CABI Ref: U3013

India's (NDUA&T) 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

Study by Directorate of Extension
Narendra Deva University of Agriculture and Technology
Faizabad, Uttar Pradresh, India
In collaboration with CABI Bioscience UK and CIMMYT, New Delhi, INDIA
Analysis and compilation by Dr Tahseen Jafry, CABI Associate

www.cabi.org
KNOWLEDGE FOR LIFE

Contents

Figures and Tables

Figures

Tables

Executive Summary

The Goal of this DFID-funded project was to improve rural livelihoods through accelerated adoption of resource conserving technologies (RCTs).

Farmers in two villages, Vishunpurva (an adopted village) and Dammar Jot (a non–adopted village) were assigned to one of the four socio-economic groups, i.e. landless, marginal, subsistence or large (= food surplus/cash cropping farmers), depending on their ability to take risks involved in adopting new technologies.

Data collected under Output 1 indicated that all socio-economic groups have benefited from using the zero tillage (ZT) machine. However, in terms of adoption, at the outset of the project the larger (food surplus and subsistence) farmers were using the machine more than the poorer groups. The main benefit is income generated from the sales of increased production. There does appear to be an issue of labour displacement; the extent to which this is a problem remains unclear and it is recommended that the project team continues to monitor the situation.

On investigating the ways in which farmers access information, for Output 2, it was found that larger (food surplus and subsistence) farmers have many more channels available to them whereas the marginal and landless have the fewest. Women farmers are dependent on their families for new knowledge and information.

The channels of information range from government departments and the private sector to farmers' fairs and local meetings known as '*chaupal*. On further scrutiny, the channels of support available do not tailor their information to meet the specific needs of all socio-economic groups of farmers. It was revealed that 'one message does not fit all'.

Researchers identified that marginal farmers much preferred on-farm activities such as demonstrations and explanations on site, and exposure visits to local farms whereas the larger food surplus and subsistence farmers preferred to engage in dialogue with manufacturers and scientists. The project team recommended a community based workshop for disseminating information so that women can also participate.

The project team has demonstrated that through improved knowledge, the adoption of the ZT machine increased among the marginal groups but decreased among food surplus farmers. This was because the food surplus farmers were hiring their machines out rather than using them themselves in order to raise a cash income.. During this research it became apparent that many of the machines in use in the satellite and sub-satellite villages were there as a result of the KVK demonstration model which had been introduced prior to this CABI project. The real test of long term adoption will only become apparent when support for these models are removed from the project satellite and sub-satellite villages.

Data collected from the researchers did show that in the satellite and sub-satellite villages, the area of wheat sown using the ZT machine ranged from 8–16% of the area of traditionally sown wheat. This does indicate that some change is taking place but the real success will be when this figure reaches more than 70%. This will only be achieved through using appropriate knowledge dissemination practices.

Acronyms and Abbreviations

8 Bigha = 1 ha

CC = Cash cropper (food surplus farmer)

Chaupal = Neighbourhood

CIMMYT = International Centre for Maize and Wheat Research

DAP = Di-ammonium phosphate

DOA = Department of Agriculture

DSR = Direct seeded rice

FSIP = Farmer–Scientist Interaction Programme

ha = Hectare

HYV = High yielding variety

kg = Kilogram

KVK = Krishi Vigyan Kendra

LL = Landless

MF = Marginal farmer

NATP = National Agriculture Technology Project

OBC = Other “Backward” Castes

Palewa = pre-sowing irrigation

q = Quintal (100kg)

RCT = Resource conserving technologies

Rs = Rupees (Indian currency)

RWC = Rice–wheat consortium

SC = Scheduled Castes

SF = Subsistence farmer

ST = Scheduled Tribes

TOT = Training of trainers

ZT = Zero tillage/zero tilled

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 NDUA&T Team

The principle investigator for the Narendra Deva University of Agriculture and Technology (NDUA&T) team was Dr Tahseen Jafry, CABI Associate and the regional co-ordinator was Dr Etienne Duveiller of CIMMYT, South Asia. The site manager was Dr. C.M. Singh and the data collection team was headed by Dr. Ram Vilas Pandey, assisted by Dr. (Mrs.) Abha Singh, Dr. Tribhuwan Singh and Dr. Nishat Akhtar.

Fig. 1. NDUA&T team at the planning workshop in Dhaka, December, 2004

Targeting 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.

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 Livelihood Impact Studies

Livelihood impact studies (Fig. 1) were conducted with four groups of farmers – large farmers (= food surplus/cash croppers), subsistence, marginal and landless – on the use of resource conserving technologies. The data from this study are compiled in a separate document. Presented below is an analysis and overview of the findings. Two villages were selected for the studies: Vishunpurva which is a village that has had exposure to ZT technology, and Dammar Jot, which is a non-adopted village, i.e. one where there has been no exposure to ZT technology. The villages are located in the district of Basti in eastern Uttar Pradesh, India. The studies captured the impact that the technologies have made on these villages. Future research work will focus on where and how the technology has spread from these villages to the wider area.

Fig 2. Impact study data collection

1.2 Results of Livelihood Impact Studies

1.2.1 Livelihood impact assessment studies

(a) Vishunpurva village

In this village, it is clear that the ZT machine (Fig. 2) has had a positive impact. There is one owner with a ZT machine in the village. He currently employs five labourers to work on his land but since the introduction of the machine he has required five fewer labourers than if he were using the conventional method of ploughing. The feedback indicates that those labourers no longer employed have engaged themselves in other paid employment. The

survey data indicate that in 2002-2003 only one marginal farmer hired the machine

Fig. 3. Crop sown with zero tillage machine

compared with four cash croppers but no subsistence farmers. However, in 2003-2004 seven Subsistence farmers and seven Marginal framers hired the machine as well as six cash croppers.

Users of the ZT machine

Owner of the ZT machine

In terms of the socio-economic situation of this farmer, he is saving time he would have spent in land preparation. There is also a return for him from the hire scheme – approximately 6000 Indian Rs. In addition, he has gained from increases in wheat yields; 2 quintals per hectare. The data indicate that although this farmer has invested in the purchase of the machine, after the cost of inputs for growing wheat and rice are taken into account he is harvesting enough to sell to give him an annual income of 64 000 Rs for rice and 92 400 Rs for wheat.

It is clear that, because of his socio-economic situation, this farmer has good knowledge, is literate and has access to resources such as training schemes, and also has access to local mechanics and the university for technical support.

Marginal farmers

In this village there are six marginal farmers who have used the ZT machine. All have had the opportunity to hire and use the machine from the owner. On the whole, time saving has been the main benefit. The gain from the time that has been saved is being translated into income from other activities including harvesting and transporting sugar cane and selling vegetables. Money is also saved through not having to hire a tractor and buy diesel for conventional tillage.

The farmers are benefiting from increases in yield which they say comes from an advancement of sowing time. Marginal farmers have to pay 1000 Rs/ha for hiring the

machine and they have other input costs (2000-3500 Rs for rice and 1600-2500 Rs for wheat). They take out loans for hiring the machine which they pay back. The majority of farmers grow for home consumption only. Only a few sell to make extra income. Therefore, most farmers need to earn money from doing other jobs, such as labouring, to be food secure.

It is interesting to note that since this group of farmer is not self sufficient and they normally need to purchase rice and wheat, it may mean that by using the ZT technology with its associated increased yields they need to undertake fewer such purchases.

Marginal farmers do have good access to the machine because one is centrally located in the village, but they have not been given any training in its use. The farmers use the machine in clay loam soil without any difficulty.

Subsistence farmers
There are six subsistence farmers in this village who have used the ZT machine. The survey results indicate that the main benefits to this group are savings in time and money. Input costs, mainly for hiring labourers, are less. Under the conventional method of sowing wheat, three labourers are used. With the ZT machine, one labourer (the tractor driver) is required. This equates to a saving of 2000-2500 Rs in labour costs for field preparation. Although the farmers took out loans to pay for the use of the machine, they were able to pay these back.

Subsistence farmers are food secure. After home consumption requirements they are able to sell between 20 and 60 quintals of rice (worth 7000 to 20000 Rs) and between 18 and 62 quintals of wheat (worth 10 000 to 37 000 Rs).

Subsistence farmers were given training in how to use the machine. The farmers use the machine in clay loam soil without any difficulty.

Cash cropper farmers
There are five cash cropper farmers in this village who have used the ZT machine.

The farmers indicate savings in seed, labour and time. With the time that is saved, farmers earn income from transporting sugarcane and engaging in other agricultural work. Overall, the indication is a saving of between 3000 and 4000 Rs/ha for field preparation. In terms of labour use, under the conventional method between eight and 10 labourers were employed for field preparation. Through the use of ZT, this number has gone down to two. The farmers did not need to take out loans to pay for hiring the machine.

The farmers are food secure. They produce enough for home consumption and for sale, and they also sell seed; all are seed growers. All the farmers have been given training in how to use the machine.

The farmers use the machine in clay loam soil and heavy clay loam soil without any difficulty.

Non-users of the ZT machine

Marginal farmers
In the year 2003-2004, eight marginal farmers did not hire the ZT machine. The reasons for not using the machine were:

- Small size of land holding.
- Small and fragmented plots.
- Lack of risk bearing capacity.
- Lack of money to hire the machine.
- Belief that the soil may compact in the absence of ploughing.
- Lack of conviction about the utility of the machine.

Subsistence farmers
In the year 2003-2004, eight subsistence farmers did not hire the ZT machine. The reasons for not using the machine were:

- A mind set focused on using conventional methods for tillage; belief that ploughed soil becomes loose and is favourable for germination of seed.

- Difficulty of operating the machine in small fields.
- Poor machine performance when there are weeds.
- In combine-harvested plots, the stubble creates problems for ZT machine operation.
- Belief that the soil may compact if fields are not ploughed.
- Land taken on lease from another farmer who is not in favour of using ZT.

(b) Dammar Jot Village

Dammar Jot is a non-adopted village. This means that it has had no specific exposure to the ZT machine. Despite the fact that there are ZT machines in use in neighbouring villages, many farmers in this village have not used it. Given below are some of the reasons.

Non-users of the ZT machine

Marginal farmers

- Never heard of ZT machine/technology.
- "It is a myth. We do not believe that without ploughing of fields, wheat germination is possible."
- Machine is not available in the village.
- Have had no exposure to ZT plots.
- Machine is not affordable.

Subsistence farmers

- Machine is not available in the village.
- Although aware of ZT plots in the neighbouring village, and convinced, the ZT machine is not available.
- No exposure or training to raise awareness. Young farmers are very interested to learn about the new technology but aged farmers are not interested.

Cash cropper farmers

- Never seen ZT plots.
- Unconvinced the machine will work in fields of weeds.
- Unconvinced it will work in combine-harvested fields because stubble will create problems.
- Lack of availability.
- "We have heard about the machine on the radio but we have not had any exposure."
- Doubts about germination without field preparation. "We need exposure to change our mindset."

1.2.2 Discussion

(a) Level of adoption

Since its introduction in 2002 in Vishunpurva village, the ZT machine has had considerable success in terms of adoption rates inside the village. Table 1 gives an indication of the level of adoption by farmer category across the village.

It is interesting to note that all cash croppers have adopted the ZT technology for sowing wheat in the rice-wheat cropping sequence. This group has the greatest capacity to benefit in terms of access to all resources and inputs required, and the largest plots of land, and as a result have the greatest returns in terms of yield and income. The marginal farmers have the lowest level of adoption whilst 50% of subsistence farmers have adopted the machine. One of the reasons for non-adoption relates to land issues, i.e. small and fragmented holdings for which the machine is not suitable. However, the poverty issue is a major problem which equates to the risk bearing capacity of the farmers. Most marginal farmers have to take out loans to hire the machine, compared with subsistence farmers and cash croppers who do not require them. Marginal farmers have difficulty in taking this risk as they cannot be guaranteed an increased yield to cover this extra cost. Furthermore, marginal farmers have not been trained in the use of the machine; therefore, lack of appropriate knowledge is also a major obstacle in adoption.

Table 1: Level of ZT adoption in Vishunpurva village

Farmer category	Total no. of farmers	No. adopted ZT machine
Landless	12	0
Marginal	33	7
Subsistence	15	7
Cash cropper	6	6
Total	56	20

(b) Machine use and labourers

Fig. 3 illustrates how the ZT machine has been used by different farmers groups. This figure is an illustration of winners and losers. Clearly, a number of labourers have been displaced or not re-employed as a result of the introduction of the machine. The results show that eight labourers now have to find alternative employment to generate income. The survey data did indicate that these labourers did find alternative employment but what remains unclear is the overall impact this has made on their lives, e.g. having to travel to locate work, expenses in living accommodation incurred by working elsewhere. What also remains unclear is the extent and significance of labour displacement in this village and beyond. This is a matter that needs to captured and understood more fully.

In terms of access, it would appear that all socio-economic groups of farmers have access to the machine. In the year of introduction, only one marginal farmer hired the machine, but in the subsequent year, 7 marginal farmers hired it, which indicates that there is knowledge flowing and access. But the overall situation, as described in Table 1, is that marginal farmers have the lowest level of adoption.

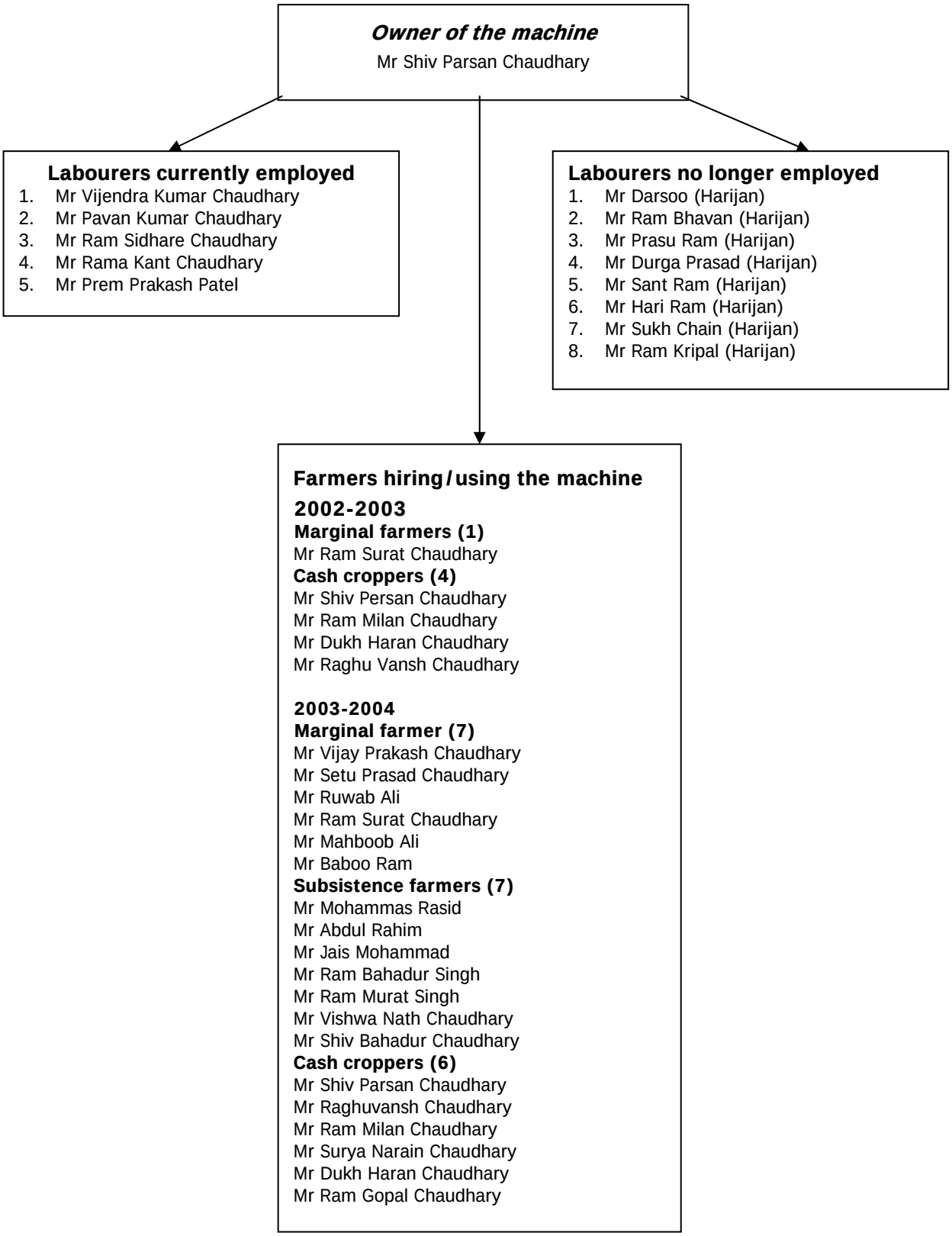
(c) Non-exposure to ZT machine

Dammar Jot is a village in which there has been no exposure to the machine. The reasons for non-use of the machine were:

- Lack of knowledge, information, exposure and training.
- Lack of access and availability.
- Unaffordability.

Project Output 2 looks at addressing how to increase the adoption of the machine by the poorer and Marginal farmers and is reported in the next section.

Fig. 3. *Machine users and labourers (Vishunpurva Village)*



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 Introduction

Reaching farmers with agricultural knowledge and information is critical for pulling them out of poverty. In relation to the ZT machine and in line with Project Output 2, the project team investigated how knowledge and information flows to farmers and how this can be improved (Fig. 4). This section of the report pertains to the findings of the project team according to the stated objective.

Fig. 4. Project team – farmer interactive discussions

2.2 Agricultural Knowledge Flow Systems Identified

Information was collated on the existing sources of knowledge available to farmers collectively in the project villages. This is summarized in Table 2 and Figs. 5 and 6.

Table 2: Sources of knowledge available to farmers

Sources of knowledge / information	Vehicles for information
1. Government	
1.1 Agri. University/KVK	Demonstration Training Farmers' gosthi Farmers' fair Farmer–scientist interaction Exhibition Publications/literature Help-line Kisan call centre
1.2 Department of Agriculture	Subsidy awareness
1.3 U.P.State Agro-Industrial Corporation	Sale promotion
1.4 Electronic media	Radio talk TV talk
2. Non-Government	
2.1 Rice-Wheat Consortium	Exposure visit
3. Private sector	
3.1 Drill manufacturer	Exhibition
3.2 Print media	Newspapers
4. Others	
4.1 Neighbours	Chaupal meeting
4.2 Family members	Male head intervention

The sources of information available to farmers were classified by them (nil to ***) in terms of how often they occurred, level of technical competency and how far they led to adoption, and also ranked (I to IX) according to how effective they thought the source was in delivering information them (Table 3).

Table 3: Prioritization of effective sources for information flow in adopted village

Sources of knowledge	Contact frequency	Technical competency	Adoption extent	Rank
1. Government				
1.1 Agri. University/KVK	***	***	***	I
1.2 Department of Agriculture	*	**	Nil	VII
1.3 U.P. State Agro-Industrial Corporation	Nil	**	*	VIII
1.4 Electronic media	**	**	***	IV
2. Non-Government				
2.1 Rice–Wheat Consortium	*	**	*	VI
3. Private sector				
3.1 Drill manufacturers	Nil	*	Nil	IX
3.2 Print media	*	**	*	V
4. Others				
4.1 Neighbours	***	**	***	II
4.2 Family members	***	*	***	III

In addition, further detailed discussions were held with farmers to jointly identify some of the strengths and weaknesses in the existing knowledge dissemination systems. This was done to help the project team to identify and develop a strategy for pro-poor dissemination of information pertaining to the ZT machine so that there is equitable access to it. The strengths and weaknesses can be seen in Table 4.

Table 4: Strengths and weakness of current knowledge flow systems

Sources of knowledge	Strengths	Weaknesses
Agri. University/KVK	Research based institutions Skills oriented vehicles of information Multi-disciplinary approach	Too few extension scientists Lack of educational resources
Department of Agriculture	Subsidy awareness & programme	Poor professional extension support Rare visits and training
Agro-industrial corporation	Sale promoter	Lack of technical manpower
Electronic media	Wide coverage Fast dissemination	Not skills oriented No target for adoption
Drill manufacturers	Visual show	Lack of widespread outlets
Print media	Rich technical content Easily available	Readability & understanding for literate only. Beyond the reach of pro-poor Not skills oriented
Neighbours	Local dialogue based Chaupal oriented meeting Acceptability	Lacking expertise Poor female participation Dilution of information
Family members	Convincing Acceptability	Male dominated Lack of expert knowledge

Having access to knowledge about the technology is not the only reason for non-adoption of the machine. The project team conducted an assessment of each category of farmer to determine the reasons/causes of non-adoption (Table 5).

Table 5: Reasons for non-adoption of ZT technology, by socio-economic group

Large farmers/Cash croppers	Subsistence farmers	Marginal farmers	Landless farmers
1. Unavailability of machine	1. Unavailability of machine	1. Low risk bearing capacity	1. Resource poor
2. Rigid to traditional farming/social constraint	2. Lack of technical knowledge.	2. Fewer resources	2. Very small or no land holding
3. Less interest	3. Social constraint	3. Small farm holding	
	4. Less risk bearing	4. Lack of technical know-how.	
		5. Less interest	
		6. Social constraint	
		7. Rigid to traditional farming	
		8. Unavailability of machine	

Further reasons that can explain adoption blockages are given below:

Community level

- Low risk bearing capacity.
- Farmers' lethargy/indifference/mindset.
- Gender issues.
- Affordability.
- Migration.
- Knowledge and skills.
- Lack of vehicles for conveying information.
- Small size of holdings.

Institutional level

- Resources.

- Bias in extension strategy.
- Absence of mechanism for reaching practising farm women.
- Lack of follow-up procedures.

Manufacturers perspectives

- Lack of manufacturers at local level.

Linkages

- Weak linkage between institution and development departments.
- Lack of public–private partnerships.
- Weak university–NGO linkages.

Policy issues

- The cost of ZT machines could be subsided by the government, particularly for the poorest farmers.
- Absence of an incentive policy for farmers using ZT.

Fig. 5. *Gender-related information flow to marginal farmers about ZT technology*

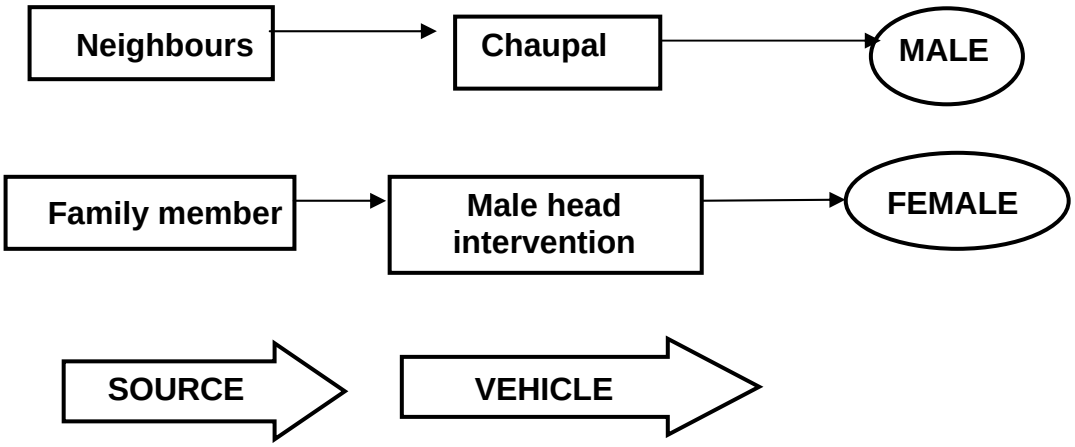
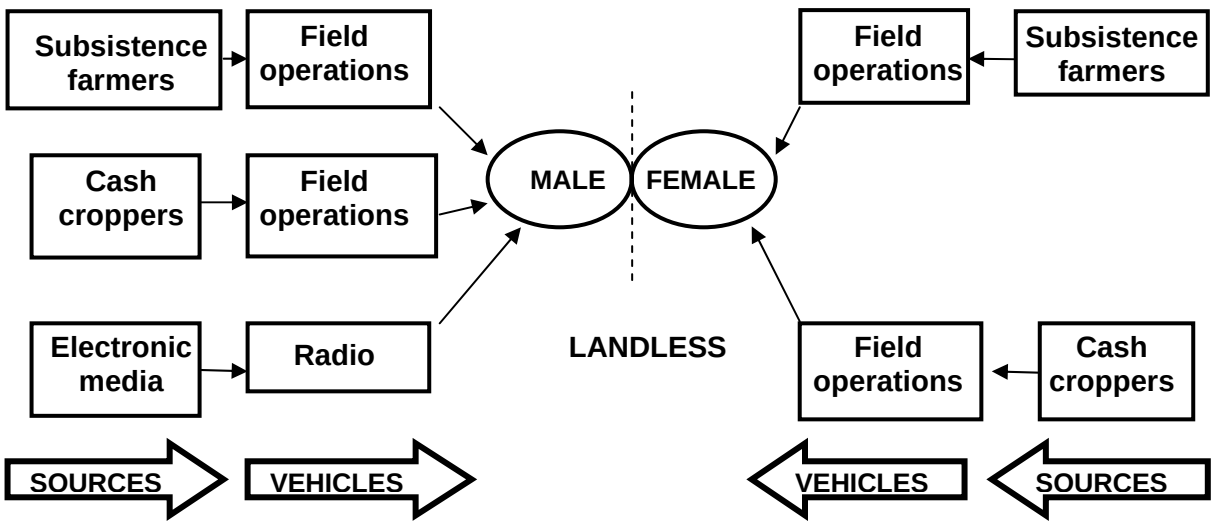


Fig. 6. *Gender-related information flow about ZT technology*



2.3. Strategies for Pro-Poor Development

Different types of extension activities have been undertaken to unblock the knowledge pathways. These activities consisted of capacity building, which included training different groups of farmers, interaction with scientists, exposure visits cum travelling seminar field days and farmers' fairs; in addition, on-farm activities consisted of demonstrations in farmers' fields. Another approach used print media publication of popular articles, preparation and distribution of posters, folders, leaflets, charts, calendar etc., use of electronic media, including radio and television broadcasts of scientific talks, interviews and experiences of farmers. Some progressive farmers created an active group to take the lead as a source of information about latest technology and disseminate this by personal contact to other farmer groups. Finally, district line departments participated in farmers' fairs and meetings to facilitate technology dissemination. All these activities target all groups of farmers including cash croppers and marginal, subsistence and landless farmers, with more emphasis being placed on marginal groups of farmers. Table 6 shows how sources for spreading information about ZT technology were ranked in terms of importance to the various farmer groups.

Table 6: Vehicles for dissemination of ZT technology, by farmer group

Large farmers/Cash croppers	Subsistence farmers	Marginal farmers	Landless farmers
1. Exposure visit	1. Exposure visit	1. Exposure visit	1. Personal contact
2. Conducted tour	2. Print Media	2. Personal contact	2. Field day
3. Print Media	3. Electronic Media	3. Farmers' fair	
4. Electronic Media	4. Farmers' fair	4. Field day	
5. Personal contact	5. Field day	5. Training	
6. Training	6. Training	6. Print Media	
7. Field day/ Gosthi	7. Personal contact		
8. Farmers' fair	8. Dist. Agric. Office		
9. Dist. Agri. Office			

Other dissemination strategies considered included:

Extension (see Fig. 7)

- Skills oriented training by Agri. University / KVK.
- Front line demonstrations on complex, diversified and risk prone farmers' fields.
- Exposure visit to ZT adopting village.
- Farmer–scientist interaction.
- Technology dissemination and intensification, mainly by Department of Agriculture and NGOs.

Promotion for community organization

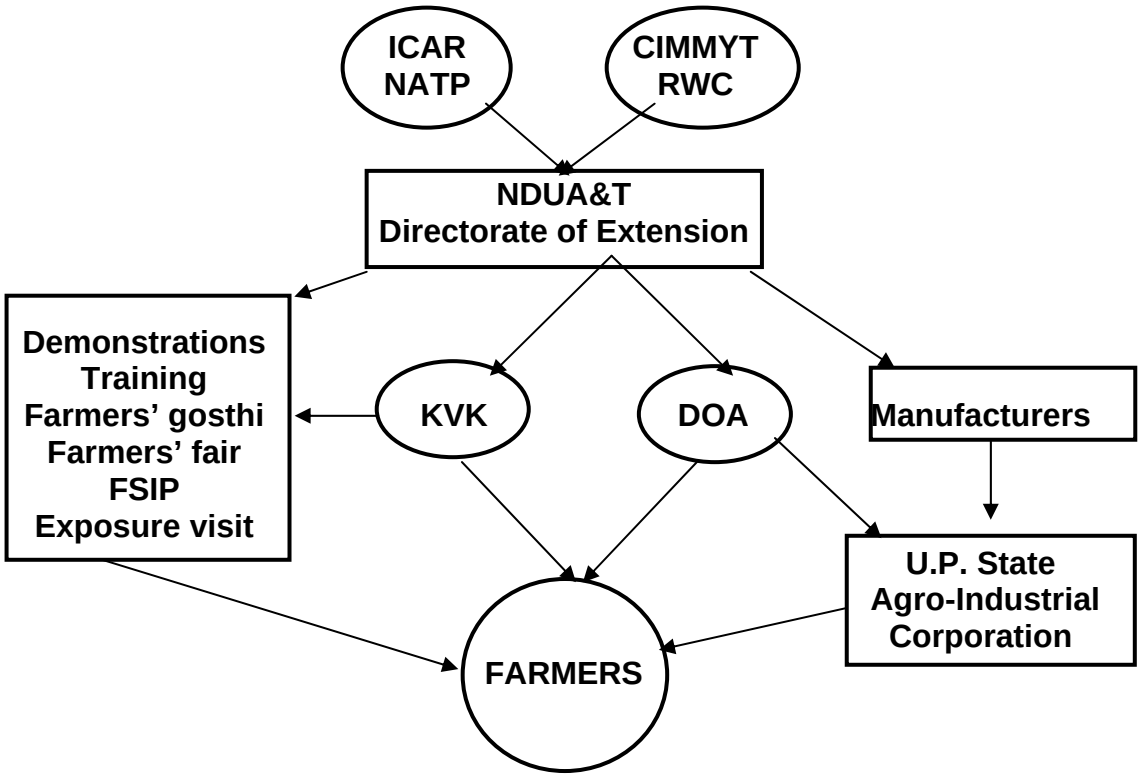
- Gender-specific self help group formation.
- Custom hiring mechanism.
- Farmers' school facilitation.

Credit support

- At nominal interest.

Specific details of all extension activities are given in Table 7

Fig. 7. *Dimensional modalities adopted by Directorate of Extension, NDUA&T for speedy transfer of ZT technology*



2.4. Feedback from Farmers

Among the different extension activities, the exposure visit cum travelling seminars were found to be most effective by subsistence and marginal groups of farmers because they could see the demonstration themselves and discuss their problems with others. Cash croppers preferred interactions with scientists and print and electronic media.

Field days, farmers' fairs and training are means of information dissemination, which all socio-economic categories of farmers were able to attend.

During demonstrations, cash croppers take the initiative, as they are resource rich and have the risk bearing capacity, although in terms of the number of the farmers who attend demonstrations, the subsistence farmers form the largest group, followed by marginal farmers. But area-wise, cash croppers represent the largest cropping area, followed by subsistence farmers and marginal farmers.

Among print and electronic media, large farmers preferred popular articles in newspapers and a folder with information, and preferred TV to radio. Subsistence farmers preferred information folders over popular articles and posters, while radio was their preferred electronic medium.

Marginal farmers displayed their liking for information folders, posters and charts in print media, and radio in electronic media. Of all activities described above, skills training, exposure visits, field days and demonstrations were found to be most effective for all categories of farmers.

The farmers also made some suggestions on what activities would be effective for further dissemination. These are:

Cash Cropper

- Suggested the active involvement of manufacturers / sale promoters and extension functionaries during demonstrations and training.

Subsistence Farmer

- Suggested more skills oriented training and demonstrations.

Marginal Farmers

- Suggested more demonstration exposure visits and interaction.

Further information pertaining to the impact the ZT machine has made is given in the next section of this report which pertains to Project Output 3.

Table 7: Details of activities implemented for unblocking knowledge pathways

Major	Sub activities	No.	Participants	Date / period	Venue	Output
1. Capacity building	**RICE**					
	Farm training on ZT management	8	220	10.07.05 – 15.07.05	Vishunpurwa & satellite villages	Skills orientation for ZT rice
	Training for service provider on calibration operation and maintenance of ZT machine	1	10	04.09.05	KVK, Basti	Entrepreneurship development
	Training for farmers on weed management in zero tilled rice	6	90	30.06.05 – 02.08.05	Vishunpurwa, Dammarjot, Bangawan, Chainpurva, Pariya & Maharadour	Skill orientation
	Training in use of fertilisers	3	60	08–10.10.05	Vishunpurwa, Dammarjot & Bangawan	Skills orientation for N management
	Farmer–scientist interaction	1	30	07.08.05	KVK, Basti	Face to face problem solving
	Exposure visit cum travelling seminar	2	120	03.10.05, 19–20.11.05	Avasapur, Basti, NDUA&T, Kumarganj, Faizabad	Knowledge exchange
	Field day	1	195	13.09.05	Bangawan, Basti	Seeing is believing
	Farmer fair	2	2000 15000	03.10.05 19–20.11.05	Satellite & sub-satellite villages	Skills orientation for ZT wheat
	WHEAT					
	Farmers' training on ZT wheat management	16	480	15.11.05 – 25.12.05	Satellite & sub-satellite villages	Skills orientation for ZT wheat
	Training for farmers on weed management in ZT wheat	8	160	12.12.05 – 10.01.06	Satellite & sub-satellite villages	Skills orientation
	Farmer–scientist interaction	3	150	18–21.11.05 12–14.1.05 15–17.12.05	Saltauva Bahadurpur Kalwari	Face to face problem solving
	ZT based Training of Trainers (TOT)	1	50	17–19.11.05	KVK, Basti	Technology awareness
	Exposure visit cum travelling seminar	1	50	24.02.05	NDUAT, Kumarganj, Faizabad	Knowledge exchange
	Field day	2	250	03.02.06 08.02.06	Vishunpurwa	Seeing is believing
	Farmers fair	1	16000	24–25.02.06	NDUAT	Acquiring knowledge
2. Farm activities	Frontline demonstration on ZT rice	44	44			Comparative performance
	Frontline demonstration on ZT wheat	586	586			Comparative performance
3. Print media	Folder in Hindi on ZT rice Chart Crop calendar	1 1 1	1000 10 50	June 2005 Nov 2005 Dec 2005		Knowledge upgrading circulated among farmers
	Views in newpapers					
	Zero till machine se boyegayi machine ka nirikshan			19.09.05 Hindustan		Awareness
	Dhan ki sidhi boayi mein layat kum paidavar jyada			19.09.05 Dainik Jagran		Awareness
	Videshi vaigyani ko ne dekha bina julai ke dhan ki boayi			19.09.05 Rashtriya Sahara		Awareness
	Zero till bidi se boayii karen se milati hai barhiya paidawar			30.09.05 Dainik Jagran		Awareness

continued

Table 7 continued

Major	Sub activities	No.	Participants	Date / period	Venue	Output
	Nai taknik apana kar upaj badhay kisan			19.11.05 Rashtriya Sahara		Awareness
	Vaigyanik bidhi se kheti kar artik sthiti sudrigh karein kisan			16.12.05 Dainik Jagran		Awareness
	Lokpriya ho rahi hai zero till taknik			04.02.06 Rashtriya Sahara		Awareness
	Zero till machine se barley gram pe kibhi boayi Karen kisan			05.02.06 Dainik Jagran		Awareness
	Vaigyanik bidhi ke prayog kar kam lagat mein adhik upaj lain kisan			10.02.06 Dainik Jagran		Awareness
	Documentation					
	Progress report on ZT wheat under RCT	1				Status and impact assessment
4. Electronic media	**Radio talk**					
	Sowing of rice with ZT technology	1	-	13.06.05	Air Gorakhpur	Dr T. Singh
	Nitrogen management in rice the through LCC	1		17.07.05	Air Gorakhpur	Dr T. Singh
	TV talk					
	Promotion of ZT rice in eastern U.P.	1	-	13.09.05	Gorakhpur	Dr C.M. Singh
	Weed management in ZT rice	1	-	15.08.05	Gorakhpur	Dr T. Singh
5. Group meeting	Creation of active group of practising male farmers for developing local leadership to promote ZT technology	4	20 16 15 15		Vishunpuwa, Dammarjot Pokharbhitva Tangpara	
6. Improving linkage with field extension system	Involvement of district authorities and extension department		Nov-Dec 05			Subsidy and input mobilization
	Extension activity					
	Field day			13.09.05 03.2.06 08.02.06	Bangawan Vishunpurwa Maharadaur	Extrapolation & area extension
	Farmers' fair			03.01.05 19–20.11.05	Avasapur NDUAT, Masodha, Faizabad	Extrapolation & area extension
7. Ensuring participation of policy maker	Field day			13.09.05 03.0.06 08.02.06	Bangawan Vishunpurwa Maharadaur	Extrapolation & area extension
	Farmers' fair			03.01.05 19–20.11.05	Avasapur NDUAT, Masodha, Faizabad	Extrapolation & area extension

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 Introduction

Agricultural knowledge and information reaching farmers were identified under Project Output 2 and pathways were developed to overcome blockages in access to knowledge and information for all socio-economic groups. In relation to the ZT machine and in line with Project Output 3, the project team describes some of the strategies in more detail and the impacts that have been made since improving knowledge and information flows to farmers. This section of the report pertains to the findings of the project team for Project Output 3.

3.2 New Technical Innovations Evaluated and Developed

3.2.1 Package of practices recommended by the project team

The project team described in its Output 2 report some of the strategies that were developed to allow all socio-economic groups of farmers to have access to new technologies such as the ZT drill and direct seeded rice (DSR). Summarized below are some of the recommendations provided by the team in relation to these technologies that farmers ought to follow to gain maximum benefit. These recommended practices were followed at demonstration sites so that farmers could view them at first glance and give their comments and reactions to the new practices being recommended.

Package of practices for direct seeded rice:

- Clay loam or clay soil.
- Pre-sowing irrigation (Palewa).
- Select early and mid late rice varieties sown with ZT machine after single ploughing.
- Use 40 kg rice seed and 120:60:40 kg/ha NPK as a basal dose, with nitrogen used as a top dressing in two equal doses.
- Spray pendimethalin at 3.3 L/ha pre-emergence, 2–3 days after seedling with rice.
- Spray 2,4-D Na salt 80 wp at 625 g/ha dissolved in 800 L of water 30 days after seeding with rice.
- One hand weeding as needed.
- One to two irrigations as needed.
- Use 25 kg/ha malathion dust for control of Gundhibug insect at the milking stage.

Package of practice for ZT wheat:

- Select loam, clay loam and clay moist soil.
- Select location specific high yielding variety (HYV) of wheat.
- Use 90-100 kg/ha seed.
- Use 120:60:60 kg/ha NPK. Use total quantity of P and K and 1/3 amount of N at the time of sowing; the remaining N to be added as a top dressing in two equal doses after the first and second irrigation.
- Spray isoproturon 75% 1.25 kg/ha or sulfosulfuran 33 g/ha 30 to 35 days after sowing for control of *Phalaris minor.*
- Two or three irrigations as required.

Farmers' reactions were collected during the periods of the demonstration plot trials. Their reactions are given below:

- Farmers are satisfied with the ZT technology. They described it as providing advance seeding, proper placement of seed and fertilizer, saving in time, labour, diesel and seed and an overall saving in the cost of production up to 5000 Rs/ha in DSR and 3800 Rs/ha in ZT wheat.

- No lodging in the wheat crop was observed from high winds at the time of irrigation in February and March.
- Sometimes the emergence of weeds affected the rice crop.
- With DSR, early and mid late varieties are more suitable than late maturing ones.
- Use of the NPK mixture at the time of sowing showed better performance than di-ammonium phosphate (DAP).
- The ZT wheat crop was observed to be healthier in combine-harvested fields than in sickle harvested paddy fields.

3.2.2 Impact of the zero tillage technology and its geographical spread

As indicated in section 3.2.1, a package of practices were recommended by the project team to the farmers which provided an indication of what the farmers need to do to make the ZT technology work for them and to gain the maximum impact. Under Output 2, the project team highlighted the knowledge transfer mechanisms that were being adopted to reach all socio-economic groups. This section highlights the project findings on the impact the zero tillage technology has made to the core (satellite) project villages and to neighbouring villages beyond (sub-satellite villages). Tables 8–11 describe the percentage and number of farm families who adopted the ZT technology and the areas they sowed using this technology for the wheat crop from Rabi 2002-03 to Rabi 2005-06. The results indicate that during the period between 2002/03 and 2005/06 there has been a significant increase in the number of subsistence and marginal farmers using the ZT technology; the biggest increase being with the marginal farmers. The tables also indicate that the number of hectares cultivated by subsistence and marginal farmers is increasing while the area cultivated by large farmers is decreasing. This may be because the large farmers are buying the machines as an income generating activity as shown in Tables 12 and 13. Some farmers were provided with a ZT machine via KVK Basti through CIMMYT, India as an exposure model to generate interest among the farming community. Table 13 indicates that those who were provided these 'free of cost' machines are also making a lucrative income. This is positive in the sense that these farmers are being entrepreneurs, but it questions whether the approach is sustainable. For instance, what would happen if the machines were withdrawn by KVK?

Table 8: ZT use pertaining to nucleus, satellite and sub-satellite villages during Rabi, wheat season 2002-03 (1)

Nucleus village	Satellite village & no. of sub-satellite villages	Distance of satellite village from nucleus village (km)	No. and % of farm families who adopted ZT technology, per category[1]					Area sown with ZT wheat (ha)[1]				
			LF/CC	SF	MF	LL	Total	LF/CC	SF	MF	LL	Total No
Vishunpurva	-	-	3	2	1	0	6	6	3	0	0	9
	Pokharbhitva (2)	1	1	3	1	0	5	18	5	1	0	24
	Suruwar kala (7)	26	7	4	1	0	12	20	5	2	0	27
	Paria (8)	14	5	7	1	0	13	5	3.6	0	0	8.6
Total	**3 satellites 17 sub-satellites**	**-**	**16**	**16**	**4**	**0**	**36**	**49**	**16.6**	**3**	**0**	**68.6**
			44%	**44%**	**12%**			**71.4%**	**24.2%**	**4.6%**		

[1]LF/CC = Large farmers/Cash croppers. SF = Subsistence farmers. MF = Marginal farmers. LL = Landless farmers.

Table 9: ZT use pertaining to nucleus, satellite and sub-satellite villages during Rabi wheat season 2003-04 (2)

Nucleus village	Satellite village & no. of sub-satellite villages	Distance of satellite village from nucleus village (km)	No. and % of farm families who adopted ZT technology, per category[1]					Area sown with ZT wheat (ha)[1]				
			LF/CC	SF	MF	LL	Total	LF /CC	SF	MF	LL	Total no.
Vishunpurva	-	-	6	20	8	0	34	33.5	14.5	3.0	0	51.0
	Pokharbhitva (12)	1	5	9	4	0	18	19.0	11.0	2.0	0	32.0
	Suruwar kala (9)	26	9	13	4	0	26	45.0	12.0	2.0	0	59.0
	Paria (10)	14	4	10	5	0	19	17.5	11.5	2.0	0	31.0
	Belahara (4)	12	5	8	2	0	15	15.0	8.0	1.0	0	24.0
	Kusaura (4)	40	2	8	1	0	11	6.5	7.5	0.50	0	14.5
	Bairagal (6)	38	4	11	2	0	17	28.5	13.5	1.0	0	43.0
Total	**6 satellites 45 sub-satellites**	**-**	**35**	**79**	**26**	**0**	**140**	**166**	**77.5**	**11.0**	**0**	**254.5**
			25.0%	**56.4%**	**18.6%**			**65.2%**	**30.5%**	**4.3%**		

[1]LF/CC = Large farmers/Cash croppers. SF = Subsistence farmers. MF = Marginal farmers. LL = Landless farmers.

Table 10: ZT use pertaining to nucleus, satellite and sub-satellite villages during Rabi wheat season 2004-05 (3)

Nucleus village	Satellite village and no. of sub-satellite village	Distance of satellite village from nucleus village (km)	No. and % of farm families who adopted ZT technology, per category[1]					Area sown with ZT wheat (ha)[1]				
			LF/CC	SF	MF	LL	Total	LF /CC	SF	MF	LL	Total no.
Vishunpurva												
	Dammarjot (7)	15	8	14	7	-	29	18	32.6	7.8	-	58.4
	Pokharbhitva (4)	1	3	4	3	-	10	11	17.4	2.4	-	30.8
	Tangpara (12)	25	7	15	12	-	34	38.5	16.2	6.9	-	61.6
	Dhekaha (10)	36	2	9	3	-	14	21.0	13.8	2.8	-	37.6
	Suruwarkala (13)	26	11	9	2	-	22	38.2	9.6	4.2	-	52.0
	Kusaura (8)	40	2	7	3	-	12	10.4	12.6	1.8	-	24.8
	Bairagal (11)	38	4	7	2	-	13	8.0	14.2	3.8	-	2.0
	Paria (17)	14	14	39	19	-	72	46.8	30.4	6.8	-	84.0
	Belahra (4)	12	2	5	2	-	09	8.0	6.0	2.0	-	16.0
Total	**9 satellites 86 sub-satellites**	**-**	**53**	**109**	**53**	**-**	**215**	**199.9**	**152.8**	**38.5**	**-**	**391.2**
			24.5%	**51.0%**	**24.5%**			**51%**	**39%**	**10%**		

[1]LF/CC = Large farmers/Cash croppers. SF = Subsistence farmers. MF = Marginal farmers. LL = Landless farmers.

Table 11: ZT use pertaining to nucleus, satellite and sub-satellite villages during Rabi wheat season 2005-06 (4)

Nucleus village	Satellite village and no. of sub.-satellite villages	Distance of satellite village from nucleus village (km)	No. of farmers who adopted ZT technology, [1]					Area sown with ZT wheat (ha)[1]				
			LF/CC	SF	MF	LL	Total	LF /CC	SF	MF	LL	Total no.
Vishunpurva	-	-	27	51	20	0	98	53	46	8.0	0	107
	Dammajot (16)	15	12	21	8	0	41	36	24	4.0	0	64
	Pokharbhitva (11)	1	6	11	7	0	24	8	9	3.0	0	20
	Tangpara (28)	25	21	46	29	0	96	40	41	10	0	91
	Daridiha (10)	23	8	20	12	0	40	21	19	6.0	0	46
	Surwarkala (18)	26	15	21	8	0	44	31	22	4.0	0	57
	Kusaura (14)	40	8	19	12	0	39	28	15.4	5.6	0	49
	Bairagal (18)	38	12	38	21	0	71	31	39	12.0	0	82
	Paria (20)	14	16	32	20	0	68	33	30	14.0	0	77
	Belahara (7)	12	7	15	5	0	27	28	12	2.0	0	42
	Bangawan (11)	16	9	17	12	0	38	26	15.2	3.8	0	45
Total	**10 satellites 153 sub-satellites**	**-**	**141**	**291**	**154**	**0**	**586**	**335**	**272.6**	**72.4**	**0**	**680**
			24.1%	**49.6%**	**26.3%**			**49.26%**	**40.0%**	**10.73 %**		

[1]LF/CC = Large farmers/Cash croppers. SF = Subsistence farmers. MF = Marginal farmers. LL = Landless farmers.

Table 12: Location of ZT machines available in Basti District

Name of farmer / institution	Address	Year of purchase	Machine provider	Entrepreneurship / demonstration	No. of machines
K.V.K., Basti	K.V.K., Basti	2001-02	NDUAT-Faizabad	Demonstration	1
D.A.O., Basti	Department Of Agriculture, Basti	2002-03	Department of Agriculture, Basti	Demonstration	1
Divakar Vikram Singh	Suruwar, Rudhauli	2002-03	Self purchased	Entrepreneur	1
Shiv Parsan Chaudhari	Vishunpurwa, Saltauva, Basti	2003-04	Self purchased	Entrepreneur	1
Ram Sidhar Chaudhari	Pokharbhitwa, Saltauva, Basti	2003-04	Self purchased	Entrepreneur	1
Kisan Vidyalaya	Kusaura, Bahadurpur, Basti	2003-04	Self purchased	Entrepreneur	1
Kisan Vidyalaya	Bairagal, Kaptanganj, Basti	2003-04	Self purchased	Entrepreneur	1
Kisan Vidyalaya	Saughat, Basti	2003-04	Self purchased	Entrepreneur	1
Kisan Vidyalaya	Rudhauli, Basti	2003-04	Self purchased	Entrepreneur	1
Ram Tej Chaudhari	Darideeha, Basti Sadar, Basti	2004-05	Self purchased	Entrepreneur	1
Vijendra Chaudhari	Vishunpurwa, Saltauva, Basti	2004-05	KVK Basti through CIMMYT, India	Entrepreneur	1
Ram Naresh Chaudhari	Tangpara, Basti Sadar, Basti	2004-05	KVK Basti through CIMMYT, India	Entrepreneur	1
Ram Nayan Chaudhari	Bangawan, Basti Sadar, Basti	2004-05	KVK Basti through CIMMYT, India	Entrepreneur	1
Total					**13**

Table 13: Income earned by ZT service providers through custom hiring services during Rabi wheat season 2005-2006

Name of ZT service provider	Address	Area sown (ha)	Gross income (Rs)	Net income (Rs)
Shiv Parsan Chaudhari	Vishunpurwa	46	40 000	24 000
Ram Sidhar Chaudhari	Pokharbhitwa	20	17 000	8 640
Divakar Vikram Singh	Suruwar, Rudhauli	19	9 000	5 000
Kisan Viddyalaya	Rudhauli, Basti	38	38 000	21 000
Kisan Viddyalaya	Kusaura, Bahadurpur	49	49 000	27 000
Kisan Viddyalaya	Bairagal, Kaptanganj	82	82 000	44 000
Kisan Viddyalaya	Saunghat, Basti	77	77 000	42 000
Ram Tej Chaudhauri	Darideeha, Basti Sadar	46	42 000	23 000
Ram Naresh Chaudhari	Tandpara, Basti Sadar	91	78 000	43 000
Bijendra Chaudhari	Vishunpurwa, Saltauva	107	105 000	60 000
Ram Nayan Chaudhari	Bangawan, Basti Sadar	45	43 000	24 000

Table 14 gives a collective overview of the spread of the ZT technology over the life span of the CABI project. This picture is a positive one in that is shows that the use of the technology is growing and that the geographical spread is growing. However, to get a clearer picture, further information was collected to put the growth of the technology into perspective i.e. how does the area of ZT wheat compare with that of the total area under wheat and the total amount of arable land available. This information is given in Table 15. The results indicate that from the project satellite and sub-satellite villages in 2005-06, the area of wheat sown under ZT conditions in comparison with area sown under traditional sowing ranged from 8-16%. Although this number is a small percentage of the total area of wheat sown, it is a start. It would be interesting to complete another set of data for the same project villages in the year 2006-07 in order to monitor the situation. However, how this percentage increases seems uncertain given the sales forecast by the UP Agro-industries. Table 16 indicates that the number of sales decreased slightly between the years 2004-05 and 2005-06, but it does show that the forecast for sales is on the increase for the year 2006-07.

Table 14: ZT technology adoption and dissemination trends under CABI Project

Year	No. of blocks	No. of villages	No. of farmers	Area sown under ZT	No. of ZT machine used
2002-03	4	17	36	68.60	03
2003-04	10	52	140	254.50	07
2004-05	10	96	269	431.40	11
2005-06	11	163	586	680	13

Table 15: Details of total arable land, area under wheat and area under ZT wheat in satellite and sub-satellite villages, 2005-06

Satellite village	Sub-satellite villages	Arable land (ha)	Area (ha)	
			Under wheat	Under ZT wheat
Dammarjot		55	31	8.0
	1. Pipra Sansarpur	51	28	2.0
	2. Pipra Hikka	26	17	3.0
	3. Khajuha	21	13	3.0
	4. Aksara	37	25	2.0
	5. Kurhaprithi	48	34	11.0
	6. Ganeshpur	72	49	3.0
	7. Sierapar	48	28	1.5
	8. Chamanganj	44	36	5.0
	9. Avasapur	31	18	2.0
	10. Bhitia	36	27	5.0
	11. Narharia	49	33	3.5
	12. Pachano	29	18	1.5
	13. Jinwa	34	21	2.5
	14. Rudrapur	36	25	2.0
	15. Kusumha	38	22	6.0
	16. Bhiria	62	43	8.0
Total		**689**	**468**	**64.0**
Pokharbhitwa		54	31	13.2
	1. Kalyanpur	21	16	1.0
	2. Hasanpur	27	19	0.4
	3. Dubahra	32	23	0.4
	4. Mehradeur	36	24	0.8
	5. Parsa Nagra	28	21	0.6
	6. Vishunpurwa	27	19	1.0
	7. Pakri	25	16	0.4
	8. Loharpurwa	22	17	0.6
	9. Saraiya	37	27	0.8
	10. Darwa	37	26	0.4
	11. Belhasa	36	25	0.4
Total		**329**	**264**	**20.0**

continued

Table 15 continued

Satellite Village	Sub-satellite Villages	Arable land (ha)	Area (ha)	
			Under wheat	Under ZT wheat
Tangpara		42	34	21.0
	1. Krishna Bhagawati	81	60	2.0
	2. Daridiha	53	38	6.0
	3. Bhainsahia	41	32	5.0
	4. Sarkuria	21	16	2.4
	5. Chhabilaha	24	19	3.0
	6. Barighata	19	15	1.5
	7. Padmapur	20	14	0.8
	8. Bharohiya	18	13	0.6
	9. Bhuwar Sarai	39	26	2.4
	10. Bankatwa	33	24	3.2
	11. Chandideeh	31	26	2.0
	12. Chanda Dubey Pakri	26	18	3.0
	13. Devrar	16	11	0.4
	14. Changerwa	42	34	2.0
	15. Bhadeshar Nath	24	17	4.0
	16. Harriya	37	34	2.5
	17. Badware	28	22	2.6
	18. Satdeiya	24	16	1.5
	19. Bhadeshwarnath Tiwari	36	24	3.8
	20. Mishraulia	46	34	8.4
	21. Kaithwalia	29	20	4.0
	22. Raja Chak	33	26	3.5
	23. Bhitaha	22	16	0.4
	24. Bharpura	14	10	0.4
	25. Laukihwa	12	7	0.2
	26. Mahson	62	40	2.0
	27. Dudhaura	47	34	2.0
	28. Nagara	30	21	0.4
Total		**950**	**701**	**91.0**

continued

Table 15 continued

Satellite Village	Sub-satellite Villages	Arable land (ha)	Area (ha)	
			Under wheat	Under ZT wheat
Bangawan		22	14	6.0
	1. Sarwalia	34	20	3.0
	2. Luxmanpur	28	19	2.6
	3. Sikta	39	26	4.0
	4. Keutali	36	21	3.4
	5. Basantpur	30	20	2.8
	6. Manauri	28	15	3.5
	7. Ratanpur	24	13	2.8
	8. Walterganj	22	10	2.4
	9. Azgawan	31	22	5.5
	10. Sarpur	35	24	6.0
	11. Nankar	37	28	3.0
Total		**366**	**232**	**45.0**
Suruwarkala		52	36	6.0
	1. Rudhauli	67	49	4.0
	2. Bharauli	38	27	2.6
	3. Bhusuri	32	24	1.8
	4. Suruwarkhurd	36	26	3.2
	5. Kathakpurwa	28	21	1.8
	6. Hanumanganj	58	40	3.4
	7. Dhansa	42	31	2.0
	8. Baskhorkhurd	31	23	1.6
	9. Mahra	26	19	1.0
	10. Karmakala	56	42	4.8
	11. Mustafabad	43	31	2.2
	12. Athdama	85	57	4.8
	13. Sagra	65	48	3.6
	14. Siharikhurd	44	31	3.8
	15. Siswa	34	26	0.8
	16. Tighra	39	27	1.4
	17. Darwa Pandey	41	32	2.0
	18. Pachari	52	41	10.0
Total		**792**	**631**	**57.0**

continued

Table 15 continued

Satellite village	Sub-satellite villages	Arable land (ha)	Area (ha)	
			Under wheat	Under ZT wheat
Kusaura		40	28	4.5
	1. Banipur	39	26	6.2
	2. Bisav	30	16	2.0
	3. Bhoyar	38	23	3.8
	4. Kalwari Ahetmali	56	41	2.5
	5. Rojhiya	41	30	3.0
	6. Padmapur	33	24	3.5
	7. Chhabaila	28	21	2.5
	8. Barhanpur	52	38	1.8
	9. Pallia	38	31	3.0
	10. Kalwari Mustahkam	84	60	4.0
	11. Nauli	37	29	4.2
	12. Govindapur	28	21	2.0
	13. Kachore	25	16	3.0
	14. Narainpur	39	27	3.0
Total		**608**	**431**	**49.0**
Bairagal		57	40	12.6
	1. Dubaulia	56	41	6.2
	2. Mahrajganj	48	34	5.5
	3. Raja Patkhauli	37	24	4.0
	4. Aksara	34	20	4.8
	5. Gulauri khurd	28	16	2.0
	6. Rakhiya	39	24	3.5
	7. Manjharia	33	22	4.4
	8. Madhana	28	20	2.5
	9. Gothwa	25	14	1.2
	10. Thanekhas	36	24	4.0
	11. Pokhra	44	32	6.0
	12. Belwadari	31	24	3.2
	13. Deoria	39	27	4.0
	14. Uji	44	31	3.0
	15. Kusmaur	52	37	5.0
	16. Kaurikol	40	28	4.0
	17. Baghadeeha	37	24	3.4
	18. Naktidei	34	22	2.7
Total		**742**	**504**	**82.0**

continued

Table 15 continued

Satellite village	Sub-satellite villages	Arable land (ha)	Area (ha)	
			Under wheat	Under ZT wheat
Pariya		58	40	15.0
	1. Pipri	32	21	3.0
	2. Deipar khurd	41	30	4.8
	3. Pokhar	38	26	3.0
	4. Kakarailia	32	18	2.6
	5. Bhujainia	29	17	1.4
	6. Muradpur	42	30	6.3
	7. Deipar Bujurg	39	27	0.8
	8. Bhadikhurd	46	33	3.4
	9. Jinwa	58	30	2.8
	10. Narhariya	47	32	3.6
	11. Barosar	52	31	3.8
	12. Saltauwa	70	51	6.8
	13. Pachanu	42	30	4.6
	14. Belhasa khurd	46	31	2.0
	15. Mehar daur	38	27	1.8
	16. Banjara	28	17	0.6
	17. Rudrapur	33	24	2.2
	18. Nagaicha	49	32	3.0
	19. Chhanwatia	43	3.0	2.0
	20. Mujaffrabad	47	32	3.5
Total		**910**	**582**	**77.0**
Belahra		64	41	6.0
	1. Umra khas	90	70	14.0
	2. Shiva	67	46	6.4
	3. Dasia	68	45	4.2
	4. Puraina	71	53	3.0
	5. Pipra Sansarpur	48	30	6.0
	6. Kusumha	40	26	1.4
	7. Chamanganj	39	27	1.0
Total		**487**	**338**	**42.0**
Darideeha		53	38	10.0
	1. Bhadeswar nath	24	17	3.0
	2. Mahadeva	76	50	7.0
	3. Padmapur	53	39	4.0
	4. Bhitaha	32	21	1.0
	5. Mudwara	39	27	1.0
	6. Mahson	62	40	5.2
	7. Mishraulia	46	34	4.8
	8. Bharohia	18	13	2.0
	9. Krishna Bhagauti	81	60	8.0
Total		484	339	46.0

Table 16: ZT machines supplied by UP Ago, Basti to districts

Year	Total number of ZT machines sold per district			Overall total number of ZT machines sold
	Basti	Siddharth Nagar	Sant Kabir Nagar	
2005-06	2	1	2	5
2004-05	6	5	3	11
2003-04	1	2	1	4
2002-03	1	1	1	3
Sales forecast for 2006-07	**5**	**7**	**6**	**21**

3.3. Analysis of the results from output three

The project team has made concerted efforts in promoting the uptake and adoption of new technological practices (ZT machines) among the farming community. Different strategies have been adopted (as shown in the section covering Output 2) to reach all socio-economic groups of farmer. Although the results are encouraging in that there appears to be more adoption of the technology among marginal and subsistence farmers, however, the landless group of farmers remains untouched by developments. The reason for this is simply that they do not own the land to benefit from these agricultural technologies. The only way they could benefit is if they hired land on a lease basis, or if they became involved with one of the larger farmers in a ZT entrepreneurship.

Many of the project satellite and sub-satellite villages have been visited for the first time during the implementation of the CABI project over the last 3 years. In this time the project team has developed good rapport with the villagers. It has been difficult to convince farmers (in all socio-economic groups) about the benefits of the adoption and uptake of a new agricultural practice or technology when they have been using the same methods and practices for decades. With this in mind, the project team has succeeded in that there is enthusiasm and interest in further adoption, however small the percentages are. What remains to be seen is whether the percentage of adoption will continue to increase after the completion of the CABI project. The CABI/CIMMYT team will recommend that the project team keeps some records of this progress through completing a simple template. It is anticipated that over time a real picture of success will emerge.

Overall Discussion of the results from three outputs

Output 1

Impact studies of using the zero tillage machine

These livelihood impact studies have captured the impact of the introduction of the ZT (zero tillage) machine on the livelihoods of farmers from different socio-economic backgrounds. Overall the impact is positive with saving being made on input production costs and time taken in the agricultural operation. Any yield increases could result in increased food security for some farmers.

However, the negative impact seems to be on the labourers who are no longer being employed to work on land preparation. It is thought that these labourers are now employed in other work. During field work, farmers did comment on the fact that there was a 'shortage of labour to do agricultural work such as land preparation and sowing'. With this in mind, the ZT machine can be considered as a positive alternative to using labour which is already scarce. However, the scale and the extent of the employment issue remain unclear and would perhaps warrant further investigation.

In terms of adoption, it would also appear that the marginal farmers have the least level of adoption. This is not surprising since this is the only socio-economic group that did not receive any specific training in its use. Other reasons are that they have a much lower risk bearing capacity and have small and fragmented land holdings which may be unsuited to 4-wheel tractor-based land preparation systems. The aim of this project was to increase the adoption by the poorest, such as the marginal and landless farmers. The project team did acknowledge this need and have conducted further investigations to determine the best mechanisms to get information to these groups so that they can also benefit from the impact of the technology.

Output 2

Agricultural knowledge systems pertaining to zero tillage machine

There are many sources of information available to farmers, ranging from formal government bodies, through to informal farmers' fairs and personal contacts via *chaupal* meetings. In terms of effectiveness, generally all the farmers ranked direct contact with extension staff at the KVK as the most effective means of information transfer followed by exchanges between family members and neighbours. The private sector and the state machinery sector were seen to be the least effective. Women farmers have the fewest sources of information available to them. The results of this research suggest that women are dependent on male family members for new knowledge and information (Fig. 8).

Fig. 8. Women farmers have least access to information

Farmers were able to identify why some knowledge transfer systems are more effective than others. Many of the weaknesses originate from inappropriate institutional support, e.g. an extension service that is not skills oriented, with an inability to reach the poorer farmers. For example promotional literature is not understood by poorer farmers, most of whom are illiterate. The subsidy awareness programme and sales promotion were unable to convince the poorest farmers of the benefits of adopting new technologies.

These weaknesses were reflected in farmers' reasons for not adopting the ZT machine. The project team developed a strategy which was supposed to reach each socio-economic category of farmer and in order to improve access to ZT technology by the poorest farmers. The results of this study demonstrated that the marginal farmers accessed their information from farm based activities ranging from exposure visits to local farms, demonstrations on site, and local field days. Subsistence farmers preferred more skills based training programmes. Large farmers were keen for exchanges with agricultural extension staff, manufacturers and scientists. In order to address the specific needs of women, the project team focussed on a community approach to training and held workshops especially for women farmers.

These findings reveal that different socio-economic categories of farmers prefer different sources of information, and this is based on their ability to absorb the information that is provided. In terms of the ZT machine, if farmers were provided with information on the benefits of the machine in a manner that could be understood by all the community, then there is the likelihood of the machine being adopted on a much wider scale than is at present.

Output 3

Creating enabling environments

The project team did capture the impact of the adoption of the ZT machine after the knowledge dissemination strategies had been developed and put in place. The results showed that the adoption among the subsistence and marginal groups was increasing whereas the adoption by the large farmer groups was decreasing. The explanation for this was that the machines that were being 'adopted' had been provided free of cost by KVK Basti via CIMMYT as an exposure model to generate interest. The suitability of this method of promotion has merits and drawbacks. The food surplus farmers had been provided with ZT machines, free of charge, prior to the CABI project and since the CABI project began, the machines have been being hired out to the marginal and subsistence farmers, resulting in considerable profits. The real test of the sustainability of this strategy will be when the demonstration model is finally removed from the villages. Whether the farmers will purchase their own machines will be an indicator of successful adoption. Data collected by the research team showed that the number of machines purchased actually decreased between 2004-05 and 2005-06. However the forecast was for an increase in sales in 2006-07. The project team needs to keep track of these sales figures as it would indicate whether the ZT system can be sustained economically.

Data were also collected on the further dissemination of the ZT technology. The results show that in the project satellite and sub-satellite villages the percentage of wheat sown using the zero tillage machine ranged from 8-16% of the total area sown to wheat using the traditional method. Although this figure is small it does indicate that there is some change taking place even during the short lifespan of this project. However, the real indicator of success will be when this percentage figure rises in to 70, 80 or 90% in these project satellite and sub-satellite villages and beyond. How long this process will take remains unknown but it would be worthwhile for the project team to keep track of this.

Final conclusion on assessing the impact and facilitating the uptake of resource-conserving technologies in the Basti area of India

The results of this research project, revealed some interesting findings. Firstly, the project has demonstrated that the ZT machine can benefit marginal, subsistence and food surplus farmers in terms of labour costs and increased wheat productivity. However the issue of labour displacement was highlighted during this research and the real extent of the problem remains unclear. The fact that there are employment opportunities in the nearby towns is encouraging but this may not always be the situation. However, there is a labour shortage at certain times of the year and this could be further impacted by the spread of ZT technology.

This research also concludes that farmers' requirements for new knowledge and information vary according to their socio-economic group. It is recommended that any new RCTs that are introduced by the project team are accompanied by an appropriate strategy to provide knowledge and information that enables all socio-economic groups to benefit from it.

The project team made some progress in facilitating use of the ZT machine by marginal farmers. This facilitation was assisted by the fact that several ZT machines were already being deployed (via KVK and CIMMYT) mainly by food surplus farmers for "demonstration" purposes. These farmers have realised that they can profit more from hiring the machine out to neighbouring marginal farmers, instead of using it on their own land. This can be seen as a win–win situation so long as the marginal farmers are gaining through reduced production costs. However, the real test of long term adoption will only be realized once the demonstration machines are removed from the villages. Until this is done there will no sense of ownership, or of the true economic cost of operating the machines. As a recommendation it is suggested that removal of these machines is done sooner rather than later.

Appendix 1:

Details of Operational Research Site at Basti

Country	India
State	Uttar Pradesh
District	Basti
Villages	1. Vishunpurva (adopted village before impact study) Technology - Zero till 2. Dammar Jot (non-adopted village before impact study) Technology-Conventional till
Implementing agency	Directorate of Extension N.D. University of Agriculture & Technology, Kumarganj, Faizabad-224 229, Uttar Pradesh, India
Starting date	June 2003
Site Manager	**Dr. C.M. Singh** Director Extension N.D. University of Agriculture & Technology, Kumarganj, Faizabad-224 229, Uttar Pradesh, India Tel.: 05270-262821 (O) 05270-262025 (R) Mobile: 9415328617 Fax: 0527-262821

Investigators

1. Dr. R.V.Pandey
(Specialization in Soil Science)
Additional Director Extension
NDUAT, Kumarganj, Faizabad
Tel.: 05270-262821 (O)
05542-246855 (R)
Fax: 05270-262821

2. Dr. Tribhuwan Singh
(Specialization in Agronomy)
Officer-in-Charge
Krishi Vigyan Kendra, Banjaria Farm
P.O.-Kataya
Distt. Basti-272 302 (U.P.), India
Tel.: 05542-248019 (O)
05542-285380 (R)
05542-315535 (M)

3. Dr. (Mrs.) Abha Singh
Social Scientist
L/31, Neel Vihar Colony
P.O.-Ram Nagar Colony
Distt.-Faizabad (U.P.), India
Tel.: 05278-246393
Email: hnsingh@sancharnet.in

4. Dr. Nishat Akhtar
(Specialization in Fisheries)
Project Assistant
Krishi Vigyan Kendra, Banjaria Farm
P.O.-Kataya
Distt. Basti-272 302 (U.P.), India
Tel.: 05542-245263 (R)
Mobile: 9415037449

Survey Description of Selected Sites

Village name	**Vishunpurava**		
No. of households	66		
Distance from nearest town (Km)	20		
Irrigation sources	Electric tube-wells and diesel pump sets		
Topography	Flat		
Soil fertility status	N: Low, P_2O_5: Low, K_2O: Medium Deficiency of zinc and sulphur in soil		
Soil type	Clay loam		
No. of farms	89		
Average land holdings (ha)	1.39		
Cropping pattern	Rice–Wheat Sugarcane–Wheat Sugarcane–Rice		
Summary of socio-economic information	**Caste-wise distribution of families**		
	Caste	No.	%
	Kshatriya	4	6
	Mushlim	9	14
	Kurmi	20	30
	Konhar	1	2
	Kanhar	3	4
	Dhunia	10	15
	Harijan	17	26
	Washerman	2	3
	Total	66	100
	Community-wise distribution of families		
	Particulars	**No.**	**%**
	General	13	20
	OBC	34	51
	SC	19	29
	ST	-	-
	Total	66	100
	Particulars	**No.**	**%**
	Male	340	51
	Female	321	49
	Total	661	100
	Particulars	**No.**	**%**
	Illiterate	457	69
	Literate		
	Up to primary	66	10
	Middle	47	7
	High school	42	6
	Intermediate	38	6
	Graduate	11	2
	Total	661	100
Access to water	Water table 3.5 m in rainy season and 9 m in summer season.		
Important food crops	Rice and wheat		
Current food security	Shortage to assured		
Important cash crop	Sugarcane		
What opportunities for local farmers training are available ?	Krishi Vigyan Kendra, Basti State Department of Agriculture		
Name of local community based organization	Not existing		
Local information sources	• Agri. University (NDUAT)/KVK • State Department of Agriculture • Diversified Agriculture Support Project • All India Radio & Television • Block Community Centre • Seed Certification Agency • Seed Companies/Sellers • Neighbours • Family members		
Predominant local religion	Hindu		
% rice-wheat farmers using fertilizers	100% but not balanced dose		
% rice-wheat farmers using herbicides	40		
% rice-wheat farmers using zero tillage	12		
% rice-wheat farmers using improved seed	100		

Name of improved rice varieties being used	Sarjoo 52, Pant Dhan 10, Pusa Basmati 1, Mahsoori, Sambha Mahsoori, Swarna, T 3, Hybrid Suraj.
Name of improved wheat varieties being used	PBW 343, Kundan, Raj Laxmi, PBW 154, HUW 234, UP 2338
Name of local suppliers of zero tillage machinery	U.P. State Agro-Industrial Corporation, Basti
Name of suppliers of improved seed	• State Department of Agriculture • Co-operative • U.P. State Agro-Industrial Corporation • Tarai Development Corporation • Local private seed sellers
Name of micro credit facilities	Kisan Credit Card through Nationalized Bank (Punjab National Bank)

Village name	**Dammar Jot**		
No. of households	106		
Distance from nearest town (Km)	10		
Irrigation sources	Electric tube-wells and diesel pump sets		
Topography	Flat to sloping		
Soil fertility status	N: Low, P_2O_5: Low, K_2O: Medium Deficiency of zinc and sulphur in soil		
Soil type	Clay loam		
No. of farms	151		
Average land holdings (ha)	0.59		
Cropping pattern	Rice–Wheat Sugarcane–Wheat Sugarcane–Rice		
Summary of socio-economic information	**Caste-wise distribution of families**		
	Caste	No.	%
	Lonia	40	38
	Rajbhar	38	36
	Kurmi	21	20
	Blacksmith	1	1
	Harijan	5	4
	Dharikar	1	1
	Total	106	100
	Community-wise distribution of families		
	Particulars	**No.**	**%**
	General	-	-
	OBC	100	94
	SC	6	6
	ST	-	-
	Total	106	100
	Particulars	**No.**	**%**
	Male	576	52
	Female	534	48
	Total	1110	100
	Particulars	**No.**	**%**
	Illiterate	960	86
	Literate		
	Up to primary	55	5
	Middle	42	4
	High school	30	3
	Intermediate	21	2
	Graduate	2	-
	Total	1110	100
Access to water	Water table 1.5 m in rainy season and 7 meters in summer season.		
Important food crops	Rice and wheat		
Current food security	Shortage to satisfactory		
Important cash crop	Sugarcane		
What opportunities for local farmers training are available ?	Opportunity for training not available		
Name of local community based organization	Not existing		
Local information sources	• State Department of Agriculture • All India Radio & Television • Block Community Centre • Seed Companies/Sellers • Neighbours • Family members		

Predominate local religion	Hindu
% rice-wheat farmers using fertilizers	100 % but not balanced dose
% rice-wheat farmers using herbicides	12
% rice-wheat farmers using zero tillage	Nil
% rice-wheat farmers using improved seed	94
Name of improved rice varieties being used	Sarjoo 52, Mahsoori, Sambha Mahsoori, Narendra 97
Name of improved wheat varieties being used	PBW 343, PBW 154,HUW 234, UP 2338, UP 2003
Name of local suppliers of zero tillage machinery	U.P. State Agro-Industrial Corporation, Basti
Name of suppliers of improved seed	• State Department of Agriculture • Co-operative • U.P. State Agro-Industrial Corporation • Tarai Development Corporation • Local private seed sellers
Name of micro credit facilities	Kisan Credit Card through Nationalized Bank (Allahabad Bank)