



Research Paper

Local Capacity Assessment for Supporting Innovation and Change in the Rice-Wheat System of the Punjab, Pakistan

Nadeem Akmal, Hassnain Shah,
Muhammad Azam Niazi, Sajida Taj, Tabinda Qaiser and Murad Ali

Received 09 November, 2013; Accepted 09 January, 2014 © The author(s) 2013. Published with open access at www.questjournal.org

ABSTRACT:- The study was based on primary data gathered, in which total 234 male and 106 female heads of farming households were interviewed to investigate Local Capacity for supporting innovation and change in the Rice-Wheat System of the Punjab. It was identified that facilities like seed of improved varieties, repair of farm machinery and manufacturing of a few machines were available at local level in the area. In the adoption of new technologies majority of the farmers had no conflicts or political influences. Overall, 66% respondent farmers reported that drill cost as too high, 47% were of the view the rental charges of Zero Tillage drill were too high, 77% reported prices of improved seed as high, while 55% confirmed formal credit was available to them. Similarly Agricultural Extension and On Farm Water Management were the main institutions delivering information for diffusion and adoption of RCT innovations.

Keywords: Rice-Wheat System, Innovation, Local Capacity

I. INTRODUCTION

It is widely acknowledged that technological innovation is one of the main sources of economic development. Many strategies to improve livelihood in developing countries involve development and dissemination of technological innovation. Various studies have shown that the poor countries rarely benefit from technologies developed, because these are not appropriate for application under their socioeconomic and agro-ecological environment. One of the solutions to this problem for developing countries is to build local capacity to generate and modify technologies according to their needs and circumstances of the local environment.

Most of the time collective action (with or without material support from outside the community) is also an additional support. In each village, there are unique problems and opportunities, which need a locally planned response. This highlights the limitations of extension and advisory services, which provide a uniform, centrally planned set of activities. The combination of methods used in the study helped to articulate local needs, adoption behavior, support system for innovations, aspirations and constraints in a way that initiated a dialogue between farmers and advisers. There have been a lot of innovative developments and change in farming systems over the past 20 years. Most innovations during that time have come to address the productivity issue (new breeds of animals, crop varieties, agronomic practices, machinery). Most of them have been well adapted to the local environment and situation. But local farming systems do face severe constraints which individual farmers are unlikely to be able to solve without the development of local capacity to support innovations. Particularly, innovations from formal sources have been less well adapted to the local environment.

Governmental, regional and local agencies and Research and Development institutions promote innovations and new technology through different investment tools and build innovation support systems locally. Innovation systems or environments are one set of tools promoting innovation capacity of the local actors (stakeholders). National Agricultural Research System (NARS) is a part of local innovation supporting system and a part of the innovation building capacity.

The Punjab's rice-wheat cropping system being a component of South Asia Rice Wheat system plays a key role in sustaining national food security and remained center of many research and development activities. However, the yields of these crops are not increasing with same pace as in earlier years (Mann and Garrity, 1994). There is a substantial gap between actual and potential yields in Pakistan's rice-wheat systems (Byerlee *et al.* 1984 and Sheikh *et al.* 2000). The productivity of this important cropping system has been decreased or stagnated (Randhawa, *et al.*, 1981; Aslam, *et al.*, 1993 and Aslam, *et al.*, 1991). The purpose is to identify the

elements that are facilitating and impeding innovation. This understanding may then be used to further improve the innovation environment, and would help to maximize the innovation potential.

To eradicate hunger and poverty, improvements in such areas as infrastructure (e.g., water availability and distribution), communication and education, health and agricultural innovations are needed. At the same time, the adoption of agricultural innovations remains critical too. The present study was designed to identify the role of local capacity for supporting innovations and technological change that enable farmers to access and adopt the innovations that could help for sustainable production. The study focused on local capacity for supporting agricultural innovations and change with the following objectives.

OBJECTIVES

1. To study the resource compatibility of communities for supporting new technologies
2. To assess the capacity (financial and technical) of local institutions for supporting new technologies
3. To suggest policy measures for strengthening local capacity for supporting innovations.

II. METHODOLOGY

This study was specifically planned to study Local Capacity for supporting innovation and change in the Rice-Wheat System of the Punjab. The study was based on primary data gathered through a formal survey conducted in the rice-wheat system of irrigated Punjab. Before designing the questionnaire, technical discussions with experts like breeders, agronomists, pathologists and engineers in the farm machinery institute, National Agricultural Research Centre, Islamabad were held. On farm size and land ownership basis, the farming population of the study area was divided into four categories, i.e. landless, marginal, and self sufficient/subsistent and cash croppers. The classes of farmers who possess no land and obtain land from some land owner on rent or share basis but not greater than 5 acres were classified as *landless farmers*. At least one adopter respondent tried selected from ZT promoted village. The *marginal farmers* were those who have less than 2.5 acres of land, just sufficient for food security needs of the household, do paid labor in order to buy inputs as well as food to makeup the shortfalls. At least one adopter respondent was selected from ZT promoted village. The term *self-sufficient/ subsistence farmers* pertains to farming households having land holding bigger than marginal farmers but not greater than 12.5 acres. These farmers have just enough land to guarantee household food security under normal conditions. However, (s) he must do paid labor in order to buy inputs. At least one adopter respondent was selected from ZT promoted village. The farmers possessing more than 12.5 acres of operational holding were placed under *cash cropper farming* class. Such farmers have enough land to guarantee household food security while the surplus land is used to grow cash crops and the income from cash crops is used to finance farm inputs. These farmers selling more than 85% of the produce as marketable surplus are grouped in this category. At least one adopter was selected from ZT promoted village.

A separate questionnaire was also designed for interviewing the wives of the sample farmers. The sample was drawn from three districts namely Gujranwala, Sheikhpura and Sialkot. Keeping in view the financial and time constraints, the formal survey was conducted in 4 Tehsils of Gujranwala, 3 Tehsils of Sheikhpura and one Tehsil of Sialkot district (Table 1).

In total 234 male and 106 female heads of farming households were interviewed. The composition of sample respondents by ZT adopter categories, gender and farming class is presented in Table 2 below and in sample districts in Table 3. Descriptive analysis was conducted on the gathered information from the respondent farmers.

Table 1: Distribution of sample villages and tehsils in the study area

Districts	No. of Tehsils	No. of Villages
Gujranwala	4	20
Sialkot	1	8
Sheikhpura	3	12
Total	8	40

Table 2: Distribution of sample farmers (#) by gender, adopters across farming categories

Category	Adopters		Non-adopters		Dis-adopters	
	Male	Female	Male	Female	Male	Female
Landless	5	2	8	5	1	0
Marginal	4	3	18	27	7	2
Subsistence	23	9	51	18	13	4
Cash Cropper	33	17	39	14	32	5
Total	65	31	116	64	53	11

Table 3: Distribution of sample farmers (#) by gender, adopters across districts

District	Adopters		Non-adopters		Dis-adopters		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
Gujranwala	29	15	46	26	32	6	107	47
Sialkot	13	8	33	15	6	1	52	24
Sheikhupura	23	8	37	23	15	4	75	35
Total	65	31	116	64	53	11	234	106

III. RESULTS AND DISCUSSION

1.1 Socio-economic Profile and local capacity to support innovations

The availability of different assets determines the capacity to adjust with different changes, requirements and even shocks in the society. Therefore, the present position and availability of different assets to the communities in relation to the adjustments with the new knowledge and technologies was studied. All these assets and capitals determine the socio economic profile and in turn had their impact on the improvement of livelihood of the people.

The socio economic conditions have direct relationship with the capacity to support innovation and change, as there are distinct differences in information seeking behavior and technology acquisition between gender and socio-economic categories within farming communities. Although there is an increasing interest in “innovation” and particularly in the outcomes of innovation in new products and processes in this technological era yet a great attention has also been focused on the pre-conditions for innovation and to attempt to identify and reproduce factors which are understood as being necessary to support and foster an “innovation culture” or “climate” that can keep pace with the emerging requirements. Therefore the socioeconomic profile of the sample respondents was studied covering, age, education, family size, access and control over natural physical and financial assets. These factors in turn can portray the real picture of capacity farming community to support the innovation and the impediments to adopt these novelties.

1.2 Human Capacity at Local Level

Human capital is the most important asset of any nation, which directs all other assets for its betterment. The age, education, experience, availability of labour force etc, directs the decisions and choices regarding the adoption and adjustments of innovations both at local and institutional level. The information was collected from those farmers who were actively involved in farming activities. On overall basis the adopter farmers were of little less age (42 years) as compared to disadopters (44 years) and non adopters (45 years). The results indicated (Table 4) that the tendency to adopt or test (in case of disadopters) new technology is higher in lower age group (with the exception in case of marginal farmers only). The difference in female average age was not very significant in all categories. The results indicated that the middle age group generally respond positively to new ideas and take risk to test or adopt the innovative techniques.

Table 4: Average Age (years) of the sample respondents by ZT adopter and farmer categories.

Farmer categories	Adopters		Non-Adopters		Dis-adopters		Overall	
	Male	Female	Male	Female	Male	Female	Male	Female
Land less	52	39	43	36	42	NA	46	37
Marginal	54	31	51	47	44	44	50	45
Subsistence	44	43	46	47	44	49	45	46
Cash cropper	39	42	46	41	43	40	43	41
Overall	42	41	47	45	43	44	45	44
Statistical significance Male = 0.146								
Statistical significance Male = 0.235								

Source: Survey, 2009

1.3 Education level

It is generally believed that the best investment of all is the one made in human capital development. Hence, high educational accomplishment may entail a larger set of employment opportunities, and specifically in a rural context a better awareness of the full potential of the new agricultural technologies and associated agricultural practices (Malik, 1996). Similar picture has been observed through the present study, as the cash croppers had the highest education levels, followed by subsistence, marginal and landless farmers both in case of males and females, family education level of the cash cropper was highest, followed by subsistence, marginal and landless farmers (Table 5). The results also indicate that the education level of non-adopters was less as compared to adopters and disadopters. In all the farmer categories the farmers’ families were more educated than the farmers themselves that shows the increased importance given to education by the farmers.

Table 5: Mean education (schooling years) by ZT adopter and farmer categories.

Farmer categories	Adopters		Non-adopters		Dis-adopters		Overall	
	Male	Female	Male	Female	Male	Female	Male	Female
Land less	3	5	4	2	0	0	3	3
Marginal	5	6	4	3	6	3	5	3
Subsistence	5	3	5	3	6	4	5	3
Cash cropper	9	6	6	6	9	7	8	6
Overall	7	5	5	4	7	5	6	4
Statistical significance (Male) = 0.000								
Statistical significance (Female) = 0.011								

Source: Survey, 2009

1.4 Farming Experience

Farming experience depicts the overall involvement of farmer in farming activities. The experience and age have direct correlation, normally more the age more the farming experience. Farming experience of marginal farmers was highest followed by subsistence, land less farmers. The cash croppers were youngest so naturally had lowest farming experience. Similarly the farming experience of non-adopters was highest, followed by adopters and disadopters. The overall farming experience mean of the study area farmers was 24 years.

Table 6: Farming experience (years) of sample farmers by ZT adopters and farming categories.

Category	Adopters	Non-Adopters	Dis-Adopters	Overall
Land less	23	22	18	20
Marginal	33	30	24	29
Subsistence	23	25	23	24
Cash Cropper	19	27	21	22
Group Total	24	26	21	24
Statistical significance = 0.113				

Source: Survey, 2009

1.5 Land Holding

As the farmers were classified on the basis of their own land holding therefore the average own land holding increases from marginal to cash croppers. Those farmers who did not have their own land and only leased in or shared in the land were classified as landless farmers. Overall, the average land holding of the farmers was 19.40 acres. The capacity of the farmers to adopt new technologies and take risk mainly depends upon their ownership or access to assets. Land holding is the most important and vital asset of the farming community on which their livelihood depends and their decision regarding the adoption of any new technology is also dependent on it. The same is evident from the survey results that that the average land holding of the adopter/disadopters farmers was higher than non adopters.

Table: 7 Land Holding (Acres)

Category	Adopter	Non adopter	Disadopter	Overall
Land less	0.0	0.0	0.0	0.0
Marginal	2.9	4.8	4.7	4.5
Subsistence	6.0	5.2	8.8	5.9
Cash Cropper	46.9	25.4	42.1	37.4
Group Average	26.1	11.6	28.2	19.4
Statistical significance = 0.000				

Source: Survey, 2009

1.6 Assets Holding

Assets indicate the well being and capacity of the farmers to take risks. Therefore, to examine the capacity and standard of living of the households, their ownership was solicited for a selective inventory of seventeen household and farm items. These indicators of wealth were ownership of refrigerator, cycle, car, telephone, washing machine etc and farm implements like tractor, zero till drill, thresher etc. It can be concluded that majority of the tractor owners of those areas where ZT technology was promoted by OFWM department are not yet convinced enough to invest in this technology on their own.

Regarding the age of farm and household assets, the sewing machines, radio, car and bicycle were the oldest household assets possessed by the sample farmers. In farm assets, tube well, tractor and disc ploughs were the old farm assets possessed. By adopter categories, in general, the age of farm and household assets was highest in case of cash croppers and lowest in case of landless farmers (Table 9). For some assets, the position of marginal farmers is relatively better than subsistence while for others; the opposite can be observed (Table 8).

Table 8: Number of years of assets

Assets	Landless	Marginal	Subsistence	Cash Cropper	Overall	Probability
Household Assets						
Sewing machine	10	12	13	15	14	0.396
Radio	10	14	12	13	13	0.926
Car / vehicle	-	2	5	17	12	0.571
Bicycle	15	9	10	12	11	0.357
Tape recorder	3	8	8	9	9	0.801
Refrigerator	-	7	6	9	8	0.133
Disc / rotavator	-	12	4	8	8	0.671
Motorcycle/ scooter	-	10	5	9	8	0.519
Television	2	5	8	10	8	0.023
Washing machine	6	9	6	9	8	0.151
Telephone	-	4	3	5	4	0.419
Farm Assets						
Tube well	8	10	12	15	14	0.248
Tractor	-	11	6	13	12	0.156
Disc / rotavator	-	8	4	12	8	0.671
Hand sprayer	4	4	6	7	6	0.780
Zero-till drill	-	-	3	4	4	0.994

Source: Survey, 2009

1.7 Community participation/linkages with innovation supporting activities

The participation of the farmers or their involvement in innovation supporting activities is also a source of capacity building of farming community. However, the farmers were found liking trainings, sowing demonstrations and farmer field days relatively more than other activities. It was found that the linkages of the farming community with different institutions were very poor. However, in relative sense, the situation at subsistence and cash croppers' farms is comparatively better than landless and marginal sized farms (Table 9).

Table 9: Social and economic factors (% yes) hindering access to RCTs

Activities	Landless	Marginal	Subsistence	Cash Cropper	Overall	Probab.
Trainings	3	6	7	14	6	0.243
Sowing demonstrations	-	-	3	8	5	0.212
Farmers field days	-	3	6	6	5	0.782
Harvesting demonstrations	-	-	2	3	2	0.746
Participation in farmers field schools	-	1	-	3	1	0.364
Visits to research stations	-	-	-	1	0.4	0.740

Source: Survey, 2009

2. Local Capacity of Supporting Innovations and Change

2.1 Availability of technology support infrastructure at local level

Regarding the presence of various agencies or facilities available at local level, it was revealed that facilities like seed of improved varieties, repair of farm machinery and manufacturing of a few machines were available at local level in the area (Table 10). This implies that the technology dissemination infrastructure is available locally.

Table 10: Presence of technology support institutions at local level by respondent types

Items	Landless	Marginal	Subsistence	Cash Cropper	Overall	Probability
Males(% yes)						
Availability of seed of imp. variety	79	56	71	73	71	0.349
Availability of repair & spare parts	50	44	52	57	51	0.194
Manufacturing of new farm machinery at local level	29	39	43	53	46	0.157
Seed farms of seed company in area	7	4	5	11	7	0.402
Registered seed grower in the area	7	0	4	8	2	0.057
Females (% yes)						
Availability of seed of imp. variety	57	28	61	56	49	0.017
Manufacturing of farm machinery at local level	29	16	42	31	29	0.062
Availability of repair & spare parts	29	25	32	25	27	0.419
Registered seed grower in the area	3	4	3	2	3	0.134
Seed farms of any seed company in the area	1	2	2	3	2	0.218

Source: Survey, 2009

2.2 Availability of technology support from extension

Regarding the availability of technological support from the department of agricultural extension, a notably high proportion of farmers reported having contact with agricultural extension department and the availability of required guidance from them. Although the females of each farming family have reasonable practical contribution and role in decision making of farming activities but they had no contact with extension agents because of cultural bindings and no recruitment of female extension agents in the extension system. Females were asked about the guidance of their males or invitation for field days and their response was “do not know” or simply “no” for each extension factor (Table 11).

Table 11: Seeking guidance from extension about improved technologies by respondent type-

Items	Landless	Marginal	Subsistence	Cash Cropper	Overall	Probability
Males (% Yes)						
Contact with extension	14	37	45	52	43	0.039
Required guidance available	29	36	45	42	39	0.587
Invitation from extension to participate in field days	7	17	17	20	18	0.681
Literature on new RCTs available	-	11	21	23	19	0.125
Females(% Yes)						
Contact with extension	-	0	0	0	0	-
Required guidance available	0	0	0	0	0	-
Invitation from extension to participate in field days	0	0	0	0	0	-
Literature on new RCTs available	0	0	0	0	0	-

Source: Survey, 2009

2.3 Financial matters influencing access to RCTs

Regarding the nature of financial matters influencing access to RCTs, overall, 66% respondent farmers reported that drill cost was too high, 47% were of the view the rental charges of ZT drill were too high, 77% reported about high prices of improved seed, and 55% about the availability of formal credit. About respondent categories, a declining trend across categories was observed regarding high price of ZT drill, stagnating for rental charges, and increasing for availability of formal credit (Table 12). The concerns about the price of ZT drill or its custom hiring services are according to *a priori* expectations. For further demand, efforts were develop cheaper drills so that their rental charges could possibly drop.

Interviews of the female respondents revealed the following information: 21% respondents reported that drill cost was too high, 16% were of the view the rental charges of ZT drill were too high, 33% reported about high prices of improved seed, and 5% about the availability of formal credit. About respondent categories, no clear trend across categories was observed (Table 12). Many females did not know about the cost of drill, rental charges and price of improved seed etc.

Table 12: Financial matters influencing access to RCTs by respondent type

Items	Landless	Marginal	Subsistence	Cash Cropper	Overall	Probab.
Males						
Drill cost not affordable (% yes)	85	72	67	59	66	0.012
Rental charges too high (% yes)	50	49	45	41	47	0.713
Price of imp. seed not affordable (%yes)	93	72	76	76	77	0.894
Availability of formal credit (% yes)	-	52	67	72	55	0.003
Females						
Drill cost not affordable (% yes)	43	19	14	6	21	0.522
Rental charges too high (% yes)	14	12	26	8	16	0.312
Price of imp. seed not affordable(%yes)	43	25	25	42	33	0.361
Availability of formal credit (% yes)	-	6	6	3	5	0.581

Source: Survey, 2009

3. Extension and development Institutions

Agricultural Extension and On Farm Water Management were the main institutions delivering information for diffusion and adoption of RCT innovations. An effort was made to assess the capacity of these institutions in terms of their budget allocation, staff strength and knowledge of the field assistant.

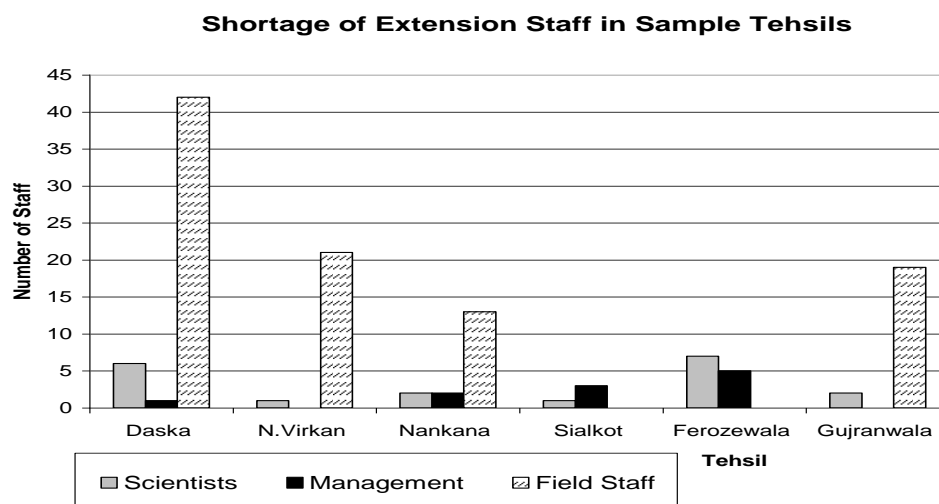
3.1 Budget Allocation

There was a common complaint that after the enforcement of Government's devolution plan the budget position had worsened. The budget was now in the hands of District Coordination Officer and it was up to him how much to release and when. The budget in Traveling Allowance (TA) head was the most complained about. According to the respondents the budget under this head did not cover even one fourth of the expenses of an Agricultural Officer (AO) and the rest of the touring was done at AO's own expense. The Field Assistant (FAs) had no provision of TA. The AOs and FAs were hardest pressed players on the scene. AOs did not have the budget and were dependent on the Deputy District Officer (DDO) for reimbursement of the amount they spent from their own pocket in the first place. This was considered a big bottleneck in the smooth functioning of AO offices. Therefore AOs were of the view that budget release should be given in advance and adjustments should be given after making the expenditures.

3.2 Strengths of Staff

Not only the well qualified but sufficient number of staff is also required for the smooth functioning of any organization. Proper ratio of both the technical and support staff must also be maintained to appoint right person for the right job. These things increase the efficiency of the organization. The knowledge strengths of the

staff were also made the part of inquiry. There was a considerable shortage of staff at the field offices and many posts were reported to be were lying vacant. The field staff includes field assistants, baildars and budders.



3.3 Knowledge of Field Staff

The quality of the knowledge extended is directly related to the quality of knowledge possessed. To find out the views of the extension officers they were asked to rate the quality of knowledge possessed by the officers as well as field staff in their offices and the offices subordinate to them. The rating was in three levels viz. Good, Satisfactory and Poor. Seven out of twelve extension officers could rate themselves and their colleagues as having up to date knowledge, while five out of twelve officers rated their field staff as having up to date knowledge. Overall most of the officers rated their field staff's knowledge as at least up to satisfactory level.

Table 13: Extension's views about the knowledge of Extension Officers and Field Assistants

Knowledge Status	Officers	Field Assistant
Good	7 (58.3)	5 (41.7)
Satisfactory	4 (33.3)	5 (41.7)
Poor	1 (8.3)	2 (16.7)
Total	12 (100)	12 (100)

Source: Survey, 2009

IV. CONCLUSIONS AND RECOMMENDATIONS

Farming communities possess technological knowledge, as well as the capacity to innovate by themselves. These capacities have usually been neglected by the formal research and extension systems. Although most of the farmers in all categories were old and average age group with sufficient farming experience yet their participation in the trainings of the local institutions was very nominal. Literacy level of the active farmers was very poor particularly of landless and marginal farmers.

A significantly high proportion of farmers reported about financial concerns involved in access to the technology, which is understandable. However, the strength of social and economic factors hindering was poor implying that the slow growth in adoption of RCTs like ZT drill and laser leveling is due to financial constraints. The facilities like availability of spare parts and improved seed, manufacturing of machinery at local level were reported by a notably high percentage of respondent farmers. The degree of contact between extension and male farmers was not so bad while the poor nature of this contact for females is basically due to social and economic reasons as they do not allow the women folk to interact with extension agencies.

The institutions like extension and OFWM had shortage of field staff. The private manufacturers of ZT drill, initially obtained help of Farm Machinery Institute of PARC. Now the further spread of the ZT drill design is basically through visual copying. However, the cost of the drill is still very high and not many can afford to buy it or get its services on rental basis. Other findings of the study are as under:

The linkages of the farming community with different institutions were very poor. However, in relative sense, the situation at subsistence and cash croppers' farms is comparatively better than landless and marginal

sized farms. A considerably high proportion of farmers reported having contact with agricultural extension department and the availability of required guidance from them. However, the case of invitation of farmers for participation in the field days and availability of literature about RCTs was relatively weak.

Recommendations

In the light of above conclusions, the following suggestions are put forward for uplifting the local capacity of the farmers and line departments.

- The farm machinery research institute of PARC is suggested to work intensively in designing a cheap ZT drill through introducing various alterations in design and materials to be used. Keeping in view the resource poorness of majority of the farmers in the area, this recommendation is extremely important especially from landless, marginal and subsistence categories of farmers in the area.
- The department of agricultural extension should be made integrated partner in spreading the RCT technologies especially ZT drill and laser leveling. The staff and training limitations should be resolved through new recruitments and their training.
- The results of the experimental and demonstration plots on zero tillage drill and other resource saving technologies should be included in the media campaign of television through national hookup. This is also relatively important for landless, marginal and subsistence categories of farmers as they have now better access to radio and television than the past.
- The diffusion of rice and wheat varieties should be closely monitored in order to maintain a reasonable level of genetic diversification in the area.

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