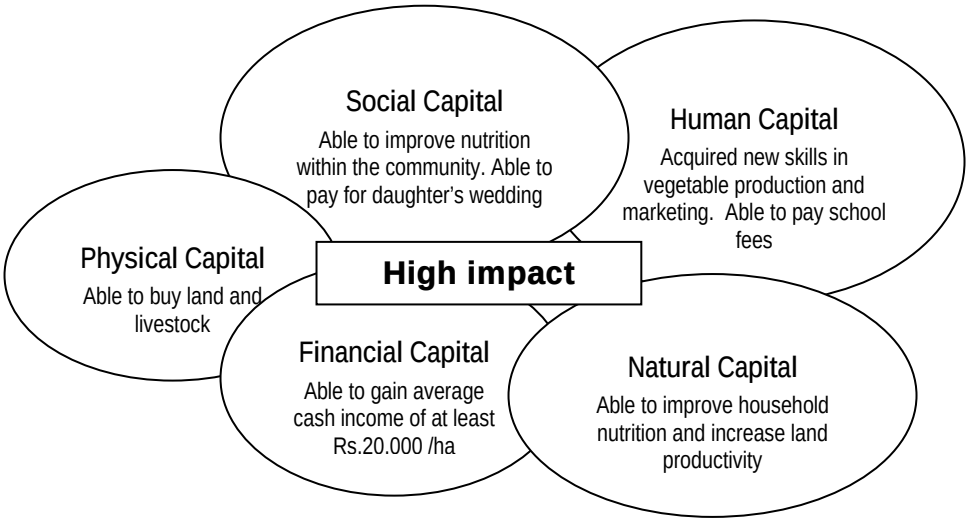
In Benauli, none of the women used a PT to cultivate their land either for the first or the second planting and instead used mainly oxen, at a cost of Rs.3,000 per ha, or in two cases a 4-wheeled tractor, at a cost of Rs.2,800 per ha. The women failed to access a PT in Benuali because there are only two PTs available for hire in this village, and again, the men take priority.

Fig. 9. Lalita Devi

Fig. 10. Sikil Devi

Fig. 11. Jhagari Devi

Figure 12.
Impact of training in vegetable production on the Livelihoods of women in Belwa and Benauli



3.1.4 Providing training for mainly Marginal and Landless farmers in the operation, maintenance and repair of PTs

In order to facilitate an enabling environment to encourage the purchase of more PTs and enable poorer farmers to benefit financially from the provision of a PT maintenance and repair service, the Nepalese team planned to provide a training course for 40 farmers. According to their Action Plan this training would focus on the operation, maintenance and repair of PTs and involve local farmers from six districts in the Terai region, including 50% Marginal and Landless farmers, see Table 9.

In the event no Landless farmers were selected for this training and only three out of twenty were Marginal farmers, however, six of the participants were Subsistence and eleven (55%) were Food Surplus farmers, see Table 19. Eight of the Food Surplus farmers already owned PTs, while one of them owned a 4-wheel tractor. All the Marginal farmers who participated in this training were said to be labourers who were employed by the PT owners.

Despite being committed to enabling Marginal and Landless farmers to become established as PT mechanics in their own right, during the planning workshop the NARC team was unable to follow through on this activity: By selecting mainly Food Surplus farmers and their labourers for the mechanics' training course, the opportunity of improving the livelihoods of Marginal and Landless farmers as independent service providers was missed. As a result this training exercise had a low/no impact on the livelihoods of Marginal and Landless farmers in the Terai region, see Fig. 13.

Figure 13.
Impact of training in PT maintenance on the Livelihoods of Marginal and Landless farmers in the Terai region

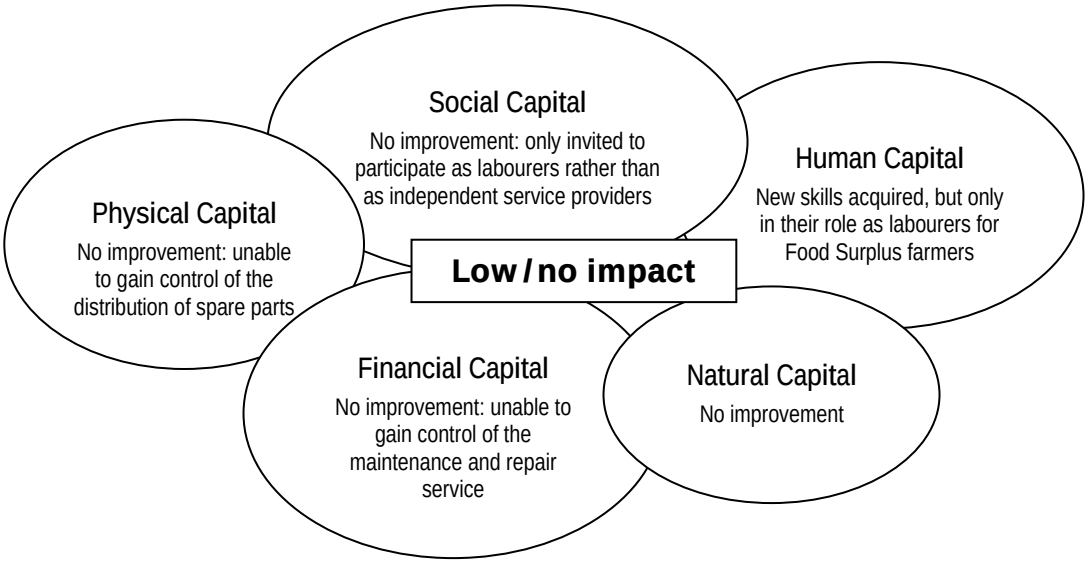


Table 19: Farmers trained in the operation, maintenance and repair of PTs

Farmer name	Religion /caste	Village, District	Socio-ec group	Family size			Total paddy requirement kg	Landholding ha	RSSI %
				<10	10-18yrs	>18			
Gokul Bidari	Brahman	Hetauda11, Makwanpur	Marginal	0	3	3	1,908	0.33	71
Om Prakash Kushwaha	Koiri	Hariharpur-8,	Marginal	2	1	6	2,830	0.65	94
Gajendra Chaudhari	Tharu	Santpur-1, Rautahat	Marginal	2	1	2	1,370	0.33	99
Sugriblal Mandal	Dhanuk	Bahuwari Pidari-2, Parsa	Subsistence	3	1	5	2,648	0.65	101
Surya Nath Mahato	Koiri	Tulsiyahi Jabdi-3, Dhanusha	Subsistence	1	2	3	1,826	0.65	146
Binod Nayak	Tatma	Tulsiyahi Jabdi-2, Dhanusha	Subsistence	1	2	8	3,651	1.35	152
Govind Adhikari	Brahman	Santpur-3, Rauthat	Subsistence	2	2	5	2,739	1.1	165
Mahamud Alam	Dewan	Parsurampur-5, Bara	Subsistence	3	1	2	1,553	0.7	185
Sanalal Prasad	Kurmi	Biranchibarwa-7, Parsa	Subsistence	8	0	8	4,384	2.0	187
Ramakant Chaudhari	Tharu	Sukhipathara-7, Bara	Food surplus	1	2	4	2,191	1.35	253
Birendra Mahato	Dhanuk	Bhawanipur-8, Parsa	Food surplus	5	0	6	3,105	2.0	264
Amirak Chaudhari	Tharu	Santpur-9, Rautahat	Food surplus	0	2	3	1,643	1.1	274
Laxman Chaudhari	Tharu	Santpur-7, Rautahat	Food surplus	5	0	6	3,105	2.35	310
Rajkishor Tiwari	Brahman	Hariharpurbirta-2, Parsa	Food surplus	4	2	7	3,835	3.35	358
Dipendra Pd Sah	Teli	Sukhipatahara-5, Bara	Food surplus	4	1	6	3,196	3.35	430
Hulas Chandra Chaudhari	Tharu	Hadiya-7, Udaypur	Food surplus	2	0	2	1,096	1.2	449
Birendra Kumar Sah	Teli	Kachorwa-7, Bara	Food surplus	2	2	7	3,469	4.0	473
Shambhu Mahaseth	Sudi	Tulsiyahi Jabdi-4, Dhanusha	Food surplus	7	3	11	6,118	8.65	580
Shatrughna Pd Vijayi	Teli	Kachorwa-9, Bara	Food surplus	2	1	6	2,830	4.65	674
Mukesh Kumur Sah	Kalwar	Paltuwa-9, Rautahat	Food surplus	3	0	9	3,834	7.65	818

50 Data collected by Ganesh Sah & team. Analysed & compiled by Sam Page, CABI Europe, March 2007.

3.1.5 How a Marginal farmer is benefiting from being in control of a PT

Fig. 14. Md Manir Miyan with his PT, seed drill and trailer

Md. Miyan was a Marginal farmer, whom we met by chance in Belwa village during the data collection exercise for Output One. Although this farmer had not been included in any of the PT User Groups he had gone ahead and set up his own business, providing a tillage and transportation service for local farmers. Md Miyan told us that in order to purchase a PT from a local distributor, he was required to give his total landholding of 0.7 ha as collateral and a deposit of Rs.30,000 before he could obtain a loan of Rs.70,000 from the local bank. Initially he repaid this loan at a rate of Rs.10,000 per 6 months, plus interest at Rs.1,100 per month. This has now been reduced to Rs.700, including interest at a rate of 12.5% per year. He expects to repay this loan within 3 years.

Md Miyan was asked to provide information on his income and expenditures over a three month period, between 1st November and 31st January, when the land is being prepared for boro rice or wheat, so that the profitability of his enterprise could be assessed. During this time he charged Rs.200 per hour to till dry soil for wheat and vegetable production and Rs.250 per hour to prepare wet soil for rice production. Farmers paid Rs.300 per hour for him to seed their crops using the seed drill, attached to the power tiller. They also paid Rs.70 for their produce to be transported from field to homestead and Rs.25 per quintel (100 Kg) to carry it to the local market in Jeetpur.

Md Miyan received an income of Rs.12,000 for providing a tillage service and Rs.35,000 for providing a seeding service to more than 100 neighbouring farmers during the three month period. He also gained Rs.36,000 from ferrying produce between the field, village and market during this time. His expenditures during the same period amounted to Rs.18,000 for fuel, repair and maintenance costs, Rs.4,500 for additional irrigation pump attachments and Rs.2,100 for loan repayments. As a result, Md Miyan made a net profit of Rs.58,400 (equivalent to USD973) over this three month period, see Table 20.

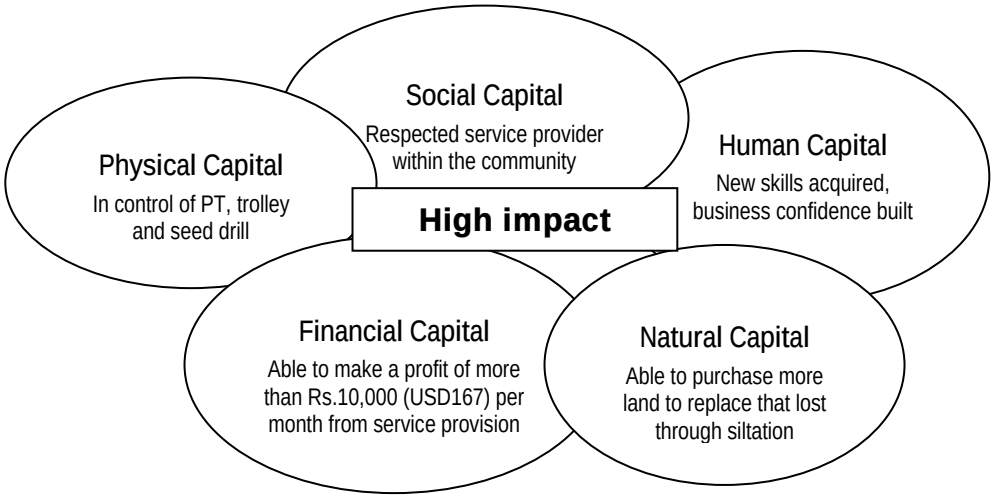
Table 20:
Md Manir Miyan's income and expenditures from his PT service during the period 1 Nov., 2005 to 31 Jan, 2006

Activity	Charge (Rs)	Income (Rs.)	Expenditure (Rs.)
Dry ploughing (PT only)	200/hr	0	
Soil puddling (PT only)	250/hr	12,000	
Seeding (PT + seed drill)	300/hr	35,000	
Transport (PT + trolley)	70/ trip (field to village) 25/quintel (village to market)	36,000	
Fuel costs			11,000
Repair and Maintenance			7,000
New attachment costs			4,500
Loan repayments	700/month		2,100
Total Income		83,000	
Total Expenditure			24,600
Profit:		58,400	

Unfortunately, Md Miyan has recently become landless because his land has been completely inundated by sand from the river. As a result, he and his family now depend solely on the income that they derive from providing a PT service for their survival.

Md Miyan's highly successful PT enterprise clearly demonstrates that, given favourable terms, Marginal or Landless farmers could both repay individual loans and make sufficient income for meeting household needs by providing a tillage and transportation service. Furthermore, once farmers with little or no land are able to control these machines this service will become increasingly accessible to all socio-economic groups of farmers. Figure 15 shows the high impact that the ownership of a PT is having on the livelihood of this Marginal farmer.

Figure 15.
Impact of owning a PT on the Livelihood of an enterprising Marginal farmer in Belwa



3.2 Improving access to improved seed for the poorest farmers

In research conducted under Output One it was discovered that the better-off, Food Surplus farmers had the best access to improved seed varieties, while Marginal farmers had very low access to improved seed due to reduced mobility, lack of information and poverty. In order to ameliorate this situation the Nepalese team decided to introduce a process of "participatory varietal selection".

Participatory varietal selection (PVS) is defined as a process of active and functional involvement of farmers in the planning, implementation, monitoring and evaluation of improved varieties and their promotion. According to CIMMYT, the main objective of the PVS process is to offer several new varieties to a wide group of farmers during an early stage in the varietal development process in a way that is systematic, cheap, relevant and is a low risk to farmers. The approach is simple and enables the participation and contribution of even the poorest farmers, see Box 5.

Box 5: A summary of guidelines for participatory varietal selection in Nepal

Methodology for implementing PVS, using "mother" and "baby" trials

In the "mother" trial, 6 - 10 new varieties are grown together as a single replicate in a central location within the village. This is often done with a progressive or wealthier farmer, who has a risk-bearing ability and has sufficient land on which to locate the trial.

In the "baby" trials, each of these new varieties are grown separately by individual smallholder farmers and compared with his/her own variety. Each farmer is provided with 0.5 to 1 kg of improved seed. Each baby trial is located between 20-30 minutes walking distance between each other to allow regular visits by all farmers.

Suggested pre-harvest traits to be assessed by farmers;

- Germination
- Plant height
- Disease tolerance
- Lodging tolerance
- Low inputs responsive
- Drought tolerance
- Maturity duration
- Ear size
- Ear compactness
- Production estimate
- Shade tolerance

Guidelines for the use of Mother-Baby trials in PVS, CIMMYT, Kathmandu, 2005

NARC scientists led by K. P. Bhurer conducted two PVS trials, one in Belwa village and one in Benauli village, in order to involve farmers in the wheat improvement process. The method used by these scientists involved tasking two Food Surplus farmers in Belwa (Anirudha Prasad Dahait and Abhaya Das) and two Food Surplus farmers in Benauli (Ram Jatan Yadav and Jawahir Prasad Yadav) with establishing "mother" trials on their land. These mother trials compared seven, elite, Bhairahwa breeding lines of wheat, namely BL2217, BL2047, BL2015, BL2064, BL2067, BL1968 and BL1473. This seed was provided to the Food Surplus farmers free of charge. Unfortunately, the poorest farmers were excluded from the on-going monitoring and evaluation process in both Belwa and Benauli, as this PVS method did not involve any "baby" trials on neighbouring farmers' land (see Box 5). Farmers were said to be "not interested because seed multiplication is too time consuming".

Table 21: Socio-economic grouping of farmers who participated in the PVS trial in Belwa 2004 – 2006

Farmer's name	Religion/ Caste	Socio-ec group	Gender	Family size			Landholding (ha)		Rice self-sufficiency (months)	Total paddy requirement (kg)	RSSI (%)	Off-farm employment
				<10yrs	10-18yrs	>18yrs	Owned	Leased				
Abhay Das*	Tharu	Food surplus	Male	5	0	12	20.0	0	12	5,295	1,549	None
Hriday Narayan Mahato	Teli	Food surplus	Male	0	3	4	1.7	0	12	1,082	644	None
Ramji Prasad Yadav*	Yadav	Food surplus	Male	2	4	4	3.0	0	12	2,922	421	Factory work: Rs 2,000/month
Rashid Ansari	Muslim	Food surplus	Male	3	0	4	2.0	1.7	12	2,009	408	None
Aniruddha Prasad Dahait*	Tharu	Food surplus	Male	5	3	12	5.3	3.3	12	6,117	355	Tillage service
Indradev Mahato	Dhanuk	Food surplus	Male	2	4	3	1.7	0	12	2,557	273	None
Ram Ayodhya Sah	Teli	Food surplus	Male	5	2	3	1.7	0	12	2,558	272	None
Shahid Miya	Muslim	Food surplus	Male	4	2	3	1.5	0	12	2,375	259	None
Jagarnath Sah	Yadav	Food surplus	Male	2	0	8	2.0	0.7	12	3,286	250	Trader
Samsaid Ansari	Muslim	Food surplus	Male	5	0	6	1.65	0.33	12	3,105	218	Carpenter: Rs 3000/month
Rameshwar Sah	Kanu	Subsistence	Male	4	1	4	1	0	12	2,466	166	Factory work: Rs 4,500/month
Parmanand Churasiya*	Barai	Subsistence	Male	3	3	6	1.0	1.33	12	3,552	115	Son works in factory
Mahadev Dahait	Tharu	Subsistence	Male	2	0	3	0.4	0.5	10	1,461	112	None
Gaya Mandal	Dhanuk	Marginal	Male	2	0	3	0.3	0	8	1,461	84	Labourer
Suryamani Dahait	Tharu	Marginal	Male	2	0	7	0.3	2.0	12	2,921	42	Business
Kolai Mahato	Dhanuk	Landless	Male	3	0	6	0	0.33	2	2,739	0	Labourer

* Farmers that hosted the PVS "mother" trials

Table 22: Socio-economic grouping of farmers who participated in the PVS trial in Benauli in 2004 - 2006

Farmer	Religion/ caste	Socio-economic group	Gender	Family size			Landholding (ha)		Rice self-sufficiency (months)	Total paddy requirement (kg)	RSSI (%)	Off-farm employment
				<10yrs	10-18yrs	>18yrs	Owned	Leased				
Chhotelal Sah*	Kalwar	Food surplus	Male	2	1	2	3.33	0	12	1,370	997	None
Anuthalal Yadav	Yadav	Food surplus	Male	5	1	8	4.0	0	12	4,109	399	None
Ram Jatan Yadav*	Yadav	Food surplus	Male	5	1	8	4.0	0	12	4,106	399	None
Jawahir Prasad Yadav*	Yadav	Food surplus	Male	6	1	5	3.0	0	12	3,194	385	None
Jaynarayan Prasad Sah*	Kalwar	Food surplus	Male	4	1	7	2.0	0	12	3,561	230	Shop keeper
Krishna Yadav	Yadav	Marginal	Male	2	2	10	1.1	0	12	4,564	99	None
Sitaram Yadav	Yadav	Marginal	Male	6	8	7	1.0	0.7	12	4,747	86	Teacher + shop-keeper
Krishna Sah	Kalwar	Marginal	Male	5	6	6	1.0	0	12	4,749	86	None
Bhagwat Prasad Yadav	Yadav	Marginal	Male	1	1	1	0.15	0	4	822	75	Labourer
Girija Prasad Yadav	Yadav	Marginal	Male	3	2	3	0.4	0	8	2,192	75	Labourer
Narayan Yadav	Yadav	Marginal	Male	4	0	3	0.3	0	9	1,827	67	None
Bharat Yadav	Yadav	Marginal	Male	5	0	2	0.2	0	6	1,645	50	Business
Sukai Yadav	Yadav	Marginal	Male	0	1	2	0.1	1.33	7	1,004	41	Labourer
Atmaram Yadav	Yadav	Marginal	Male	4	2	5	0.2	0.1	5	3,105	26	Labourer
Laxman Sah	Kalwar	Marginal	Male	5	1	5	0.15	0.33	7	3,014	20	Labourer
Roz Mohammad	Muslim	Marginal	Male	4	2	4	0.05	0.33	2	3,288	6	Butchery

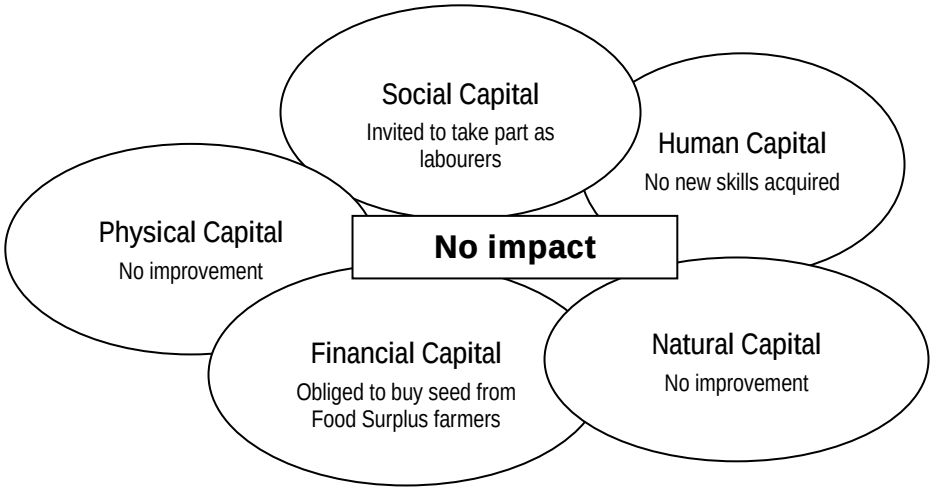
* Farmers that hosted the PVS “mother” trials.

Only when the crop had matured and ready for harvest did each of the host farmers invite other male farmers (mainly friends and employees) to assess the seven wheat lines in terms of three characters, i.e. lodging tolerance, straw length and grain size, on one day only. In Belwa the farmers who participated in this exercise were mainly Food Surplus, farmers, but also included three Subsistence, two Marginal and one Landless farmer. The Landless farmer and one Marginal farmer belonged to the *Dhanuk* caste and were employed as labourers by the host farmers, see Table 21. It was reported that Anirudha Prasad Dahait (the Food Surplus farmer hosting the PVS trial in Belwa) subsequently sold three quintels (300 kg) of each of the progeny of these elite lines as seed to neighbouring farmers and as a result gained an income of Rs.187,500 (USD3,125.00).

The PVS exercise in Benauli village was conducted in the same manner. In this case the one-day assessment involved eleven Marginal farmers; many of these men were employed as labourers on the PVS host farmers land, see Table 22.

Despite the clear intension of involving the poorest farmers, this PVS process benefited mainly Food Surplus farmers in Belwa, while in Benauli the Marginal farmers who were invited to take part in the one day varietal selection were mainly labourers who were employed by the host farmer, rather than independent, smallholder wheat farmers. Furthermore, by allowing Food Surplus farmers to sell the seed from these elite lines, not only was the systematic wheat breeding process undermined, but these fortunate farmers were able to obtain large profits and once again, control access to this vital technology. Therefore, this PVS process had no impact on the livelihoods of Marginal farmers in either Belwa or Benauli, see Fig 16.

Figure 16.
Impact of wheat PVS on the Livelihoods of Marginal farmers in Belwa and Benauli



3.3 Conclusions and recommendations

The Nepali team had planned to improve the livelihoods of the poorest farmers, including women, through the provision of training in skills that can be used to generate income. These skills included vegetable gardening, PT repair and maintenance and also good seed selection.

All the women who attended the training in vegetable production were able to improve their livelihoods in terms of household nutrition and most were able to market some of their produce in order to raise a cash income. This income was used to purchase household items, school fees, agricultural inputs and in one case pay for a daughter's wedding. The women from Marginal households in Belwa, obtained the highest income from selling their vegetables. This process led to significant improvements in all five livelihood capitals, most notably in *human* and *financial* capitals which will inevitably lead to increased status both within the household and in the wider community. Although these women were unable to use their increased wealth to hire the PT, this situation is bound to change in time, particularly as more PTs become available.

The attempt to improve the livelihoods of the poorest male farmers was less successful: By focussing the training in PT repair and maintenance on the needs of Food Surplus farmers, the opportunity to put the control of the PT repair and maintenance service into the hands of the poorest farmers was lost. As a result of this project, Food Surplus farmers were put in control of all five PT machines and the skills and parts required for their repair and maintenance. This situation will ensure that Food Surplus farmers gain maximum benefits from this new technology and is unlikely to make access to the PT more equitable.

The livelihood of the Marginal farmer, Md. Miyan, has improved significantly, in terms of all five capitals, through being a PT owner and service provider. He is able to gain a profit of at least USD167 per month by hiring his PT and seed drill to other farmers and by transporting people and produce to market. This case clearly demonstrates that by providing enabling factors (especially loans that don't require collateral) to encourage ownership of PTs by Marginal and Landless farmers, a "win-win" situation can be created, in which the livelihoods of the poorest farmers are significantly improved at the same time as access to the PT service is opened up to all socio-economic groups.

The involvement of Marginal farmers in the PVS process was minimal and again the Food Surplus farmers were able to take control of the new seed technology. The Food Surplus farmers were also able to benefit financially from selling the progeny of the breeding lines. Future PVS work should involve all socio-economic groups by adhering to the CIMMYT guidelines for Mother-Baby trials. Marginal farmers should also be able to benefit from the sale of properly selected, good quality seed.

Final conclusion on assessing the impact and facilitating the uptake of resource-conserving technologies in Nepal

Activities conducted under Output One resulted in the minority Food Surplus farmers being the main beneficiaries of the PT dissemination project and as a result the poorest groups were unable to improve their livelihoods. In order to ameliorate this situation, recommendations were made on creating a "win-win" situation, in which the control of new technologies would be put into the hands of the poorest farmers and women, while keeping the benefits accessible to all.

During the Planning workshop, the Nepali team drew up a highly relevant and achievable Action Plan for delivering Outputs Two and Three, in terms of optimising pro-poor development: They planned to give 20 radios to each women's group in order to get listeners feed-back from their radio broadcasts, train a minimum of 50% Marginal and Landless women farmers in vegetable production and 50% Marginal and Landless male farmers in PT repair and maintenance.

Unfortunately, the Nepali team did not provide radios to the women's groups so could not get feed-back on the relevance of their informative weekly broadcasts. Under Output three, the team again focussed their activities on the better-off farmers: Food Surplus and Subsistence farmers were in the majority during the women's vegetable production training course and the training in PT repair and maintenance. Food Surplus farmers were also put in control of the PVS process. As a result, the livelihoods of the Food Surplus farmers (and some Subsistence farmers) who were involved in this project have improved significantly, and in some cases this has been at the expense of the livelihoods of Marginal and Landless farmers. These poor farmers were not given the opportunity to either gain control of, or improve their access to PTs, despite the documented success of Md Miyan, a Marginal, now Landless farmer who is able support his family and pay back his loan by providing a full-time tillage and transport service. Neither did the Marginal farmers get the opportunity to have control over the supply of improved seed. This means that the livelihoods of Marginal and Landless farmers were not significantly improved in terms of any of the five capitals as a result of this three year project. This may have been due to the following;

- Political instability in the area preventing frequent field visits.
- Fear of upsetting the status quo, in terms of the prevailing social hierarchies in Belwa and Benauli.
- Staff changes and retrenchments in CIMMYT which affected follow up.
- Infrequent visits to project area by CABI Project Manager due to fear of Maoist activities.
- Confusion between the objectives of the CABI and IFAD projects.
- Inability to link up with a local NGO that focuses on addressing the needs of the rural poor.
- Concerned to get the fast results offered by working with literate, resource-rich farmers.

The data also shows that the *Tharu* caste in Belwa and the *Yadav* caste in Benauli were disproportionately represented in the PT User Groups from Belwa and Benauli, which were analysed under Output One, and also the women's vegetable production training in Belwa and Benauli and the PVS in Benauli, which were analysed under Output Three, see Boxes 3 and 4. Furthermore, participants from Muslim households were not included in the women's vegetable production training or the PVS process in Belwa despite being in the majority (52%) in that village. This was probably because the NARC scientists had tasked a Hindu Food Surplus farmer in each of the two villages to select farmers for the training sessions. It would not be surprising therefore, if these farmers had chosen their relatives and friends for these sessions. In Belwa this Food Surplus farmer was Anirudh Prasad Dahait (see Fig 17) and in return for being in control of the farmer selection process he was able to gain a number of advantages from this and other projects, see Box 6.

Box 6:
Benefits received by one Food Surplus farmer in Belwa

The case of Anirudh Prasad Dahait

Food Surplus farmer living in Belwa
Landholding: 4.0 ha
Hindu caste: *Tharu*
RSSI: 233%

Benefits received from this project:

- Member of the PT Users' Group
- Week-long training in PT maintenance
- Soft loan to buy PT as part of the business group
- Hosted PVS trial
- An income of USD3, 125.00 from selling seed from elite lines of wheat that had been multiplied during the PVS in 2006.
- Wife received training in vegetable production.

Other benefits from recent NARC/CIMMYT projects

- Training in true potato seed production
- Training in vegetable IPM
- Training in rice seed production

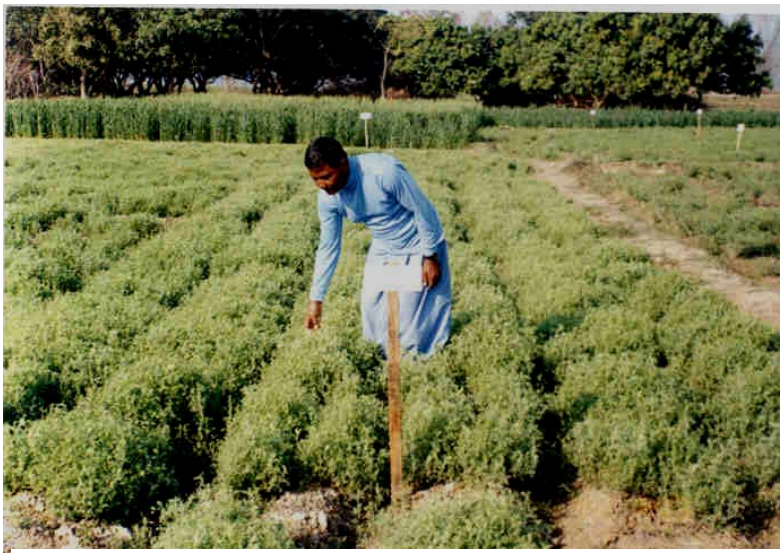


Fig.17. Food Surplus farmer, Anirudh Prasad Dahait inspecting his crop

It is recommended that scientists working on future projects in the Terai region, that are aiming to promote equitable access to new technologies, receive additional training in ways of improving the livelihoods of the poorest farmers (see section 1.6, page 32) and are provided with incentives for working to alleviate poverty. The people of the Terai region are currently crying out for a new system of development that does not discriminate on the grounds of religion, caste or gender, see http://news.bbc.co.uk/1/hi/world/south_asia/6353363.stm and agricultural scientists have a crucial role to play in this.