FACTORS AFFECTING THE ADOPTION OF NO-TILLAGE CROP PRODUCTION SYSTEM

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ABSTRACT

The objective of this research was to identify and quantify the important factors related to the adoption behavior of farmers towards no-tillage crop production system. In 2008-09 data were collected from two cropping zones i.e. rice-wheat zone (Gujranwala and Sheikhupura) and cotton-wheat zone (Faisalabad). A logit regression model was estimated to identify and evaluate impact of major variables (education, progressive farmers, age, interpersonal communication and ground water) on the adoption of no tillage technology by farmers in study areas. Results indicate that the education of the farmers increases the adoption of NT also increases. It is not necessary that progressive farmers are also adopters of this technology. If the age of the farmer is below 35 years, there are 1.02 times more chances that the farmer will adopt the NT technology. Interpersonal communication variable does not have any role in NT technology adoption process. Agricultural farms where the ground water was not fit for irrigation have vast potential for adoption of NT crop production technology. It is recommended that farmers should be motivated to adopt no tillage technology in the areas where quality of ground water is not fit for cultivation. This NT production system practice may enhance the efficient utilization of resources in Pakistan.

Key Words: No-tillage, Conservation tillage, Zero-tillage, Logit regression, technology adoption.

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INTRODUCTION

The adoption of conservation production technology or no-tillage (NT) has been studied by many researchers. The emphasis of these studies was on the factors which have influence on the adoption process of conservation tillage system (Hua and Sohngen, 2004; Ervin and Ervin, 1982; Djido et al., 2009). Several other studies have also compared the NT system with the conventional tillage (CT) system. The average yields of no-tillage cotton crops were 36 % higher than CT during 1988-92 periods (Triplett et al., 1996). Income and yields were higher for no-tillage cotton production than conventional tillage cotton production systems in Mississippi. Therefore, NT cotton production system should be preferred over CT system (Hussain et al., 2005). The adoption of NT system has the potential to reduce the soil erosion and improve productivity of these soils (McGregor, 1978). The adoption of no-tillage performance has been revealed to reduce the soil erosion as well as conserves the soil moisture. It has also been investigated that the extremely dry and wet conditions increase the adoption of conservation tillage (Ding and Schoengold, 2007). The no-tillage practical crop production demonstration convinced more than 60 % farmers to adopt the no-tillage production system (SAIC, 2004). Conventional Tillage (CT) involves ploughing or intensive tillage and the crop is cultivated in prepared seedbed where less than 30 % ground cover residue or cover crop is maintained after planting or less than 500 pounds per acre of small grain residue equivalent is maintained throughout the critical wind erosion period. No-Tillage (NT) refers to planting the crop in undisturbed soil with a minimum of 90 % ground cover from the previous crop’s residue maintained after planting; or where at least 1,000 pounds per acre of small grain residue equivalent are maintained on the surface during the critical wind erosion period (Distch et al., 1988).

In general in the study area, there is a shortage of canal irrigation water supply as well as very less annual rainfall which hampers crop yield and profitability. Majority of the farmers in this area are using CT which reduces organic matter in the soils, leading to deterioration in soils over time as well as accelerates the evaporation of soil moisture. Continuously rising prices of the fuel/oil has substantially increased the costs of crop production. The CT
is relatively more costly because a large number of field operations are needed as compared to NT. Farmers can choose alternative crop production systems to cope with various problems such as crop production risks, rising costs of crop production, maximization of profitability and to conserve the input resources that are soil fertility, soil moisture and soil biota. The basic objective of this study is to identify the important factors related to the adopters of individual technologies that are adoption of no-tillage crop production system. To provide the recommendations for the formulation of agricultural policies and for the promotion of adoption of no-tillage crop production system.

**MATERIALS AND METHODS**

The no-tillage adoption rate is relatively greater in rice-wheat zone than the cotton-wheat zone of the Punjab. In 2008-09, cross-sectional data were collected from the three districts of the Punjab that is Gujranwala, Sheikhupura and Faisalabad from the respondents on both the qualitative and quantitative variables. Initially, a list of all the districts in each cropping zones i.e. the rice-wheat zone and cotton-wheat zone, was prepared and two districts were selected from rice-wheat zone (Gujranwala and Sheikhupura) and one district from cotton-wheat zone (Faisalabad), randomly. Then a list of all villages in each district was obtained from respective agriculture departments in each zone. Subsequently, from each selected district three villages were selected randomly. In the rice-wheat zone 12 farmers were selected from each of the selected villages taking into account the list of all farmers in each village obtained from agriculture department for this purpose. Hence a total of 72 farmers were selected for interview from the rice-wheat zone. Similarly, in cotton-wheat zone, from two (selected) villages 10 farmers from each village and from one (selected) village 11 farmers were selected randomly. Thus a total of 31 farmers were selected for interview from the cotton-wheat zone. As a result, a sample of 103 farmers (72 + 31) was used for data collection. The logit model was used for data analysis. Logistic regression methods are becoming increasingly prevalent for data analysis, when outcome variable is discrete, taking on two or more possible values (Hosmer and Lemeshow, 2000). The outcome variable in logistic regression is binary or dichotomous. The practical use of logit and probit models is continuously increasing in multiple disciplines (Hoetker, 2001). The ordinary logit model:

\[
\ln \left[ \frac{P(Y=1|X)}{1-P(Y=1|X)} \right] = \alpha + \sum \beta_i X_i + \varepsilon
\]

Where:
- \( P(.) = \) Probability that a no-tillage technology (Y) is adopted.
- \( \alpha = \) Constant term.
- \( X = \) A set of core explanatory variables.
- \( \beta = \) A vector of unknown parameters.
- \( \varepsilon = \) Disturbance term.

The dependent variable of this model represents whether a farmer is an adopter or non-adopter of no-tillage crop production system. The influential factors (variables) assumed to be affecting the adoptions of no-tillage crop production system are given here:

i. Education is expected to be positively related with the adoption of no-tillage production system.
ii. Progressive farmers may be the adopters of new production technologies like no-tillage.
iii. Age may be negatively related with the adoption. Younger farmers may be more dynamic adopters of no tillage crop production system.
iv. In case of interpersonal communication among farmers for the adoption of no-tillage production system, it is assumed that it may or may not be an effective method to promote the adoption. It needs to be investigated on regional and cultural basis. The adopters might have a stronger belief on the information disseminated by the agricultural extension department and it may be more effective as compared to interpersonal communication.
iv. Where the ground water is not fit for irrigation, may likely affect (enhance) the adoption of no-tillage, as no-tillage conserves the soil as well as soil moisture.
particularly make such type of decisions only on the basis of  
indicates that there are 0.03 times  
below 35  
likely to adopt NT production system.  
share of owned lan  
f  
completely depends on the circumstances of the farmers. When all the factors are in favour of decision making the  
for decision making. Because there are several other factors in consideration for making adoption decisions, hence it  
more and more time for decision making.  
system.  
which mean  
no  
the farmer adopts a particular production system.  
chances of adoption of no  
odds ratios are  
Hosmer Lemeshow Test = 9.36 (Chi-square) which is nonsignificant indicating that overall model was correctly  
spelled. The estimated Nagelkerk R² value is 0.43 is within the upper range of most of the other studies.  
Table II  
The coefficients of the estimated logistic regression model  
<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated Coefficients</th>
<th>Standard Error</th>
<th>Significance</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-4.111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.124</td>
<td>0.137</td>
<td>0.366</td>
<td>1.132</td>
</tr>
<tr>
<td>Progressive farmer</td>
<td>-2.081</td>
<td>1.242</td>
<td>0.094</td>
<td>0.125</td>
</tr>
<tr>
<td>Age</td>
<td>0.018</td>
<td>0.061</td>
<td>0.766</td>
<td>1.018</td>
</tr>
<tr>
<td>Interpersonal communication</td>
<td>-3.428</td>
<td>1.353</td>
<td>0.011</td>
<td>0.032</td>
</tr>
<tr>
<td>Ground water</td>
<td>3.573</td>
<td>1.562</td>
<td>0.022</td>
<td>35.626</td>
</tr>
</tbody>
</table>

The Nagelkerk R² = 0.43  
Hosmer Lemeshow Test = 9.36 Chi-square with 8 df (p=0.313)

The estimated odds ratio for education is 1.13 which means if the education of a farmer increase by one year, the adoption rate of no-tillage will increase by 1.13 times more. The education positively influences intensity of conservative tillage adoption (Hua et al., 2004).

Similarly, in case of progressive farmer the odds ratio is 0.125 (the estimated coefficient has negative sign) which means being a progressive farmer there are 0.13 times less chances that the farmer will adopt the NT production system. Although progressive farmers are smarter in adopting the new technology however, progressive farmers may also need confirmation or verification to ensure that NT is really useful and profitable. Diffusion of technology may require more and more time for decision making. Therefore, relatively as no-tillage is new technology, it may require more time for decision making. Because there are several other factors in consideration for making adoption decisions, hence it completely depends on the circumstances of the farmers. When all the factors are in favour of decision making then a farmer adopts a particular production system. As the share of owned land increases, the share of the land that is conservation tilled decreases (Hua et al., 2004). In general progressive farmers have all the land as ownership or greater share of owned land. Consistent to this study, the results of our study also confirms that progressive farmers have less likely to adopt NT production system. The estimated odds ratio for the age is 1.02 which means if the age of the farmer is below 35 years there are 1.02 times more chances that farmer will likely to adopt the NT production system. Similarly, the estimated odds ratio for the Interpersonal communication is 0.03 (the estimated coefficient has negative sign) which indicates that there are 0.03 times fewer chances that the farmer will adopt the NT production system. Hence this may not be a reliable source of information for making a very important decision. Farmers in general and educated farmers particularly make such type of decisions only on the basis of an authentic source of information. Hence, the effect of this
factor does not have any influence in decision making. This is a very important finding of this study because in general many individuals have this perception that interpersonal communication has a decisive effect in the adoption process of new technologies and this is not true in case of NT production system. The estimated odds ratio for ground water (for crop field irrigation) is 35.63; it means those agricultural farms where the ground water is not fit for irrigation have vast potential for adoption of NT system that is at such type of farms there are 36 times more chances that the farmers will adopt the NT crop production system. Because, poor quality of water requires that the farmers may adopt water conservation technologies.

CONCLUSION AND RECOMMENDATIONS

The goal of this research was to be aware of the important factors related to the adoption behavior of farmers towards no-tillage crop production system. A logit regression model was estimated for this purpose. The ratio of the correct prediction is 94.2 %. The likelihood ratio test is significant at 1 % level indicating the model has good explanatory power. The relevant explanatory variables included in the model were education, progressive farmers, age, interpersonal communication and ground water. Among all the selected explanatory variables, two variables that are ground water and interpersonal communication were significant at five percent level of significance. The odds ratio for ground water is 35.63 which show that those agricultural farms where the ground water is not fit for irrigation have greatest potential for adoption of NT system. Because, poor quality of ground water (which may be supplemented with canal irrigation water) requires that the farmers may adopt water conservation technologies. Likewise, the odds ratio for the interpersonal communication is 0.03 (the estimated coefficient has negative sign) which indicates that this variable may not be playing any role in the adoption of NT production system. Hence this may not be a reliable source of information for making a very important decision.

The findings of this study can be used to infer conclusions for the new crop production technology at farm level. Some recommendations have been suggested as a guideline for evolving appropriate policies to enhance the adoption rate of no-tillage technology.

i. The findings of this study indicate that NT may be a good farming practice in the areas where the ground water for irrigation is unfit. Hence, it is recommended that government may take measures to promote the NT technology.

ii. It is recommended that farmer’s training programmes should be initiated by the agriculture extension department to inculcate the technical skills about NT technology.

iii. This study also revealed that interpersonal communication did not play an effective role in affecting the adoption of NT. Therefore, it is recommended that government may intervene to fill this gap by providing requisite technical information about NT to the farmers.

REFERENCES


