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# ECONOMIC COMPARISON OF DIRECT SEEDED AND TRANSPLANTED RICE: EVIDENCES FROM ADAPTIVE RESEARCH AREA OF PUNJAB PAKISTAN

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## ABSTRACT

The study was conducted in three of the four districts of Adaptive Research Zone, Sheikhupura; which contains Sheikhupura, Lahore and Kasur districts for economic comparison of direct seeded (DSR) and transplanted super basmati rice during Kharif-2014. Average yield, cost of production, net economic benefits and benefit cost ratio for DSR and transplanted rice was calculated. Extent of area under DSR technology was also determined. Farmers growing both DSR and transplanted rice were selected using purposive sampling technique and sample size was 36. Data was collected by face to face interview by using a well-structured questionnaire having personal, farm related and cost variables. The results revealed that DSR technology was adopted on 22.8% of rice area on surveyed farms. Average paddy yield, total cost of production, net economic benefits per hectare and BCR for direct seeded rice were 3.09, Rs.112047, Rs.15014, 1.11 and for transplanted the figures were 3.19, Rs. 134882, Rs.-8433, 0.95 respectively. Thus, in the year 2014, farmers gained profit from practicing DSR technology and born loss from transplanted rice crop. It was found that farmers were growing DSR through seven different sowing methods and using different seed rates. Moreover, weeds infestation is a major problem in DSR technology that can be overcome through a combination of cultural as well chemical control methods. It was concluded that DSR is a promising technology subject to weeds management. Better coordination between research, extension and farming community can bring fruitful results with respect to adoption of DSR technology.

**Keywords**: DSR, Transplanted rice, Net Benefits, BCR

## INTRODUCTION

Rice is an important food and cash crop across the globe. In Pakistan's agrarian economy, rice plays multifarious roles as it is the 2nd staple food after wheat and provides source of employment and foreign exchange. During the fiscal year 2013-14, Pakistan earned US$ 1.667 billion through exporting rice and it has 0.7 % share in national GDP and 3.1 % in value added services. (GOP, 2013-14). Pakistan is one of the largest rice producing countries of the world and produces about 6 million tons of rice every year.

In Pakistan rice is grown on 2.8 million hectares of arable land, with an annual production of about 6.8 million tonnes. In Punjab, rice is grown on 1.7 million ha of land with total production of 3.5 million tons that accounts 51% of total national production of rice in Pakistan (GOP, 2014). Gujranwala, Sheikhupura, Sialkot, Narrowal, Hafizabad, Mandi Bahaudin Din, Okara, and Jhang districts of Punjab account for more than 70 percent of Basmati rice production in the country (Abedullah et al,. 2007).

There has been a significant growth in rice production in the country since independence. Area under rice increased from 856,000 hectare in 1947 to 2.8 million hectares in 2014 whereas production increased from 0.7 to 6.8 million tons during the same period. Increase in total production came from increase in area along with high yielding varieties; improved agronomic practices supported with fertilizers and plant protection measures (Memon, 2013).

In Pakistan mostly rice is cultivated through traditional transplanting method. This method not only requires a lot of water, but also is laborious, cumbersome, time consuming and involves a lot of expenditure on raising nursery, its uprooting and transplanting etc. During the

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sowing season, scarcity of farm labour coupled with higher labour cost results in relatively lower plant population, delayed transplanting and use of aged seedlings. All these issues directly lead to low paddy yield. Although transplanting is the common method of rice production but impending water scarcity, lack of farm labour along with the increased labour cost has compelled all the stake holders to think about the other alternatives to conventional ways of rice planting. Shifting from transplanting to direct seeding is a promising available alternative. Although rice cultivation by transplanting is generally considered superior to that by direct sowing, yet the latter is also reported as a successful method in some parts of the world (Adair et al., 1992). It saves labour (Murugaboopathi et al., 1991) and is more economical than transplanting (Awan et al., 2007).

In many countries of the world, direct seeding of rice is extensively used with profitable results (Naklang et al 1996, Sharma 1996, Anagadi 1993). It significantly gave higher yields than transplanted rice in some of the research trials when appropriate cultural practices were adopted (Awan et al., 2007). Considering the above scenario, a study was conducted to compare the economics of direct seeded rice and of traditionally transplanted rice. It also aimed to determine the extent of DSR in the above mentioned areas, so that some valuable recommendations be given to the farming community and extension workers for its successful adoption.

## MATERIALS AND METHODS

The study was carried out in Adaptive Research Zone Sheikhupura which consists of four districts namely Lahore, Kasur, Nankana Sahib and Sheikhupura. Lahore, Sheikhupura and Kasur districts fall in rice zone of the Punjab having different cropping rotations such as rice - wheat, potato – wheat, sugarcane–wheat, Kharif fodder/ maize–wheat, mash–wheat, sunflower - Kharif fodder – Wheat (Khan, 2015). Before conducting the interviews of the respondent farmers, a list of such farmers who were growing super basmati through both the technologies i.e. Direct Seed Rice (DSR) as well as transplanted, was compiled with the help of Agriculture Extension Department at district level and Engro EXIMP working on DSR in the area. It was found that DSR technology is not being practiced in Nankana Sahib, so Nankana Sahib was excluded from the study region.

A well-structured questionnaire was developed and was pretested in the field before launching the actual data collection. A total of 36 respondent farmers practicing DSR as well as transplanting method were interviewed for collection of data. About 67% of the respondents were interviewed from Sheikhupura district (as promotion of DSR technology was more prominent by a private company, ENGRO) followed by Lahore district (19%) and Kasur district (14%).

Economic cost of production of super basmati rice was calculated by asking some direct questions from the respondent farmers and cost of production publication of Crop Reporting Service (CRS), Punjab for the year 2014-15 was also consulted (GOP, 2015). Data on some variables such as cost of bund making, cost of spreading fertilizer, cleaning of irrigation channel, cost of capital investment, management charges etc. were taken from this publication. The data was analyzed using statistical software package SPSS (17.0).

The procedure adopted by Ahmad and Chaudhry (1987) and Chaudhry et al., (1992) was used for cost estimation. Variable cost incurred per acre on land preparation, seed and seeding, plant protection measures, fertilizers, micronutrients, farm yard manure, harvesting and threshing labor used for different operations, management component, mark up on investment @ 9.5% for six months was summed up. Total economic cost of production per acre was estimated by adding the land rent to the variable cost.

By following Ahmad and Chaudhry (1987) and Chaudhry et al., 1995, the gross income/ gross value product (GVP) per acre was estimated by multiplying total paddy production with its unit price and then dividing the resultant by total acreage of super basmati. Value of rice straw if any was added to this income in order to reach to the gross revenue of the crop The procedure adopted by (Chaudhry et al., 1987) was used for calculation of net income according to which net income per acre is the money available to management after meeting all the crop production expenses and is calculated by deducting total cost of production including land rent from the gross income earned from one acre of land.

## RESULTS AND DISCUSSION

Personal as well as farm level attributes of the farming families affect a lot in decision making with respect to adoption of new technologies and enhancing farm's productivity. Since the same person practicing both the technologies was interviewed, so mean values of the personal attribute are given accordingly. Average age of the respondent farmers involved in decision making at the sample farmers was 49 years with 9 years of schooling and family size of 8 individuals per family. Average length of farming experience of the sample farmers was 26 years. Out of 36 respondents interviewed for the purpose, 50% were large farmers having 25 acre or above operational holding followed by medium holding farmers (36.1%) having 12.5 to less than 25 acre of operational holding and small holding farmers (13.9%) having less than 12.5 acre of operational land.

### Extent of DSR Technology

Out of total cropped area of 1896 acres of the respondent farmers, rice was being cultivated on 1465 acres equivalent to 77.2% of the total cropped area, whereas DSR technology was adopted on 334 acres out of 1465 acres equivalent to 22.8% of rice area on overall basis. Maximum extent of DSR technology across districts was calculated in district Kasur (52.2%) followed by Sheikhupura (23.5%) and Lahore (8.0%). Thus, extent of rice cultivation in Lahore and Kasur districts is less as compared to Sheikhupura.

Respondent farmers were using a varied seed rate (15-50 kg $ha^{-1}$) with a mean of 10.35 kg $ha^{-1}$and were seeding rice through seven different methods *i.e.* broadcasted soaked seed in "*a"(moisture)* soil condition (39%) followed by broadcasting of dry seed in dry soil and applying irrigation afterwards (27%), broadcasting of dry seed in wattar condition (11%) and broadcasting soaked seed in dry soil followed with immediate irrigation (8%), broadcasting sprouted seed in wattar condition (6%), drilling of dry seed in wattar condition (6%) and drilling of soaked seed in wattar condition (3%). Moreover, the respondent farmers planted directly seed rice on nine different time periods, with an interval of one week starting from 3rd week of May and ending at 3rd week of July. Whereas they transplanted super basmati on 10 different time periods, with an interval of one week starting from 2nd week of June to 3rd week of August. This shows that every farmer is practicing DSR in his own way. If proper route of technology dissemination had been adopted, different practices of DSR technology would not have been adopted by the farming community. It revealed the fact that the technology had gone to the end users without fulfilling the due course of evaluation and standardization by research and extension departments.

### Yield Comparison

Paddy yield comparison of super basmati DSR with transplanted technologies across districts given in the Figure 1 showed that on an overall basis paddy yield with transplanted technology (3.19 tonnes per hectare) was 3.19% higher than under DSR (3.09 tonnes per hectare) which was not a significant difference. Yield comparison across districts indicated that paddy yield under DSR (3.25 tonnes per hectare) was slightly higher in district Sheikhupura than under transplanted methodology (3.23 tonnes per hectare), whereas opposite was true in case of Lahore (DSR 2.70 tonnes per hectare as compared to transplanted 3.01 tonnes per hectare) and Kasur districts (DSR 2.93 tonnes per hectare as compared to 3.23 tonnes per hectare under transplanting method. Super basmati paddy yield was 11.7% and 10.5% higher in case of transplanting technology as compared to DSR in Lahore and Kasur districts, respectively. Non-significant difference in yield gap between the technologies showed a greater scope for adoption of DSR technology, if technical issues of weeds infestation and germination of red rice locally known as "choba" are tackled. During the course of study, some of the farmers who used double pre-sowing irrigation concept as a cultural method of weeds management reported less weeds infestation. These results are in line with previous studies that direct seeding technology of rice is almost at par in yield with the conventional planted crop. It has great potential for adoption as a substitute for transplanted rice if the weeds are controlled properly (Awan et al., 2007; Ali et al., 2007).

### Comparison of Economic Cost of Production

cost of production of DSR and transplanted rice are given in the Table 1, total economic cost of production per hectare of super basmati transplanted and directly seeded are Rs. 134882

and Rs. 112047, respectively i.e. economic cost of production of transplanted rice was 20.4% higher than DSR. Thus, comparison of economic cost of production variables in both technologies revealed that direct seeding enabled farmers to save 20% of the total cost of a transplanted crop. This result was similar to work of Nai-Kin and Romli, (2002), according to which direct seeding enabled farmers in Muda area of Malaysia to save 29% of the total cost of transplanted crop. The difference in cost saving percentage is due to the fact that Nai-Kin and Romli considered only cash expenditures, while in the present study under consideration economic costs are compared rather than financial costs. The data given in Table 1 show that DSR technology is cost saving in land preparation (15.08%), seed and sowing (66.93%) and irrigation (44.74%), whereas there is increase in cost of plant protection measures (weed and disease infestations on DSR (29.80%) is more as compared to transplanted rice crop), fertilizers (20.62%), FYM (38.75%) and micronutrients (14.04%). The data shows that major cost saving is in seed and seeding (66.93%) followed by irrigation (44.74%) and land preparation (15.08%) with an overall saving of 16.93%. The results show that cost saving in the DSR is more than that of increase in yield under transplanted that leads towards better economics of DSR technology.

**Comparison of Net Economic Returns**

When net returns were compared under DSR and transplanting techniques, t they were negative to the tune of Rs. 8433 per hectare in transplanted method whereas net returns were positive in case of DSR technology amounting to Rs. 15014 per hectare (Figure 2). The year 2014 was an abnormal year with respect to prices of rice paddy as almost 40% lower prices prevailed in the market when compared with last year (2013) prices. Even with low market prices, farmers practicing DSR technology gained profit on their investment in growing super basmati whereas those who adopted transplanted technique born losses. This result was in line with findings of Ali et al. (2012) as they reported highest net benefits of Rs.37235 per hectare under DSR (broadcasting of soaked seed in well prepared seed bed after rauni) as compared to conventionally transplanted rice of Rs.3299 per acre. Moreover, BCR of the above mentioned DSR and transplanted methods were 1.36 and 1.07 respectively.

**Comparison of Benefit Cost Ratio**

BCR for super basmati under DSR technology was 1.11 as compared to 0.95 in case of transplanting technology (Figure 3) meaning that growing of super basmati rice through DSR technology was better than transplanting method. This result was comparable with work of Awan et al. (2007) as they reported that BCR of DSR was better (1.29) than conventionally transplanted method (1.15). Thus comparison of economic analysis of Super Basmati under DSR and transplanted methodology revealed that DSR has more potential in reducing cost of production by reducing water and labor inputs compared with traditional open flooded and transplanted rice. However DSR technology faces several potential yield reducing problems such as heavy weeds infestation, lack of effective herbicide and poor crop management practices etc. that should be solved through proper management practices (Singh et al., 2002 and Pandey et al., 2002).

**Conclusion and Recommendations**

Based on study findings, it is concluded that DSR technology is better as compared to conventionally transplanted method of rice production if practiced properly as net economic returns and Benefit Cost Ratio were better under DSR technology than transplanting technique. In spite of better economics, weeds management is still a major obstacle in the way of adoption of DSR technology that leads to lower yield in DSR method as compared to transplanting technique as reported by 76% of the DSR respondents that effective weedicides are not available in the market which could control newly invading weeds such as Dhidhen grass (Echinochloa Crusgalli), Narru (Paspalum Distichum), Lumb grass / kallar grass (Lipotchloa Chinensis) etc.

The respondent farmers were practicing DSR technology on 22.8% of rice area on overall basis. Maximum extent of DSR technology across districts was calculated in district Kasur (52.2%) followed by Sheikhupura (23.5%) and Lahore (8.0%).

Weeds can be controlled by cultural as well as chemical control methods. If DSR technology is practiced on puddled soil, then the issue of

weeds as well as that of germination of wild rice (chobba) that deteriorates the rice quality can be solved, although there would not be cost saving in land preparation but increase in yield because of less weeds infestation would lead to better economics of DSR technology.

Moreover, enhanced role of extension department in disseminating the standardized DSR technology especially with respect to land preparation, seed rate, time of sowing and plant protection measures can play a vital role for adoption of the technology on wider scale as farmers are eager to adopt new technologies for rice production in the context of high cost of production especially that of land preparation, irrigation and labor cost incurred on conventionally transplanted rice. The study results show that cost incurred on above mentioned three variables in case of conventional method of rice transplting is 2.34 times (Rs.46042/hectare) that of in case of DSR technology (Rs.19610).

**Table – 1: Economic comparison of cost of production of DSR and transplanted rice crops**

(Rs. per hectare)

| Sr. No. | Detail of cost components | DSR | TPR | Savingsin DSR (%) |
|---|---|---|---|---|
| 1 | Land preparation | 9476 | 11159 | 15.08 |
| 2 | Nursery and transplanting/seed and sowing | 3457 | 10455 | 66.93 |
| 3 | Irrigation | 13499 | 24428 | 44.74 |
| 4 | Fertilizer | 15666 | 12988 | -20.62 |
| 5 | Farm yard manure | 2955 | 2130 | -38.75 |
| 6 | Micronutrients | 2288 | 2006 | -14.04 |
| 7 | Plant protection measures (weeds, insect pests and disease control) | 8772 | 6758 | -29.80 |
| 8 | **Total input cost** | **55148** | **69927** | 21.14 |
| 9 | Mark up on investment for six months @ 9.5% excluding water rates | 2607 | 3311 | 21.27 |
| 10 | Harvesting & threshing | 8794 | 8881 | 0.97 |
| 11 | Land rent for six months per acre | 49998 | 50685 | 1.36 |
| 12 | Management charges for six months @ Rs.14000 per 100 acres | 2076 | 2076 | 0.00 |
| 13 | **Total economic cost of production** | 112047 | 134882 | **16.93** |

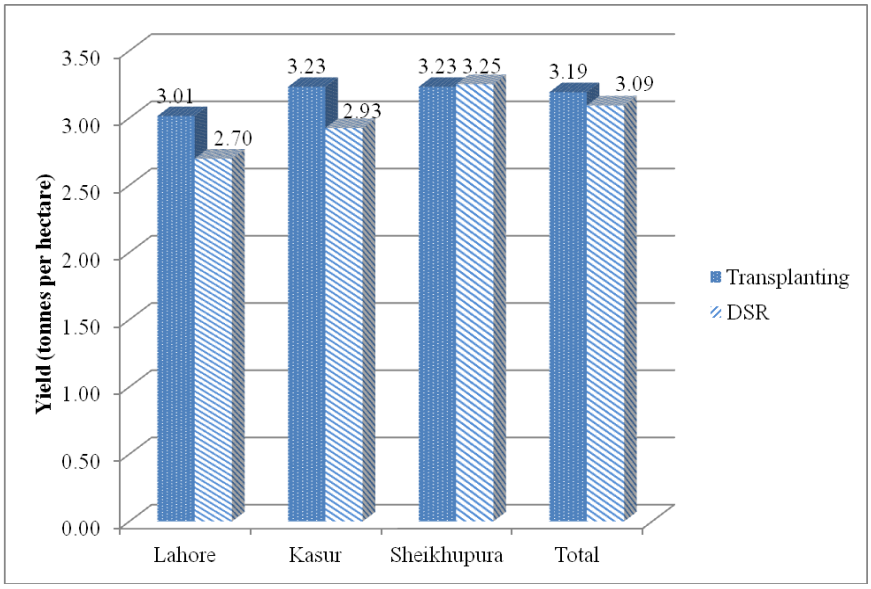


**Fig. – 1: Yield comparison of DSR and transplanted rice crops**

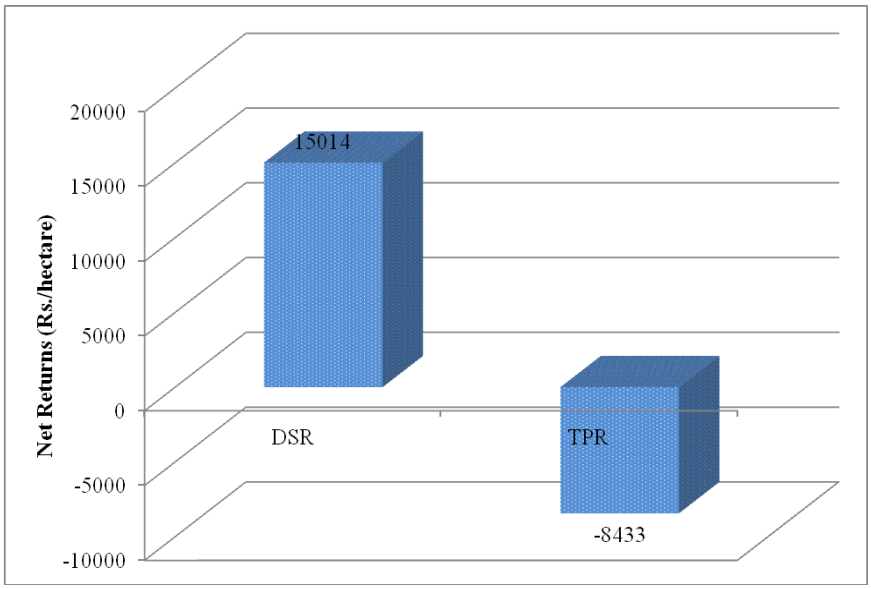


**Fig. – 2: Comparison of net economic returns of DSR and transplanted rice crops**

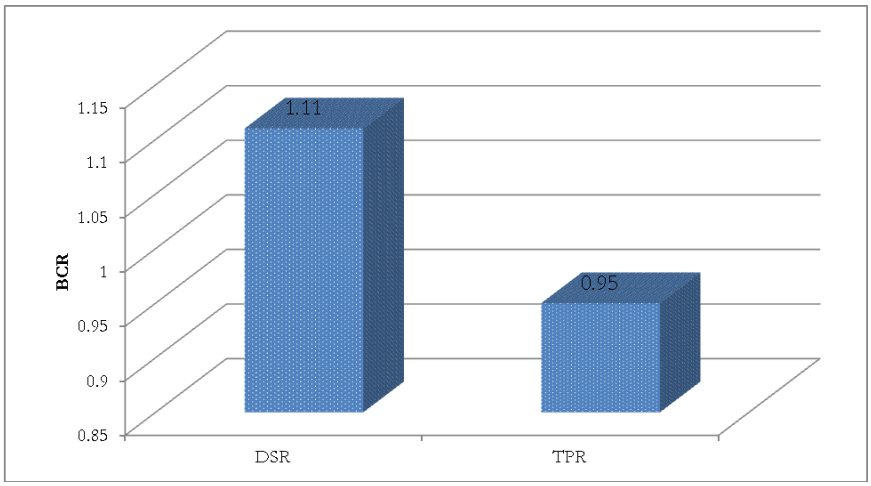


**Fig. – 3: Comparison of Benefit Cost Ratios of DSR and transplanted rice crops**

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