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Socioeconomic Factors Affecting Adoption of Sunflower Varieties in Sindh

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Abstract

This research study is based on primary data collection from sunflower growers to assess the socioeconomic factors that are affecting the adoption of sunflower varieties in Sindh. Data samples have been selected from two districts; Badin and Thatta, as these districts are considered main sunflower growing areas in Sindh. The results reveal that Sunflower growers are using Hybrid varieties i.e. 43 percent planted Hysun-33, 29 percent Hysun-38 and 28 percent Hysun-37 varieties. The finding of research using multinomial logistic regression suggests that farm size and level of education significantly affected the adoption of sunflower varieties. These factors are statistically significant at $p<0.05$. The other variables such as tenancy status and source of income are not statistically significant in the adoption of sunflower varieties in Sindh.

Keywords: Sunflower, Multinomial Logistic Regression, Sindh, Pakistan.

1. Introduction and Literature Review

Among the many factors that contributed in the growth of agricultural productivity, technology is the most important. The rate of adoption of a new technology is subject to its profitability and the degree of risk and uncertainty associated with it, and is highly influenced by the capital requirement, agricultural policies, and the socio-economic characteristics of farmers. The question of adoption or non-adoption is important; however, intensity of adoption is actually the most critical criterion in the adoption process. There are several factors affecting farmer's decision to adopt sunflower

technologies. Extension creates awareness of the existence of seed technologies. The farmers assess whether the technologies are acceptable to them given the crops they grow, farm size, experience, labour availability or demand, expected improvement in fertility, availability of credit facilities, fertilizer input cost and other factors (FAO, 1996).

In view of determine, whether it is feasible and profitable for farmers to adopt and implement the seed technology on their farms may be instantaneous, i.e., they can adopt immediately in the same year when the technology is introduced or it can take several years depending on socioeconomics factors such as education, frequency of extension contact, seed input prices, selling prices, etc (Chipande, 1987; FAO, 1996). In analysis, various assumptions can be made regarding technology choice. One assumption is that technology and crop choice is sequential to farmers who choose the technology first and then decide crops to grow which suits the chosen technology (Mangisoni, 1999; Gourieroux et al., 1984). An alternative is to model the choices simultaneously, that is improved crop and other technology choices taking place at the same time (Green, 1997; Battese, 1992), While designing this study we select similar analyzes of sunflower and seed technology choices even producers benefit from the adoption of new technology through opportunities to lower production costs, either by increasing outputs from the same inputs or by maintaining the same output from reduced inputs. The understanding of the effect of new varieties on input demand and productivity is crucial for betterment of potential diffusion of the technology among farmers. Widespread adoption of new production technology, expected to have important market effects and market-level impact can be estimated by aggregating the farm level responses which based on an assumed national adoption level.

In the context of an adoption cycle, the virtual adoption of sunflower related to dynamic farmer needs, objectives, personal characteristics, capital assets and communication, in addition to the technological characteristics of the innovations themselves. Swinkels and Franzel (1997) have developed a three-stage model, in which adoption potential depends on the feasibility, profitability and acceptability of farmers. Pannell (1999) has defined four conditions necessary for farmers' in adoption of innovative farming systems: (a) awareness of the innovation; (b) perception that it is feasible to trial the innovation; (c) perception that the innovation is worth trialing; and (d) perception that the innovation promotes the farmer’s objectives. Feasibility (the appropriate information and resources to manage a technology) and profitability were clearly defined by Swinkels and Franzel (1997). However, their acceptability component depended on a diverse range of factors, including perception of risk, suitability to accepted gender roles, cultural acceptance, and compatibility with other enterprises.

Economic literature clearly indicated the role of high-yielding technologies improving the well-being of farmers in developing countries. Socioeconomic impact of innovations through technology implications, several papers have examined theoretical and empirical issues associated with the adoption and diffusion process for new technologies. The adoption of sunflower varieties was hampered by several socio-economic factors like environmental, economic, social and institutional patterns, and their linkages to compose the context of development (Huisinga, 1997). Social and economic factors at various levels of environment where people interact through roles and relationships defined by gender, age, ethnicity and other social variables.

The literature on participation and technology adoption provides insights that are relevant to landowners' decisions regarding participation in the program and adoption of new technologies. Many economic, household, and farm-related variables have been commonly identified as determinants of adoption or participation. Farm size or area managed by the decision-maker, for example, is typically hypothesized to be positively associated with program participation in many studies (Ayuk, 1997; Caveness & Kurtz, 1993; Chambers & Foster, 1983; Nagubadi, et al., 1996; Thacher et al., 1997). Because of sufficient production capacity and incomes, farmers having large landholdings typically have greater flexibility to engage in new activities including innovative government programs (Nowak, 1987). Many studies have highlighted the importance of land tenure for promoting investments and activities such as adoption of new varieties and program participation (Godoy, 1992; Hyman, 1983; Schuck, et al., 2002). Labor demand, availability and allocation are often found to be central in determining technology adoption and program participation decisions. Some studies have confirmed the influence of income and debt on a particular adoption or participation outcome (Sureshwaran, et al., 1996; Thacher et al., 1997). Many participation and adoption studies have confirmed the role of household head or decision-maker characteristics such as age and education on the participation decision (Ayuk, 1997, Chambers & Foster, 1983; Nagubadi et al., 1996; Rahm & Huffman, 1984; etc.). Because decision-making is an activity intensive in human capital variables such as age and education, these are often significant in influencing the participation or adoption decision. Education is related not only to the ability to obtain and process information, but is often conducive to implementing knowledge-intensive conservation and sustainable agricultural technologies (De Souza Filho, 1997). Therefore, this study is planned to examine the socioeconomic factors affecting adoption of sunflower varieties in Sindh.

2. Methodology

2.1 The Sampling Population and Study Area

The population of the study comprised of sunflower growers of district Thata and Badin. A random sampling technique is used and 40 growers from each district were selected, so as to constitute the sample size of 80 respondents. It was important to choose districts where the area allocated to sunflower were relatively large in order to improve the likelihood that farmers would be motivated to participate actively in research and development activities.

2.2 Sample Frame and Size

The sampling unit for this research was sunflower growers and total 80 farmers were randomly selected amongst two districts through open and close ended questionnaire. During calculation a good representative sample size is selected from the sunflower production and socioeconomic factors that are affecting adoption of sunflower varieties in selected districts of Sindh. Hence, for the 95% ($Z = 1.96$, 2 tailed test) level of significance, within ± 5% ($e = 0.05$) margin of error and taking into account the proportion of sunflower farmers in the Thatta and Badin districts, the sample size n, was calculated as discussed by Gujarati (1988).

$$(1) \qquad n = \frac{Z^2 (1-p)\, p}{e^2} = \frac{1.96^2 (1-0.7)\, 0.7}{0.05^2} = 323$$

Including of 5% non respondents, the sample size was n = 339 farmers. Nevertheless, only 80 farmers were interviewed. The limited sample respondents were based on budgetary and time constraints consequently, 80 farmers targeted for interview in which there were no callbacks and interestingly recorded zero percent non respondents.

2.3 Model strategy and development

This model is drawn from literature on the basis of economies of scale and technology adoption. More extensive research has been done in the developing world on agricultural technology adoption. Adesina & Chianu, 2002; and Ayuk, 1997 had developed Model for technology adoption and program participation in many ways and modeling a binary outcome which is dependent on a set of hypothesized behavioral determinants.

Green and Ng'ong'ola (1993), Mbata (1994), Sharma (1997) and Rajasekharan and Veeraputhran (2002) developed model to assess socioeconomic factors that are affecting adoption of sunflower varieties by multinomial logistic analysis and employed a predictive model with simple indicators of development. This study is also adapting same strategy for analysis of two districts. Multinomial logistic model development strategy is as under.

2.4 Multinomial Logistic Regression Model

Multinomial logistic regression involves nominal response variables with more than two categories. Multinomial legit models are multi-equation models. Here, we selected response variable with k categories that generate k-1 equations and k-1 equations is a binary logistic regression comparing a group with the reference group. Multinomial logistic regression simultaneously estimates the k-1 logits. In this study, the model tests all possible combinations among the k groups, although it only displays coefficients for the k-1 comparisons. This indicates we had a response variable with three levels and the probabilities for each of these levels could be obtained as follows:

$$P(y=1) = \exp(\beta 1 * x)/(\exp(\beta 1 * x)+\exp(\beta 2 * x)+\exp(\beta 3 * x))$$

$$P(y=2) = \exp(\beta 2 * x)/(\exp(\beta 1 * x)+\exp(\beta 2 * x)+\exp(\beta 3 * x))$$

$$P(y=3) = \exp(\beta 3 * x)/(\exp(\beta 1 * x)+\exp(\beta 2 * x)+\exp(\beta 3 * x))"$$

Mentioned system of equations is unidentified and there is more than one solution to these coefficients that lead to the same probabilities. In this process the system identifiable with one of the coefficients is set to be 0. We select probability of $\beta 1 = 0$, yielding;

$$P(y=1) = 1/(1+\exp(\beta 2 * x)+\exp(\beta 3 * x))$$

$$P(y=2) = \exp(\beta 2 * x)/(1+\exp(\beta 2 * x)+\exp(\beta 3 * x))$$

$$P(y=3) = \exp(\beta 3 * x)/(1+\exp(\beta 2 * x)+\exp(\beta 3 * x))$$

The probabilities relative to the reference group, in this case, group 1 is.

$$P(y=2)/P(y=1) = \exp(\beta 2 * x)$$

$$P(y=3)/P(y=1) = \exp(\beta 3 * x)$$

Thus, the two coefficients β2 and β3 represent the log odds of being in the target groups relative to the reference group. In multinomial logistic regression the exponential coefficients are not odds ratios per se and the coefficients is to be interpreted as relative risk ratios (RRR). The relative risk in the 2x2 table is defined as

$$rr = P(11)/P(21)$$

In multinomial logistic regression the relative risk can be defined as,

$$rr1 = P(y=1)/P(\text{base category})$$
$$rr2 = P(y=2)/P(\text{base category})$$

Thus, the relative risk ratio for multinomial logit would be

$$RRR = \frac{P(y=1|x+1)/P(y=\text{base category}|x+1)}{P(y=1|x)/P(y=\text{base category}|x)}$$

3. Results and Discussion

The characteristics of the sunflower growers are important for decision making at various levels of farm management operations. These includes age, education, farming experience, sunflower farming experience, farm size, tenancy status, power source, irrigation source and land type, these are presented in Table 1.

Table 1: Scoring Criteria used for Transforming Data from the Survey for Application of a Multinomial Logistic Regression Model

Factors	Unit	Scoring criteria
Sunflower Varieties		1. Hisen 33 2. Hisen 37 3. Hisen 38
Farm Size	Acres	1. < 12.5 acres (Small) 2. > 12.5 to < 25 acres (Medium) 3. >25 acres (Large)
Education		1. Illiterate 2. Primary 3. Secondary 4. Inter 5. Graduate
Tenancy Status		1. Owner 2. Tenant 3. Owner cum tenant
Source of Income		1. Agriculture Farm 2. Agriculture Farm + Off farm

3.1 Age

On an average age of the sample sunflower growers was 40.75 years (Table 2). The large growers were aged (42.33 years), compared to small (41.18 years) and medium (39 years). There was no significant variation in age of the respondents across various farm size categories.

3.2 Education Level

Information about the education level of selected growers is presented in Table 2. The education level of the selected growers is very low in the study area. On an average they have 3.99 years of regular schooling. The education level among large growers (8.08 year) is high, compared to medium (4.77 years) and small contractors (0.36 years). There is significant variation in age of the respondents across various farm size categories.

3.3 Farming Experience

The average farming experience of the sample respondent is 17.8 years. The large farmers are found to be more experienced in farming as compared to small and medium farmers. There is a significant variation in farming experience across different farm size categories in table 2.

3.4 Sunflower Farming Experience

On an average sunflower farming experience is 2.9 years. The sunflower farming experience of large farmers is 2.8 years, medium farmers 3.2 years, while a small farmer is 2.8 years in Table 2.

3.5 Tenancy Status

Tenancy status is examined and found that 41% of the farmers are tenant, whereas 30 percent are owner and 23 percent are owner-cum-tenant (Table 2). There is a significant variation in tenancy status across different farm size categories. The comparison showed that owners operating farms are higher among large farmers, tenants are higher in small farmer's category and owner cum tenant are higher in medium farmers.

Table: 2 Characteristic of the Sample Growers by Farm Size

Farmer Characteristics	**Farm size categories**			**All**	**Sig.**
	Small	**Medium**	**Large**		
Age (years)*	41.18(11.7)	39.00(13.8)	42.33(9.09)	40.75 (12.04)	.755
Education (years)*	0.36 (2.09)	4.77 (1.88)	8.08 (4.28)	3.99(4.38)	.000
Farming exp. (Years)*	16 (9.70)	28 (13.24)	21.48 (11.64)	21.01 (12.25)	.001
Sunflower farming exp. (Years)*	2.61 (1.84)	3.23 (2.33)	3.12 (1.90)	2.94 (1.99)	.459
Tenancy status (percent farmers)					
Owner **	6 (2)	5 (1)	84(21)	30 (24)	.000
Tenant **	88 (29)	9 (2)	8 (2)	41 (33)	
Owner- cum- tenant**	6 (2)	86 (19)	8 (2)	23 (29)	
Total	100 (33)	100 (22)	100 (25)	100 (80)	

Source: Survey data, 2006

*The figures in parenthesis are of standard deviation

** The figures in parenthesis are in numbers

3.6 Source of Income

All sampled sunflower growers reported that agriculture is the major source of their income. The secondary source of income was also analyzed and found that majority 91 percent depend on agriculture. While 6 percent depend on business and 3 percent on employment (Table 3).

Table: 3 Major source of income reported by farm size

Particulars	Small	Medium	Large	All	Sig.
Primary source of income					
Agriculture	100 (33)	100 (22)	100 (25)	100.0 (80)	.000
Secondary source of income					
Agriculture	97 (32)	82 (18)	94 (23)	91 (73)	.688
Business	3 (1)	14 (3)	4 (1)	6 (5)	
Employment	-	4 (1)	4 (1)	3 (2)	

Source: Survey data, 2006

* The figures in parenthesis are in number

3.7 Institutional Credit

Access to credit is an important instrument enables farmers to acquire command over the use of working capital and consumption goods. Credit is considered as a key element in the process of modernization of agriculture. Credit not only helps in removing financial constraints but it also provides incentives to growers for adopting new techniques and practices with new aspiration and horizons, provided it is properly delivered. It is commonly believed that credit availability for small farmers is one of the main indicators of rural development. During the survey it was found that none of sunflower growers' obtained institutional credit and they depend on input dealers and informal money lenders for credit.

3.8 Sunflower Varieties

In the study area all sample sunflower growers used Hybrid varieties of sunflowers grown, viz; (Hysun-33, Hysun-37 and Hysun-38). Figure 1 shows that 43 percent respondents planted Hysun-33 Variety, followed by 29 percent planted Hysun-38 variety and 28 percent Hysun-37 varieties.

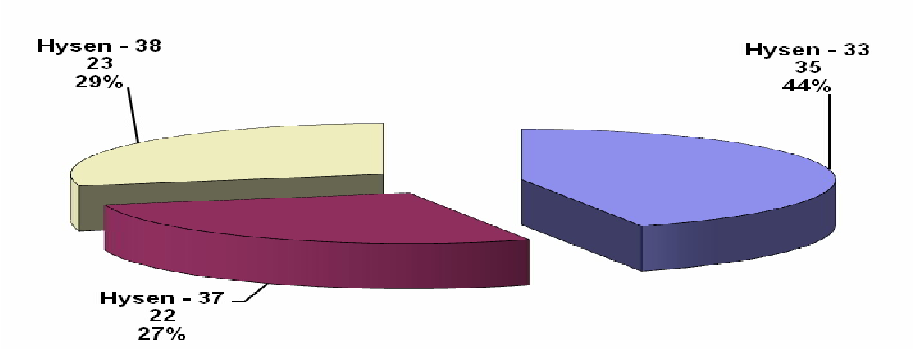

Figure 1: Area under selected sunflower Varieties in Sindh, 2006

3.9 Increasing / Decreasing Area under Sunflower

During survey future allocation for sunflower crop is investigated and found that majority 59 percent of the respondents are of opinion that they decrease area of sunflower followed by 24 percent remain same area and 17 percent have opinion to increase their area of sunflower (Table 4). The reasons for decreasing area of sunflower is reported by growers that low availability of pure certified seed, high cost and low net returns are the main causes of low yields.

Table 4: Increasing / decreasing area under Sunflower by farm size

Increasing / decreasing sunflower area	Farm size categories			All
	Small	Medium	Large	
Increasing	21% (7)	13% (3)	16% (4)	17% (14)
Decreasing	52% (17)	55% (12)	72% (18)	59% (47)
Same	27% (9)	32% (7)	12% (3)	24% (19)

Source: Survey data, 2006

* The figures in parenthesis are in number

3.10 Factors Influencing in Adoption of Sunflower Varieties

The important socioeconomic variables such as tenancy status, farm size, education level and source of income are analyzed through multinomial logistic regression model and results are presented in table 5. The Log likelihood value suggests that the model have adequately explained the sunflower production variables i.e., Farm size and level of education have significantly affected the likelihood of adopting the sunflower varieties. These factors are statistically significant at $p<0.05$ and variables tenancy status and source of income are not indicating any significance.

Table : 5 Multinomial Regression Estimates for Factors Affecting Adoption of Sunflower Varieties

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	.000	.000	0	.
Tency Status	5.545	5.545	4	.236
Farm size	26.310	26.310	4	.000
Education level	15.924	15.924	8	.043
Source of income	.000	.000	4	1.000
Final	.000	172.011	20	.000

4. Conclusion and Recommendations

The analysis of socioeconomic factors affecting adoption of sunflower varieties in Sindh is carried out and found that hybrid varieties of sunflower are dominant and planted 43 percent Hysun-33, 29 percent Hysun-38 and 28 percent Hysun-37. The major problem found that low availability of quality seed in the market and supplying of sub standard seed in 'certified package' affected the production and income of growers. It is therefore recommended that government should arrange pure seed of high yielding verities on easy term loan basis to enhance the sunflower production in the target areas.

Sunflower is still the best possible, option and short-duration crop in area. During survey it is indicated by large number of growers who have shifted from sugarcane to sunflower production in the lower Sindh, due to unethical practice of supplying sub standard seed in 'certified package' to growers will also be decreased the sunflower area.

The socioeconomic factors such as tenancy status, farm size, education level and source of income were tested through multinomial logistic regression model. The Log likelihood values suggested that the model adequately explained the sunflower production variables. Farm size and level of education are statistically significant in adoption of sunflower varieties. These factors are statistically significant at $p<0.05$.

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