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Effects of Farmers' Perceptions on the Adoption of Modern Rice Varieties in Nepal

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Abstract

Several modern varieties of rice have been released in Nepal to raise the productivity, a major staple crop. Farmers have adopted these varieties to varying degrees, especially in rainfed areas. This paper attempts to identify factors that affect the adoption of modern varieties of rice. Farmers considered suitability of rice varieties based on several characteristics. They were more concerned with biotic and abiotic stresses, which probably reflects the high incidence of these stresses in the rainfed condition. Modern varieties were superior over traditional varieties for many characteristics except in terms of taste. It is hypothesized that farmers' perceptions regarding varietal characteristics play a key role in explaining adoption behavior. This hypothesis was tested using farm-level data from rainfed areas of Nepal. An econometric model that includes farmers' perception variables was found to be superior in explaining adoption behavior than the ones that include only the usual farm and farmer related variables. Farmers' perceptions of the varietal characteristics such as pest resistance, drought tolerance and suitability for making special products were important in determining technology choices in the areas where current adoption rates are quite high. It was also found that the farms and farmers' specific variables such as education of the decision maker and his/her experience in rice farming, and availability of extension services have significant effect on adoption of modern varieties. Research approaches that incorporate farmers' preferences for various characteristics of rice in breeding programs and extension strategies that are geared towards providing accurate information for efficient revision of farmer perceptions are needed to raise the adoption rate.

1. Background and Aim of the Study

Rice is the staple food crop of Nepal. It occupies about 50 percent of the total area under food crops of 3.2 million hectares and its contribution to the total food supply is more than 50 percent. This crop alone contributes to about 40 percent of the total calorie intake. In order to increase the productivity, modern varieties (MVs) of rice were introduced in late 1960s in Nepal. Overall, the spread of MVs and associated technologies is concentrated in pockets of favorable irrigated areas, with farmers choosing to follow largely traditional practices in less favorable rainfed areas. Although over 48 MVs have been released in Nepal, limited spread of MVs and their low productivity continue to remain major constraints to increasing the rice production in Nepal. Analysis of factors constraining the diffusion of MVs, especially in the dominant rainfed ecosystem of Nepal, is hence, an important area of research.

The objectives of this paper are to analyze farmers' perceptions regarding varietal attributes and to assess how these perceptions, along with the usual farm and farmer-specific variables, determine the variations in the levels of adoption of MVs among rainfed rice farmers in Nepal.

2. Methods

2.1 Data Set

The analysis presented in this paper is based on the sample survey of technology choice of 222 rice farmers from Banke and Nawalparasi districts in the Terai region of Nepal. The farmers were selected from 3 villages of each districts using stratified random sampling. The survey included collection of data on rice varieties grown, production practices, and associated farm and farmer characteristics. The relevant data for the cropping year 2001/02 were collected through personal interviews using a set of pre-tested questionnaires.

2.2 Econometric Model of Adoption Behavior

Farmers' perceptions regarding different attributes of rice varieties are needed for analyzing the model. While eliciting perceptions, farmers were asked to rank MVs as being superior, inferior or equivalent to traditional varieties (TVs) for each of the attributes considered. A total of 158 farmers provided this comparative information, which was used for formulating the perception variables.

A Tobit model was used to estimate the determinants of adoption. The model is represented below using an index function approach.

$$y_i = \beta' X_i + \varepsilon_i \quad (1)$$

$$y_i = 0 \quad \text{if } y_i^* \leq 0 \quad (2)$$

$$y_i = y_i^* \quad \text{if } y_i^* > 0 \quad (3)$$

where y_i, a limited dependent variable, is the observed choice; y_i^* is an underlying latent variable that indexes adoption; X is the vector of socio-economic and demographic characteristics of the farm household, and the technology perceptions of the farmer; β' is a vector of parameters to be estimated; and ε_i is an error term.

Three variations of the empirical model on adoption were estimated: (1) Including only the farm and farmer specific variables (2) Including farmers' perceptions on the technology attributes only, and (3) Including the farm and farmer specific variables, and the farmers' perceptions

The farm and farmer-specific variables considered for this study are the size of the landholding (LANDHOLD) in hectares, educational status of the decision maker (EDN) in number of years of schooling, experience in farming (EXPERI) in number of years, area irrigated (PRIRRIG) in percentage and the extension support received (EXT). The perception variables included in the model are related to drought tolerance (PDROU), pest resistance (PPEST), milling recovery (PMILL), and "other-uses" of grains (POTUSE). Households differed in their perceptions of the relative performance of MVs and TVs with respect to these attributes. Accordingly, two dummy variables were specified for each attribute, one signifying the expressed superiority of MV and the other signifying the superiority of TV. Thus the benchmark situation for these perception dummies relates to those farmers who considered MVs and TVs to be equivalent with respect to the specific attribute being considered.

3. Results and Discussions

3.1 General Characteristics of Rice Production System

The average farm size is much larger in Banke than in Nawalparasi. While rice is the dominant crop in both the locations, the share of MV was higher in Banke than in Nawalparasi. While

cropping intensity and the proportion of irrigated area are higher in Nawalparasi than in Banke (Table 1.). In the study area, farmers grew about two dozens MVs and more than a dozen TVs. On average, MVs accounted for about four-fifths of the total rice area in the study villages. This indicates a high adoption rate relative to other areas of Nepal.

Table 1. General characteristics of the production systems in the study area

Features	Districts	
	Banke	Nawalparasi
Average area owned per household (ha)	2.3	1.1
Cropping Intensity (%)	151	185
Area under rice (%)	53	52
Area under MV of Rice (%)	83	75
Average Yield of MV (t/ha)	3	3
Average Yield of TV (t/ha)	1.6	2.3
Area Irrigated (%) including seasonal	35	72

3.2 Farmers' Perceptions Regarding Rice Varieties

More than 70 percent farmers' perceived TV as inferior in comparison to MV in terms of grain and straw yield. Among the characteristics grouped under the category "usage", TVs were considered superior only in terms of taste. Majority of the farmers expressed that TVs were inferior for making special food such as *chiura* and *murahi*. The TVs also appeared to be inferior in terms of the quality of straw as a fodder. In terms of drought tolerance, TVs were considered to be inferior by 55 percent of the respondents. There was a mixed response regarding the resistance to disease and insects.

3.3 Factors Determining Modern Rice Varietal Technology Adoption

In Model 1 which included only the farm and the farmer-specific variables, education, experience and availability of extension were found to have statistically significant effect on adoption. All these variables had the expected signs. When only the farmers' perceptions of the technology-specific attributes were considered, coefficients associated with perceptions related to tolerance to drought, and pests were found to be statistically significant. The signs of the coefficients were as expected. Farmers who considered MVs to be superior with respect to tolerance to drought and pests are more likely to adopt MVs. On the other hand, the reverse effect is indicated for farmers who considered TVs to be superior to MVs in these aspects. Regarding the use for speciality products, the coefficient for MV was significant but not for TV. When both sets of variable are included, the statistical significance and the sign of the coefficients in the combined model remain unchanged except for the variable PPESTMV (Table 2).

The standard log-likelihood tests were conducted considering Model 3 as the unrestricted model and Models 1 and 2 as the restricted ones (as some of the variables in these latter models are assumed to have zero effect on adoption). As indicated by the statistically significant log-likelihood test statistic, Models 1 and 2 are rejected in favor of Model 3. Thus the specification that includes the perception variables in addition to the usual farm and farmer-specific characteristics represents the data better than those that exclude the perception variables.

Table 2. Estimated result of MVs adoption by using different models.

Variables	Marginal effects		
	Model 1	**Model 2**	**Model 3 (Model 1 + 2)**
CONSTANT	22.16	26.77	20.87
EDN	0.56***		0.35**
LANDHOLD	-0.27		-0.13
EXPERI	0.28***		0.19***
PRIRRIG	1.20		1.15
EXT	3.56**		2.47*
PDROUMV		3.79***	3.81***
PDROUTV		-9.07**	-8.84**
PPESTMV		2.54*	1.91
PPESTTV		-3.04*	-3.27*
POTUSEMV		5.64**	4.29**
POTUSETV		-0.17	0.25
PMILLMV		0.76	1.62
PMILLTV		0.68	-0.17
Log-likelihood function	-692	-681	-674
Likelihood ratio of Model vs Model 3	37.00***	14.79**	

Note**: ** * ,**** and * imply statistical significance at 1% , 5% and 10% levels, respectively.
Dependent variable: The percentage of area under MVs.

4. Conclusion and Implications

The statistically significant coefficients of the perception variables reported in this study indicate that adoption could be increased by interventions that address any misperceptions farmers may have regarding the performance of MVs. Various types of methods such as demonstration and farmer- participatory trials could be effective vehicles for providing additional information needed for farmers to revise their perceptions. Other types of mechanisms for the provision of information (such as through extension advice) can similarly play an important role. An important area of research is to understand the process through which farmers revise their perceptions regarding technologies and why perceptions differ across individuals. Differential access to information and differences in information processing capacity may lead to variations in perceptions and farmers' ability to update their initial perceptions. Suitable interventions points can be identified for encouraging faster diffusion of technologies by understanding such processes.

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