Research Article

Factors Affecting Adoption of Recommended Citrus Production Practices in the Punjab

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Abstract | The present study was conducted to examine the awareness and adoption of recommended citrus production practices and to investigate the factors that can affect the adoption of recommended citrus production practices. A farm level survey was conducted in Sargodha and T.T. Singh districts to gather the information about the awareness and adoption of recommended production practices of citrus. The study sample was consisted of 140 respondents. The binary regression model has been used to evaluate the effect of different socio-economic variables on the adoption response of different recommended production practice for citrus. Average age, education and experience of the citrus growers were estimated 43.92 years, 9.74 schooling years and 17.72 years respectively. The awareness and adoption of recommended citrus practices was generally good. The results of the logit model for adoption of recommended irrigation practices however postulate positive and significant impact of citrus producing experience and family income on adoption of recommended number of irrigation and hoeing practices whereas age has significant negative impact on the adoption of hoeing practice and fertilizer applications. Positive and significant impact of family income is influencing the adoption of every recommended practice. The present paper concluded that various human resource factors like age, education and experience of the citrus growers and yield mound/acre of citrus had relative significant impact of the adoption of different recommended practices.

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Introduction

Fruits play an important role in human nutrition and health, particularly as sources of vitamin C, thiamine, niacin, pyridoxine, folic acid, minerals and dietary fiber (Wargovich, 2000). Citrus (Kinnow) occupies a prominent position in fruit industry of the world including Pakistan. Citrus is the main fruit grown in Punjab as it occupies almost 47 percent of total fruits area and production in province. Punjab province contributes above 95 percent of the overall citrus area and production. Overall area under citrus during 2012-13 was 182.1 thousand hectares with the overall area of 192.8 thousand hectares whereas production was accounted 1930.1 thousand tones in Punjab during same year. The area and production of citrus in Punjab has been increasing at the rate of 0.93 percent and 1.43 percent per annum during

2003-2013 (GoP, 2013).

The major problems faced by the Citrus growers are observed mainly during harvesting, post harvest handling and marketing, which are responsible for a large yield gap (Ghafoor et al., 2010). The losses in citrus production can be minimized through the increased adoption of recommended production practices. Adoption of recommended production practices is attributed to enhance fruit production and higher incomes to growers. Farmer's awareness about the technical aspects of the recommended technology is the key component of increased level of adoption (Singh et al., 2010). Even among farmers, there is a great variation in their levels of knowledge, as well as their readiness to accept, try new methods and adopt improved production practices. Some need more time to grasp and get convinced and hence need longer sustained support from extension agencies including horticulture department staff. That's why dissemination of knowledge about recommended practices and demonstration of their expected gains is the key to increase rate of adoption (Felistus, 2009).

Keeping in view of the importance of citrus fruit for economy of Punjab various efforts have been done in the past from the horticulture and extension departments for the dissemination of recommended of citrus production practices to enhance citrus production, however no significant improvement in production figures have been seen. This calls for the examination of the awareness and adoption of recommended production practices to evaluate the factors that can affect the adoption of recommended production practices by citrus growers. The present paper therefore planned to achieve the following objectives.

- To access the awareness level of farmers regarding recommended production practices;
- To find the adoption level of farmers regarding improved Citrus (Kinnow) production practices;
- To analyze the factors influencing adoption of the recommended citrus production practices
- To suggest policy recommendation for improving the adoption rate of recommended practices among citrus growers.

Materials and Methods

A farm level survey was conducted in Sargodha and T.T. Singh districts to gather the information about the awareness and adoption of recommended production practices of citrus. The study sample was consisted of 140 respondents. Data were collected through farmers' interviews using a well- structured questionnaire. The data thus obtained were analyzed to estimate the various responses and draw conclusions for pertinent recommendations. The respondents were classified into categories of small, medium and large farms according to size of their operational land holdings. The farmers operating a farm of 12.5 acres were termed as small farmers; those with an operational land holding between 12.6 and 25.00 acres were placed under medium farmers, whereas the farmers having more than 25.00 acres were classified as large farmers. A logistic regression was run to get the coefficients and odds ratios of the independent variables to affect the probability of the binary response. Logistic regression (logit model) is a category of probabilistic approach of research (Christopher, 2006). It was hypothesized that a farmer's decision to use or not use a recommended technology was influenced by the characteristics of the household head (age, education, farming experience and yield mounds/acre.). The binary regression model has been used to evaluate the effect of different socio-economic variables on the adoption response of recommended citrus production practice like number of irrigations, number of hoeing, fertilizer usage, harvesting practices etc. the general functional form of the Ligit model is as follows;

$$logit(p) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots\ldots\ldots b_nX_n$$

Where:
p: Probability of the presence of issue of consideration;
X: Exogenous variables. The logit transformation has been identified as log odd values as explained;

$$Odds = p/1-p$$

Where:
p: Probability of presence of characteristic; 1-p: Probability of absence of charactersistic and logit p is equals to;

$$logit(p) = ln\ (p / 1-p)$$

Based upon the choice of the farmer regarding his interest in adoption of the recommended technologies, a binary choice regression model was constructed. It consisted of a binomial dependent variable (recommended Citrus adoption attitude) i.e. either adoption

$$D_{adoption} = \beta_0 + \beta_1 ln\ age_{cg} + \beta 2 ln\ educg + \beta_3 ln\ exp_{cg} + \beta_4 ln\ income + + \mu_i \ \ldots\ldots (1)$$

Table 1: *Socio economic characteristics of citrus growers.*

Variables	Farm Size Groups			
	Small	Medium	Large	Overall
Age (years)	44.23	43.96	42.56	43.92
Education (years)	9.63	9.49	10.89	9.74
Citrus (Kinnow) orchard experience (years)	17.7000	18.702	15.2778	17.7000

Table 2: *Awareness about recommended technologies of Citrus (Kinnow) orchards (Percent Farmers).*

Use of recommended Technologies	Farm Size Groups			
	Small	Medium	Large	Overall
Rotavator	89.30	89.40	100.00	90.70
Ploughing & Planking	88.00	74.50	88.90	83.60
Land leveling	86.70	87.20	83.30	86.40
Analysis of soil sample of Citrus (Kinnow) orchards	48.00	46.80	61.10	49.30
Hoeing	97.3	95.70	100.00	97.10
Irrigation	100.00	100.00	100.00	100.00
Urea	88.00	93.60	100.00	91.40
SOP	68.00	61.70	77.80	67.10
SSP	68.00	80.90	66.70	72.10
Farm Yard Manure (FYM)	100.00	100.00	100.00	100.00
Citrus (Kinnow) diseases	70.70	74.50	83.30	73.60
Fungicides	98.70	100.00	100.00	99.30
Insecticides	72.00	76.60	88.90	75.70
Pruning with scissors	92.00	97.90	100.00	95.00
Picking with scissor and ladder	73.00	68.10	83.30	72.70

or non adoption. It takes the value of 1 if the farmer showed his interest in adoption of recommended technologies and 0 otherwise. The adoption interest model was tested with several combinations of socio-economic independent variables which can influence the decision of the farmer. The specified model regressed was as follows; (Equation 1)

Where:

$D_{adoption}$: Dummy variable showing attitude of the farmers towards adaptation of recommended technologies in Citrus 1 if adopted, 0 otherwise; age_{cg}: Age of citrus growers (Years); edu_{cg}: Number of scholling years of citrus growers; exp_{cg}: Citrus growing experience of the respondents in years; Income: Family income (Rs).

The specified logistic regression model has been evaluated for adoption of different recommended practices separately such as number of irrigation, fertilizer applications, number of hoeing etc.

Results and Discussion

Average age of the respondents of the study area was 43.92 years. The age of small farmers was 44.23 years which was comparatively more than other farm size groups. Overall average education of the respondents was 9.74 schooling years and the large farmers had the years 10.89 schooling which were higher than the other farm size groups. Overall mean experience of respondents in Citrus (Kinnow) orchards was 17.72 years and medium farmers had the experience of Citrus (Kinnow) orchards 18.70 years which was higher than the other farm size groups (Table 1).

Awareness level about citrus recommended production and harvesting practices

Results in Table 2 articulate the farmer's awareness about different production technologies in sample area. The awareness level of citrus growers was very about land prepration practices. Overall majority of the respondents (90.70 percent) were aware about recommended use of rotavator followed by land levelling (86.40 percent) and ploughing & planking (83 percent) respectively. About half of the respondents (49.30 percent) were aware about soil sample of citrus orchard to check the appropriate availability of nutrients in soil. A vast majority of the farmers (97.10 percent) were aware about recommended number of hoeing. All the respondents were aware about recommended irrigation for citrus orchard. Response regarding recommended use of fertilizers shows that majority of the farmers (91.40) were aware about recommended dose of urea, SOP (67.10 percent) and SSP (72.10 percent). All the citrus growers (100 percent) were aware about use of farm yard manure in citrus orchard. More than 73 percent farmers were aware about citrus diseases. The awareness level of insecticides and fungicides use was 75.70 and 99.30 percent respectively. Majority of the farmers (95 percent) were aware about citrus pruning. The awareness

level about improved citrus picking (picking with scissors and use of V shape ladder) was 72 percent.

Adoption of recommended citrus production and harvesting practices

Table 3 articulates the information regarding the adoption of recommended technologies by the citrus growers. The adoption level of rotavator, ploughing & planking and leveling was 82.10, 83.90 and 51.40 percent respectively. The adoption was comparatively more at large farms as compared with medium and small farms. The adoption of soil analysis before citrus planting was not up to the mark as only 40 percent of the farmers got soil analysis with more percentage among large farmers. Majority (85 percent) of the respondents use recommended number of hoeing. However, three forth (75 percent) of the respondents adopted recommended number of irrigations. The adoption of fertilizer application was 72.90 percent. The adoption level of recommended doses of Urea, SOP and SSP fertilizer was 90, 66.40 and 62.10 percent respectively. Overall majority of the farmers (92%) used the recommended dose of farmyard manure. The adoption recommended of recommended fungicides and insecticides was 98.0 and 85.70 percent respectively. More than half of the respondent (54.00 percent) were using scissor and ladder for fruit picking as recommended by the agri. department.

Table 3: *Adoption of recommended technologies of Citrus (Kinnow) orchards (Percent adopter).*

Use of recommended Technologies	Farm Size Groups			
	Small	Medium	Large	Overall
Rotavator	81.30	78.70	94.40	82.10
Ploughing and Planking	88.00	72.30	88.90	82.90
Land levelling	53.30	44.70	61.10	51.40
Analysis of soil for planting orchards	35.80	39.30	50.00	41.00
Hoeing	82.70	85.10	94.40	85.00
Irrigation	74.70	72.30	83.30	75.00
Diseases control	61.30	63.80	77.80	63.30
Fertilizer application	72.00	70.20	83.30	72.90
Urea	86.70	93.60	94.40	90.00
SOP	65.30	63.80	77.80	66.40
SSP	60.00	68.10	55.60	62.10
Farm Yard Manure.	90.70	93.60	100.00	92.90
Fungicide	97.30	100.00	100.00	98.60
Insecticides	80.00	93.60	88.90	85.70
Pruning with scissor	88.00	95.70	88.90	90.70
Picking with Scissor and ladder	39.20	57.40	66.70	54.00

Factors responsible for adoption

The slope coefficients, in binary logistic regression model are odd ratios. Same studies (Burton et al., 1999; Hosmer and Lemshow, 2002; Nkang et al., 2006) explained the odd ratios of the binary type regression model. The binary logistic regression coefficients of citrus growing experience and income are statistically significant at 10 and 1 percent level respectively. The results of the logit model for adoption of recommended irrigation practices however postulate that for every one year change in experience of citrus orchard management the log odds of adoption of recommended number of irrigation practices will be increased by 0.267. For each rupee increase in income the log odd of adoption of recommended irrigation practices increased by 0.002. Estimations show that age and education of farmer also positively affects adaption of the recommended irrigation practices but their coefficients are insignificant. The measures of pseudo R squared values like Cox and Snell R square and Nagelkarke R-square has been used to explain the overall goodness of the binary logit model and estimated 0.433 and 0.642 respectively. The chi square test value is also highly significant having value 79.554 (Table 4).

The results of the logit model for adoption of recommended hoeing practices indicate age, education and income are significant coefficients. The estimated log odds indicate that with one year increase in age of citrus growers the log odds of adoption of hoeing practices decrease by 0.020 units. The log odds value for experience showed that one year change in experience of citrus orchard management the log odds of adoption of recommended hoeing practices will be increased by 4.825 units. For every addition rupee income the log odd of adoption of recommended hoeing practices will be increased by 20.874 units. Estimations show that education of farmer also positively affects adoption of the recommended hoeing practices but its coefficients is insignificant. The measures of pseudo R squared values like Cox and Snell R square and Nagelkarke R-square has been used to explain the overall goodness of the binary logit model and estimated 0.296 and 0.518 respectively. The chi square test value is also highly significant having value 49.059 (Table 4).

Table 4: *binary logistic regression results for adoption of recommended practices.*

Variables	Coefficient (std.error)	Odd ratio	Wald test
Binary logistic Regression results for adoption of recommended Irrigation practices			
(Constant)	-22.489 (8.393)	5.844	3.376*
age_{cg}	-3.049 (1.659)	21.093	0.022
edu_{cg}	0.107 (0.718)	0.898	0.881
exp_{cg}	1.319 (0.72)	0.267	3.284*
Income	6.134 (1.260)	0.002	23.694***
Chisqare= 79.554***	Log likelihood= 77.900	Cox&snell R^2= 0.433	Nagelkerke R^2 = 0.642
Binary logistic Regression results for adoption of recommended Hoeing practices			
(Constant)	-12.894 (8.598)	0.000	2.249
age_{cg}	-3.909 (1.740)	0.020	5.264**
edu_{cg}	0.682 (0.832)	0.505	0.673
exp_{cg}	1.574 (0.757)	4.825	4.322**
Income	5.303 (1.422)	20.874	13.905***
Chisqare= 49.059***	Log likelihood= 69.299***	Cox&snell R^2= 0.296	Nagelkerke R^2 = 0.518
Binary logistic Regression results for adoption of recommended fertilizer practices			
(Constant)	-8.738 (5.678)	0.000	2.368
age_{cg}	-2.304 (1.313)	0.100	3.080**
edu_{cg}	0.101 (0.554)	1.106	0.033
exp_{cg}	0.863 (0.567)	2.371	2.315
Income	3.036 (0.655)	20.828	21.467***
Chisqare= 47.143***	Log likelihood=16.566***	Cox&snell R^2= 0.286	Nagelkerke R^2 = 0.416
Binary logistic Regression results for adoption of recommended scissor picking			
(Constant)	-1.196 (3.977)	0.303	0.090
age_{cg}	-1.545 (1.037)	0.213	2.220
edu_{cg}	0.332 (0.484)	0.717	0.704
exp_{cg}	0.375 (0.448)	1.456	0.704
Income	1.327 (0.364)	3.770	13.311***
Chisqare= 18.531***	Log likelihood= 169.913***	Cox&snell R^2= 0.124	Nagelkerke R^2 = 0.168

***: *Significant at 1% level (p<0.01);* **: *Significant at 5% level (p<0.05);* *: *Significant at 10% level (p<0.10);* **Source:** *Author's Estimation*

The results of the logit model for adoption of recommended fertilizer practices indicate age and income are significant. The estimated log odds indicate that with one year increase in age of citrus growers the log odds of adoption of fertilizer application decrease by 0.100 units. For every one rupee increase in income the log odd of adoption of recommended fertilizer applications will be increased by 20.828 units. Estimations show that education and experience of farmer also positively affects adoption of the recommended hoeing practices but having insignificant coefficients. The measures of pseudo R squared values like Cox & Snell R square and Nagelkarker R-square has been used to explain the overall goodness of the binary logit model and estimated 0.286 and 0.416 respectively. The chi square test value is also highly significant having value 47.143 (Table 4).

The results of the logit model for adoption of recommended scissor picking practices indicate income as significant variable. The estimated log odds indicate that for every additional rupee in income the log odd of adoption of recommended scissor picking will be increased by 3.770 units. The measures of pseudo R squared values like Cox and Snell R square and Nagelkarker R-square has been used to explain the overall goodness of the binary logit model and estimated 0.124 and 0.168 respectively. The chi sq test value is also highly significant having value 18.513 (Table 4).

The results of the present paper logit model are in line with the various previous studies and their respective findings are provided here to justify the results. Rachel et al. (2010) used the binary logit regression models to estimate the factors affecting adoption of recommended management practices in stocker cattle production. The results revealed that older producers and those pursuing a year round production strategy were found to lag in adoption. Felistus (2009) established a logistic model to examine the factors influencing adoption of recommended maize technology package and comes up with the findings that education and income levels of the farmers have significant impact on the adoption of entire technology package while age has no effect on adoption. Chi and Yamada (2002) conducted a descriptive study to analyze the factors that affect the adoption of new technologies and comes up with the conclusion that progressive, young and educated male farmers are more likely to adopt new technologies than conservative old farmers. The study conducted by Singh et al. (2010) analyzed the extent of adoption of recommended technologies in mango production and found that level of knowledge of mange cultivation practices contribute positively and significantly to the adoption of recommended production practices. According to Imaita (2013), education was the influencing factor in the adoption of innovation as respondents having primary education had highest innovation adoption rate than the respondents having no education.

Conclusions and Recommendations

The awareness level about recommended citrus production and harvesting practices was relatively good except soil analysis. However, the adoption level was relatively poor espacially soil analysis, land leveling and recommended citrus harvesting practices. The socio-economic characteristics like age, education, experience of the citrus growers and income had significant impact of the adoption of different recommended practices. Efforts are required for up-scaling the capacity building of growers through imparting skill to a target group of citrus. Lot of efforts are required to educate and train the farmers, regarding production and adopting recommending dose and quantity of different factors.

There is the need to increase the participation of young farmers in citrus production in order to increase the adoption of recommended technologies. Education is another factor that can contribute positively towards the adoption of new techniques. The organization of technical sessions and trainings for citrus growers can bring positive change regarding adoption of full technological package.

Authors Contribution

MA concieved the idea of the study. AB collected the data while MA, IM and AB analysed it and wrote the manuscript. TH helped in developing methodology and KM reviewed the paper. ZI overall managed the paper and references. TH and KM provided techinical assistance.

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