# ADOPTION OF RICE TECHNOLOGICAL PACKAGE BY THE FARMERS OF IRRIGATED PUNJAB

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## ABSTRACT

The adoption of modern production technologies has been the concern of developing countries. The assessment of adoption process provides valuable information to the researchers, extensionists and policy makers to identify reasons of low productivity. The present study aimed to observe the adoption level of farmers for rice production technologies. A questionnaire was designed to gather information of various aspects of rice production technologies. A formal survey was conducted in December 2002. A sample of 60 farmers was drawn randomly from 12 villages, selecting four villages from each. Sheikhupura, Gujranwala and Sialkot districts. The results revealed that most of the farmers (>70%) were aware of the rice production technologies. The extreme majority (90-97%) of farmers were fully aware of varieties, land preparation, fertilizer applications, irrigations, pest control and harvesting time.

The findings of the study conclude that some rice production technologies were well adopted while others not. The technologies based on indigenous knowledge had widely been adopted. These technologies include variety selection, raising paddy nursery, land preparation, paddy transplanting and irrigation. However, impositions of non-traditional technologies in conventional set of technologies received partial adoption. These technologies include chemical treatments like seed treatment and chemical weed control and use of pesticides.

**KEYWORDS:** *Oryza sativa;* farmers; technology transfer; Punjab, Pakistan.

## INTRODUCTION

Rice-wheat is one of the major cropping systems of the Punjab covering an area of more than 1.5 million hectare (2). It is spread over the administrative boundaries of districts of Sheikhupura, Gujranwala and Sialkot. In the recent past, new districts, i.e. Narowal and Hafizabad emerged by division of districts Sialkot and Gujranwala, are also the part of rice-wheat cropping systems. Rice, a kharif crop, has edge over other competing crops, as environmental conditions are conducive for fine rice production in rice-wheat area.

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Low agricultural productivity in the developing countries is common. One of the reasons for low yields, is non-adoption of improved and recommended production technologies. Crop production technologies developed by the research scientists have adoption resulting into low productivity.

The adoption of technologies depends on the flow of information system, farmers' resources, their behaviour and prevailing socio-economic conditions. Numerous studies have been conducted on the adoption of individual technologies. But no effort has been made in the past to determine the extent of adoption of crop production technologies as a whole.

The present study has been designed to estimate the adoption of rice production technologies.

## RESEARCH METHODOLOGY

The 'Kallar' belt, typical basmati rice production area of the Punjab, consists of districts Sheikhupura, Gujranwala and Sialkot concentric around Muridkey-Kamoki-Narang Mandi and spreading outward in all directions. Also, the area is the representative of rice-wheat cropping systems of the Punjab. So it was selected as domain for survey of assessment of adoption of rice production technologies.

The recommended rice production technologies consist of varietal choice, nursery raising, land preparation for paddy, nursery transplanting, irrigation schedule, pest management i.e., weed, disease and insect pest control and rice maturity indications to start harvesting. The information on all these aspects was gathered from the agricultural extension and research institutes. For this purpose a document "Rice Production Technology", published by the Agriculture Department, Govt. of the Punjab, was considered as a reference for standard technological package for rice production.

On the basis of informal survey and secondary information, a questionnaire was designed to gather data on farm and farmer's characteristics, socio-economic factors, awareness and adoption level of various aspects of rice production technologies. The questionnaire was pre-tested and required adjustments were incorporated before conducting formal survey in December, 2002. A multi-stage random sampling technique was applied for sample selection. A sample of 60 farmers was drawn randomly from 12 villages, selecting four villages from each district.

To arrive at decisive findings and logical conclusions, the respondents were divided into two main categories i.e. small farmers holding less than or equal

to 25 acres of agricultural land and large farmers holding more than 25 acres of land (Table 1). Three fourth of the farms belonged to small farm size category while one fourth of the respondents belonged to large farm size category.

**Table 1. Distribution of sampled respondents.**

| Districts | No. of Respondents | Farm size groups | | All |
|---|---|---|---|---|
| | | Small (≤ 25 Acres) | Large (> 25 acres) | |
| Gujranwala | 20 | 17 | 3 | 20 |
| Sheikhupura | 20 | 9 | 11 | 20 |
| Sialkot | 20 | 19 | 1 | 20 |
| All | 60 | 45 | 15 | 60 |

## RESULTS AND DISCUSSION

### Socio-economic characteristics of the farmers

*Personal characteristics:* Generally farmers' personal attributes include age, farming experience, education and their status in the community. The adoption of technologies was correlated to these personal characteristics.

Education level of the farmers in the study area was found low, nearly to primary education (Table 2). Most of the studies in the area have similar findings (3, 4). However, large farmers were significantly more educated (9 years of schooling) than small farmers (4.5 years schooling).

Age and farming experience are the other factors that may affect the adoption of technologies. Normally age and experience go side by side. In many cases the effect may be similar. In the study area farming was in the hands of quite experienced persons having more than 22 years of farming experience (Table 2). The survey results revealed that majority of the farms were operated by owners or owner-cum-tenants. Pure tenants were in less proportion (10%).

*Farm characteristics:* Farms characteristics included farm size, family labour involved in farming, traction power, irrigation source and soil type. The average operational land holdings in the study were 26.7 acres. There was significant difference in operational land holding across farm size categories. Large farmers owned 75.2 acres whereas small farmers operated around 10.5 acres of agricultural land.

**Table 2. Socio-economic characteristics of the rice growers.**

| Characteristics | Farm size group | | | Significance* |
|---|---|---|---|---|
| | Small | Large | All | |
| **Personal** | | Years | | |
| Age | 43.6 | 36.8 | 42.0 | .121 |
| Education | 4.5 | 9.3 | 5.6 | .001 |
| Farming experience | 23.3 | 18.9 | 22.2 | .397 |
| **Tenancy status** | | Percent farmers | | |
| Owner | 64.4 | 80.0 | 68.3 | .298 |
| Tenant | 13.3 | 0.0 | 10.0 | - |
| Owner-cum-tenant | 22.2 | 20.0 | 21.7 | - |
| **Land holdings (acre)** | 10.5 | 75.2 | 26.7 | .000 |
| **Family labour** | | Number | | |
| Adult male | 3.2 | 3.5 | 3.3 | .686 |
| Males in Agri. | 2.0 | 2.00 | 2.0 | .938 |
| **Traction power** | | Percent farmers | | |
| Own tractor | 24.4 | 85.7 | 39.0 | .000 |
| Rented tractor | 75.6 | 14.4 | 61.0 | - |
| **Irrigation source** | | Percent farmers | | - |
| Tubewell | 44.4 | 20.0 | 38.3 | .081 |
| Canal + tubewell (both) | 56.6 | 80.0 | 61.7 | - |
| **Land/soil type** | | Percent farmers | | |
| Clay or 'Rohi' | 4.4 | 30.4 | 10.9 | .000 |
| Clay loam or 'Bhari Mera' | 4.2 | 41.9 | 13.7 | .000 |
| Other (kalrathi) | 1.9 | 2.9 | 2.1 | .575 |

*Chi-square and t tests were used for the significance and comparison among groups and means

Tractor was the sole source of farm traction power (Table 2). No farmer was found using animal traction power. There was significant variation in tractor ownership across farm size groups. However, one fourth the farmers owned tractor while rest were hiring the services for land preparation.

Most of rice soils are heavy clayey and clay loams, locally called *rohi* and *Bhari mera* soils (Table 2). Some patches of saline sodic soils (*kalarathi*) were also found in the rice-belt.

## Cropping patterns

Rice and wheat are the major kharif (summer) and rabi (winter) crops, respectively, covering more than 65 percent of the cropped area in both seasons. Two third of the cropped area was under paddy, a cash crop of the area which was the main reason for selecting rice zone for this study. Also the rice-wheat is the dominant sequential cropping system. Fodders are the other important crops of the area in kharif and rabi seasons.

**General sources of agricultural information**

Agricultural information system has been designed to flow the information about new and improved agricultural technologies from research system to extension system and extension to the farmers through extension agents. The survey results indicate that 20 percent farmers had received information through extension and/or research systems while majority of the respondents (76 %) received information about technologies from fellow farmers.

In the last two decades, input supply companies extended extension services to the farmers for promotion of their products and helped the farmers to know about new technologies and techniques to apply inputs. The share of pesticide and other input supply companies in disseminating the agricultural technologies in rice areas, was meager.

The use of electronic media (Radio, TV & internet) is increasing over time. It is believed that electronic media play a vital role in disseminating the agricultural technologies. It was astonished to note that only few farmers had benefited from media (about 2 percent farmers) which might be due to non-suitability of timings of agricultural programmes on radio and TV (1).

**Rice production technological package**

Rice Production Technologies include recommended use of inputs and different practices at various growth stages of the crop according to the recommendations of agricultural experts. The technological package for rice production includes recommended use of varieties, nursery raising, land preparation for paddy, nursery transplanting, following irrigation schedule, weed management, insect and disease control and paddy harvesting schedule.

In the survey, farmers were inquired about their knowledge regarding recommended rice production technologies. Most of the farmers (>70%) were aware of the rice production technologies (Table 3). Knowledge about varieties, land preparation, fertilizer applications, irrigations, pest control and harvesting time was close to maximum (>90%). Application of exotic inputs and non-traditional activities for nursery and pests and disease control lowered down the farmers percentage about knowledge of recommended technologies. In this case complete knowledgeable farmers were less than 80 percent (Table 3).

**Table 3. Farmers' awareness about rice production technologies in the rice-wheat cropping system of the Punjab.**

| Production technologies | Farm size group | | | Significance |
|---|---|---|---|---|
| | Small | Large | All | |
| | Percent farmers | | | |
| Varieties | 90.0 | 100.0 | 97.0 | .620 |
| Nursery raising | 73.6 | 83.5 | 76.1 | .410 |
| Land preparation | 100 | 100 | 100 | - |
| Nursery transplanting | 75.0 | 82.9 | 77.0 | .233 |
| Fertilizer application | 93.3 | 93.4 | 93.3 | - |
| Irrigation | 100 | 100 | 100 | - |
| Weed control | 97.2 | 100 | 97.9 | .780 |
| Insect/disease control | 77.0 | 93.3 | 70.0 | - |
| Harvesting time | 100 | 100 | 100 | - |

## Adoption of recommended rice production technologies

To increase rice yields, agricultural experts are designing a set of rice production technologies (Table 4). The knowledge about technologies does not guarantee for their adoption. There may exist social and economic barriers that do not allow individuals to adopt recommended technologies. The following section deals with adoption of various rice production technologies.

*Variety:* Among all inputs, varietal selection attracts more attention of the farmers. It is an important activity in decision making to initiate rice production enterprise. Generally farmers are in search of new improved varieties. Except 3 percent of rice growers all other farmers of study area have adopted recommended varieties (Table 4). However, many farmers (38.3%) partially adopted in the sense that they have not only planted recommended varieties but also non-recommended. It was a very special case of following non-recommended practices. Non-recommended varieties are early maturing and farmers prefer to plant these varieties for early fodder for their livestock. However, the practice is on a limited area to grow fodder after early rice.

*Raising rice nursery:* Nursery raising is the first activity to be performed in rice production. The activity comprises seed treatment, seedbed preparation, seed planting and application of inputs. The survey disclosed that more than 70 percent farmers raised nursery according to the recommendations of the experts. Nursery raising was more at large farms (81%) than at small farms (71%), as the large farmers were more resourceful and aware of practicing seed treatment and pest control for rice nursery compared to small farmers.

**Table 4. Adoption of recommended rice production technologies in rice-wheat areas of the Punjab (percent farmers).**

| Production technology | Farm size groups | | | Significance |
|---|---|---|---|---|
| | Small | Large | All | |
| Variety | 100 | 86.8 | 96.6 | - |
| Nursery | 71.1 | 80.9 | 73.3 | .247 |
| Land preparation | 88.2 | 100 | 91.0 | .332 |
| Nursery transplanting | 43.2 | 35.7 | 41.4 | .432 |
| Fertilizer application | 65.0 | 67.0 | 65.5 | - |
| Urea + phosphorus | 93.3 | 93.4 | 93.3 | - |
| Potash | 37.0 | 40.0 | 38.0 | .585 |
| Irrigation | 96.3 | 93.4 | 95.0 | - |
| Weed control | 86.7 | 75.0 | 84.2 | .530 |
| Pest control | 77.0 | 93.3 | 69.8 | .420 |
| Harvest time | 93.3 | 78.6 | 89.8 | .139 |

*Land preparation:* All the farmers are well aware of the land preparation for rice nursery transplanting. Ninety one percent farmers have adopted the procedure for field bed preparation for paddy nursery transplantation except nine percent farmers that belonged to small farm size category (Table 4). Main reasons of non-adoption was delay in field bed preparation and early completion of the process by curtailing or minimizing the desired operations.

*Nursery transplanting:* Nursery transplanting is the most labour intensive and cumbersome activity in rice production as it is accomplished manually. In past, many efforts have been made to develop mechanical rice nursery transplanter, without any success. Transplanting labour is generally hired. Manual transplanting is not only labourious but also hired labour does not transplant required number of plants resulting in low yield.

The survey results indicate that 41 percent of the farmers successfully transplanted rice nursery timely and achieved the target of required plant density (Table 4). The problem was severe with small farmers because they face more labour problem to complete transplanting.

*Application of chemical fertilizers:* The farmers of study area are well aware of the importance of application of chemical fertilizers. Sometimes limited resources hinder in full adoption of chemical fertilizer use. Overall, more than 93 percent farmers applied nitrogenous and phosphoric fertilizers according to the procedure while other farmers applied under doses of nitrogen and phosphorous in fertilizer forms. However, use of potash was limited which was a part of recommendations to increase the fertility of rice soils. Thirty eight percent farmers applied potash to rice fields. There was no significant difference in use of potash among farm size groups.

*Irrigation:* Rice is an aquatic plant, thus adequate water supply is the first priority for rice production. Though there was general deficiency of irrigation water for rice production, yet farmers tried to meet minimum requirement for rice production. Some farmers (5%) could not irrigate rice crop according to the need and recommendations. The main reason was shortage of canal water and high expenditure on tubewell operation.

*Weed control:* Weeds compete with crop in nutrients, water, light, consequently reducing crop yields. The rice growers of the area observed weed control through keeping the water standing in fields at least till the rice plants established well to suppress the weeds. Also farmers applied weedicides for good control.

Majority of the farmers (84%) adopted chemical weed control techniques for weed management. The entire sampled farmers were quite aware of the chemical control methods. The farmers, who did not apply herbicides, had either no weed problem or they were short of resources.

*Pest management:* One of the major problems created by mono-cropping and repeated sequential cropping observed on vast areas, is pest attacks. When insects and diseases of specific crops find abundance area of host crops, they nourish well and their outbreaks can occur if not controlled properly and timely.

Rice-wheat cropping system is spread over more than 65 percent of the cropped area each year. If the weather is favourable for diseases and insects, pest control tactics have to be adopted. The year 2002 was a good crop season with less humidity resulting in less pest attack. This year, pesticide application expenditures were less.

Most of the farmers (70%) adopted the application of pesticides for management of pests and applied these to control diseases and insects of rice crop (Table 4). There was significant difference of pesticide use between large and small farms. The farmers who did not apply pesticides were of the view that there was no/or low pest attack and thus refrained from pesticide use.

*Harvesting:* Timely harvesting decreases harvesting losses. Harvesting before proper maturity or delayed harvesting lower the yields. Sometimes crops are harvested quite after maturity that suffer shattering and weight losses. Scarcity of harvesting labour is common problem at peak harvesting season in study area. However, increased use of combines in last decade, lowered the severity of problem.

Farmers are well aware of the signs of mature crop and try to harvest in time. About 90 percent of the farmers harvested their crop at right time. The late harvesting was mostly due to non-availability of labour or combines. The land holdings are small in the area. Usually farmers do not have their own combines. Most of the combines are owned by investors who rent out combine services. Normally the farmers hire and thus harvesting of many farmers get delayed in peak season due to delay in finding the combines.

*Information sources of rice production technologies:* Most of the rice production technologies stem from indigenous knowledge. Except use of chemical fertilizers, weedicides and pesticides for insect pest and disease, all production practices have been transferred from ancestors. Over time farmers have modified and refined them according to their needs. Experienced and old farmers have good command on these technologies.

The data (Table 5) indicate that normally the farmers consult experienced and knowledgeable fellow farmers on many aspects. In all 50 to 75 percent farmers discuss to know about various technologies. Less than 25 percent of the farmers had access to the extension or research system for advice about rice production technologies. The share of radio and TV in disseminating the rice production technologies is low, ranging from 3 percent to 15 percent. Input dealers like pesticide companies have promoted their products for weed, insect pest and disease control through their technical and sale representatives. The proportion of farmers benefiting directly from their campaigns is low.

**Table 5. Farmers' sources of information for recommended production technology.**

| Production technology | Sources of information | | | |
|---|---|---|---|---|
| | Extension/ research | Fellow farmers | TV/radio | Input dealers |
| Variety | 26 | 66 | 8 | - |
| Nursery raising | 21.7 | 63.0 | 15.2 | - |
| Land preparation | 9.1 | 84.1 | 6.8 | - |
| Nursery transplanting | 17.9 | 71.8 | 10.3 | - |
| Fertilizer application | 19.5 | 75.6 | 4.9 | - |

| | | | | |
|---|---|---|---|---|
| Irrigation | - | 94.4 | 4.9 | - |
| Weed control | 15.6 | 62.5 | - | 21.9 |
| Insect control | 14.3 | 50.0 | 3.6 | 32.1 |
| Harvesting | 3.3 | 93.3 | 3.3 | - |

## CONCLUSIONS AND RECOMMENDATIONS

The survey concludes that many rice production technologies are well adopted especially the technologies based on indigenous practices. These technologies include variety selection, raising paddy nursery, land preparation, paddy transplanting, irrigation, etc. However, super impositions of non-traditional treatments on local technologies have mostly partial adoption. These technologies include chemical treatments like seed treatment and chemical weed control and use of pesticides.

*Training of the trainers:* Awareness among the farmers is a primary tool towards the adoption of any modern technology. A well established extension system is in force for this purpose. Unfortunately, there is dichotomy between research and extension system lacking proper dialogue on technology generation, development and dissemination among farmers. The situation is severe at lower level of extension and research systems keeping the extension agent deprived of proper technical knowledge necessary for dissemination of technologies. In this situation, regular training programmes, workshops and seminars on innovations and crop production technologies are to be developed in collaboration with research institutes to update the extension agents' knowledge. The activity may be carried out at Markaz level (Agriculture Officer level). Equipping the extension agents with updated knowledge would help transfer of information about production technologies effectively and skillfully.

*Establishment of information exchange forums:* The strengthening of linkages between research, extension and farmers has always been emphasized. For strengthening effective links, a proper information exchange forum can be initiated at lower level where farmers can participate easily. All stakeholders interested in agricultural development can be member of the forum and they could participate freely. Seminars, workshops, discussions or any other mode of communication can be sought according to the situation for creating awareness regarding agricultural production technologies. The idea can be threshed out and matured through proper meetings and discussions among research, extension, educationists, farmers and other interested groups. It will help create awareness among the farmers.

*Authenticity of recommended technologies:* The farmers are approached through various sources to motivate them for adoption of recommended technologies. Many times recommended technologies delivered to the farmers do not match with each other. It creates confusion among the farmers. The common example is the formulation of recommendations for crop production by research and extension wings separately without collaboration and discussions. Sometimes mass media is also used to disseminate the conflicting technologies. To avoid such instances of confusion, the technology generating and delivering agencies are required to hold thorough discussions before preparing the literature. The messages from various sources should carry uniform recommendations for specific areas and crops.

*Role of mass media in disseminating the technologies:* The personal contacts are useful source to create awareness and motivation. However, it is difficult rather impossible to approach each farmer through personal contacts. Its alternative is the use of mass media (electronic and print), which is spreading at a faster rate. Each source of mass media is beneficial for specific target groups. Literate farmers can make use of both print and electronic media, according to their choice and capacity. Illiterate farmers can benefit from radio and TV. Thus if recommended technologies are disseminated effectively through mass media, these can be widely popularized in a short possible time.

Currently radio and TV is used for creating mass awareness but the timings are not suitable for the farmers. The times for broadcast/telecast of agricultural programmes need to be reviewed. At prime time, various programmes sponsored by the commercial companies are broadcast and telecast. A special channel on agriculture may perhaps solve the problem.

*Educating the farmers:* Role of education has always been recognized for the adoption of technologies. Education help increase the general understanding level. Many studies and forums have emphasized to increase the rural education and many agencies both public and private are involved in uplifting literacy rate. However, these are localized in nature leaving little effect on rural communities. A perspective planning is needed aiming to increase the literacy rate. Ultimately, it would help the farmers in understanding the latest crop production technologies in a better way.

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