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Factors hindering plantation of improved apple varieties in Kashmir valley: An economic analysis

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Abstract

Improved high-yielding apple varieties are important for reducing hunger and food insecurity in developing countries and improving horticultural production and productivity. The study uses cross-sectional data obtained from a survey conducted during 2021 fruit season, a probit model analysis was used to determine the probability of adopting new, improved apple varieties (NIAVs) by growers from two main apple-producing districts of Kashmir valley *i.e.* Shopian and Pulwama. The results revealed that the education of the respondent, extension services availed and apple plant accessibility play significant roles in decisions regarding the adoption of new apple varieties. Moreover, farming variables like holding size is the key factor influencing the probability of adopting NIAVs in the study area. The extensive role performed by extension services, enormous emphasis on dissemination, demonstration, and growers participatory studies and training packages to popularize and undertake new apple varieties and enhance their adoption rate are required on a large scale in the study area. The study suggests that policy intervention ought to be made to improve the educational status of apple-growing households and develop programs on a varietal package of apple which offer apple growers a variety of choices in selecting the appropriate varieties for adoption. Such programs ultimately help growers develop more profit-oriented behaviour, which will not only enhance adoption rate, profitability, and production but will also improve food & nutritional security in the region in particular and the whole valley in general.

Key words: Rate of adoption, new apple varieties, probit model, technological intervention, production gain.

Introduction

Improved plant technology can be an option for apple growers to increase production, reduce poverty, and achieve better living standards. Adopting high-yielding plant varieties has revolutionized the horticultural industry through increased productivity per unit of land, and better quality fruit with better fruit size. The adoption of NIAVs has transformed the nature of low-productive and subsistence horticulture to a highly productive commercial one (Wani *et al.*, 2021; Just and Zilberman, 1988). The adoption of NIAV's are supposed to increase the production, productivity per unit of land and employment man-days worldwide. The study tries to analyze the impact of new apple varieties compared to old/traditional apple varieties in terms of their production, productivity, income gain and employment avenues to the region's skilled, semi-skilled and even illiterate people.

Evolving, promoting and adopting plant varieties helps yield sustainablity and improve the livelihood of rural apple growers (Wani *et al.*, 2021a; Asfaw *et al.*, 2012). Cultivation of apple in the region is the dominant horticultural activity which has improved the living standard, reduced poverty and enhanced the livelihood of the populace in the country (Gumma *et al.*, 2011; Wani *et al.,* 2021). However, the adoption of new yield-increasing apple varieties in Jammu and Kashmir is fairly low (24%) and its share in UT contribution is not fairly enough (Wani *et al.*, 2012).

In terms of area and production, apple is the largest crop, followed by rice, maize and wheat. Various reports on horticulture and food security assessments in Jammu and Kashmir have noted that low horticultural productivity is a significant constraint to achieving food security in the UT. (Wani *et al.,* 2021b; Bohle and Adhikari, 1998; Gittelsohn *et al.*, 1998; Seddon and Adhikari, 2003; FAO, 2010; Pyakuryal *et al.*, 2010; Sanogo and Maliki, 2010; Wani *et al.,* 2021). Apple producers have less understanding and accurate information about recent changes in the apple area over the years to design appropriate production plans and technology targeting schemes in the region (Gauchan *et al.*, 2012). In this context, it has been a challenge for Jammu and Kashmir to increase the production and productivity of horticultural products, especially apple, the dominant horticultural crop, to sustain the growth of the region and reduce the poverty scenario in the union territory.

Apple production in Jammu and Kashmir largely depends on climatic variability, as the maximum of apples is produced in rain-fed surroundings, especially in Karewa (hilly terrain) of Shopian and Pulwama. For example, apple production and yield have noticeable fluctuation, which increases during the favourable spring seasons, but drop sharply during unfavourable years (Wani

et al., 2013a; Gauchan *et al.*, 2012; Poudel *et al.,* 2013). Pulwama district exists mainly in the low land type; the primary source of irrigation remains local streams, ponds, and rain floods. About three-fourth (74%) of the apple is produced in the flat lowland of the Pulwama and the rest (26%) in the Karewas (Wani *et al.*, 2013).

Jammu and Kashmir's horticulture is characterized by marginal and small landholdings with land endowments scattered in different plots or parcels. This is because the ever-increasing population has pressured land to be fragmented (Wani *et al.*, 2012; Gauchan *et al.*, 2012). Therefore, growers' perceptions of new varieties are particularly important in determining which apple plant variety they will adopt (Sall *et al.*, 2000). Further, growers' perceptions of the technology-specific attributes of apple varieties are the major factors in determining adoption and use intensity (Adesina and Zinnah, 1993). As Joshi and Pandey (2006) stated, analyzing apple data from rain-fed environments in Jammu and Kashmir, growers' perceptions of varietal characteristics play key roles in determining technology choices. Therefore, the present study highlights the factors responsible for growers' perceptions of technology-specific characteristics in adoption decisions relating to improved apple varieties based on the plot level data in two districts of Kashmir valley.

Many donor agencies have invested substantial resources in horticultural technologies in developing countries. However, most new horticultural technologies have not achieved the desired goals (Faltermeier and Abdulai, 2009). These studies focused on adopting single horticultural technology rather than a bundle of innovations that might enhance horticultural productivity in an integrated approach. Therefore, to realize the increased horticultural productivity by rural apple growers, adoption should occur in an integrated system. The past literature (Just and Zilberman, 1988; Uaiene *et al.*, 2009; Wani *et al.*, 2013a; Becerril and Abdulai, 2010) regarding the adoption of new technology opined that decisions about adoption depend on several factors which are full of uncertainty, risk and asymmetric information. Keeping these challenges in view, the UT of Jammu and Kashmir need to adopt such apple varieties that will improve the production and productivity scenario in the region and address the issues of unemployment, nutritional security, and poverty to the greatest extent. NIAVs have been recently introduced in Kashmir. Therefore very little is known about the attitudes and perceptions of growers regarding new, improved apple varieties adoption at the field level. To fill this research gap, this study attempts to determine the key factors associated with improved high-yielding apple varieties adoption at field level in Jammu and Kashmir, particularly in two districts of Kashmir.

Jammu and Kashmir Agricultural Production Department and Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir are the main and nodal agencies for agricultural/ horticultural research in the region and mainly the focus of these agencies is on the new apple varieties from the past decade. The nodal agencies are developing and delivering new generations of modern apple varieties to suit the needs of diverse ecosystems and populations. However, there is a lack of adequate information regarding newly released improved varieties and their adoption patterns in growers' fields (Launio *et al.*, 2008). For example, growers are overwhelmingly growing old and obsolete apple varieties; 85% of all the planting material demand in 2021 was for apple varieties released before 1995. Therefore, this study categorized apple varieties into two groups: old and new improved varieties based on their productivity potential. The study aims to make it clear to the growers and policy planners how through the adoption of NIAV's, highest benefits per unit of land can be reaped. The study tries to open a gateway for adopting new apple varieties instead of traditional varieties. The research study was carried out to help identify the factors responsible for adopting new and improved varieties of apples despite having tremendous potential for income increment and employment generation.

Materials and methods

Selection of study site: This study was conducted in two districts of Jammu and Kashmir, namely Shopian and Pulwama. Study sites from the Pulwama district are accessible by motorable roads and close to market centers, whereas the selected villages from the hill district (Shopian) were less accessible from roads and markets than the Pulwama district. The hill district Shopian is located within a radius of 45 kms. Pulwama district is situated in a 35 km radius towards the southern part of Kashmir valley. The sampled districts constitute a major apple-producing region, distinctly effective, appropriate agroecology for fruit production, contributing best to regional production (Digest of Statistics, 2020). Similarly, these districts consist of many commercial growers and adopters, using high-yielding and hybrid varieties of apples from the past few years. Growers in the region have also adopted numerous improved horticulture technology, get entry to extension services, productive and fertile lands, and infrastructures along with roads, markets, irrigation, rural credit establishments and cooperatives compared to different districts/ regions of the valley.

Theoretical and empirical framework: This optimization takes place in the presence of a constrained budget, information, credit access, and the availability of both technology and other inputs. Thus, households are assumed to maximize their income function subject to these constraints (Asfaw *et al.*, 2012). The difference between the income from adopting improved apple varieties (IiA) and the income from not adopting the technology (IiN) may be denoted as Ii*, such that an income-maximizing farm household, i, will choose to adopt new technology if the income gained from adopting is greater than the income from not adopting (Ii* = IiA – IiN > 0). The model used to depict the variation in income is of the following order;

$Ii^* = Vi'\gamma + ui$ (Feleke and Zegeye, 2006; Janvry *et al.,* 2010; Asfaw *et al.,* 2012; Kohansal and Firoozzare, 2013)

Where Ii' is the latent variable representing the probability of the household's decision to adopt NIAVs, and takes the value '1' if the grower adopts NIAVs, '0' otherwise.

Likewise, the probit model used in this study is of the following equation.

$$I_1 = \Upsilon^0 + \Upsilon^1 V^1 + \Upsilon^2 V^2 + \Upsilon^3 V^3 + \Upsilon^4 V^4 + \Upsilon^5 V^5 + \Upsilon^6 V^6 + \Upsilon^7 V^7 + \Upsilon^8 V^8 + ui$$

Where the term V^1 depicts the respondent's age, V^2 represents the gender of the respondent, V^3 depicts the education of the respondent, V^4 depicts the family labour involved, V^5 depicts land under apple cultivation, V^6 depicts available extension services, V^7 depicts the distance to the local mandi, V^8 depicts insect-pest

resistance, γ is a vector of parameters to be estimated, and ui is the error term.

Data collection and sampling method: The data used in this study was obtained from a survey conducted in two districts of South Kashmir during April-Nov, 2021, the main apple growing season in Jammu and Kashmir. A multistage, random sampling procedure was employed to select districts, villages and farm households. In the first stage, two districts (Pulwama and Shopian) were purposively selected based on the intensity of NIAVs production, agroecology and accessibility. This was followed by a random sampling of eight community development blocks (CDB, CDB is the lowest administrative unit of the local government at the village level) at the second stage (two CDBs from each district). In the third stage, 20 villages were randomly selected. A random sample of 480 households from selected villages was surveyed using standardized questionnaires at the final stage. The respondents interviewed are the household head or household managers, male or female members who directly decide and manage the orchards.

Results and discussion

Descriptive statistics: Table 1 presents a descriptive analysis of the respondents from the sampled districts. As observed, 63.75% of the households do not adopt NIAVs. The average household head age was 55 years and economically active family members were recorded at 4.21 persons per household. Growers, on an average, had 9.53 years of formal schooling, which is consistent with the average in Jammu and Kashmir (DES, 2020). Growers, on an average, had 7.79 kanals of middle land under apple cultivation, likewise 8.67 contacts with the extension agents during the previous year (Table 2).

Table 1. Number of households adopting and not-adopting the NIAVs from the sampled area

Sampled Districts	Sampled households (No.)		Total
	Non-adopter	Adopter	
Shopian	144	96	240
Pulwama	162	78	240
	306 (63.75 %)	174 (36.25 %)	480 (100%)

Table 3 presents differences between the means of characteristics of adopters and non-adopters of NIAVs. There appeared to be a significant difference in age and education of the household head between adopters and non-adopters. Farm size was significantly higher for adopters than non-adopter counterparts, whereas the number of active family members was comparable between the two groups. Moreover, most NIAV adopters had access to improved seeds and extension services compared to non-adopters. Interestingly, there was no significant difference in gender and distance to the market.

Factors influencing the probability of adopting NIAVs: The results of estimated probit models are presented in Table 4, which represents the propensity to adopt NIAVs by sampled households. Some variables significantly affected the probability of adopting horticultural technology and agreed with some of the findings in previous studies. The study reveals that education plays a significant role in decisions regarding household affairs and so is true regarding the adoption of NIAVs. The result suggested that the more educated the grower is, the more likely they will

Table 2. Variables influencing the adoption of NIAV's in the sample area

Variable	Description	Mean	Standard Deviation
NIAV adoption	Value =1, if plants NIAV's or = 0 if otherwise	0.72	0.53
Respondents age	No. of years	54.71	11.70
Gender of the respondent	Value =1 if the household head is male, or = 0 if otherwise	0.91	0.85
Education of the household head	No. of years of schooling	9.53	4.40
Family labour	Active family members (between 14– 60 years)	4.21	0.89
Land under apple	Apple orchards in (Kanals)	7.79	3.33
Available Extension service	Number of extension demonstrations received	8.67	7.17

Table 3. Characteristics of adopters and non-adopters of new improved apple varieties.

Variable	Adopter	Non-adopter	Difference	*t*-value
Respondents age	44.21	50.31	6.1	5.73
Gender of the respondent	53.23	56.70	3.47	-1.41
Education of the respondent	9.53	7.72	-1.81	-12.83
Family labour	4.21	2.92	-1.29	-2.47
Land under apple	7.79	6.18	-1.61	-13.70
Distance to local fruit mandi	13.34	11.40	-1.94	-2.51
Insect-pest infestation	6.41	2.50	-3.91	-13.40

adopt NIAVs, possibly because he can process information more rapidly than others. This result is consistent with earlier studies (Langyintuo and Mungoma, 2008; Kassie *et al.*, 2011; Asfaw *et al.*, 2012). To assess the effect of farm size on the probability of adopting NIAVs, cultivated land owned by households was included in the model. The positive and significant sign on farm size indicated that as farm size increased, the likelihood of adopting NIAVs increased.

The availability of extension services significantly increased the adoption of NIAVs among sampled households, underlining the importance of extension in promoting adoption. This result is consistent with (Feleke and Zegeye, 2006; Mignouna *et al.*, 2011; Asfaw *et al.*, 2012; Mariano *et al.*, 2012). The household characteristic-related variables such as family labour, age, and gender of the household head have no statistically significant effect on the adoption of NIAVs. The findings conform with Gauchan *et al.* (2012). The gender variable not being significant here is possible because, in general, most of the household decisions in farming operations, including plant variety selection, are made in consultation with female members. Hence, men are not the sole decision maker for choosing plant varieties in Jammu and Kashmir. Table 4 presents the estimated marginal effects to examine the individual effect of each independent variable toward the decision to adopt NIAVs by households.

Adopting improved apple varieties has provided growers with numerous options for saving labour, energy and time, thereby improving the efficiency of horticultural operations. The use of the cross-sectional data and the probit model (plot-level analysis), examined the factors affecting the adoption of NIAVs by growers, particularly from two main districts of Jammu and Kashmir, UT. The results concluded that there seems to be no significant gender differential and family labour between adopters and non-adopters of improved apple varieties. However, there were significant differences in age, the number of years of schooling, farm size

Table 4. Estimates of adoption of new improved apple varieties in the sample area of Jammu and Kashmir

Variable	Parameter estimate		*z*-statistics	Marginal effect (Average)
Age of the respondent	0.021	(0.027)	0.81	0.041
Gender of the respondent	0.200	(0.332)	0.48	0.032
Education of the respondent	0.116	(0.112)	3.87	0.013
Family labour	0.243	(0.221)	1.40	0.018
Farm size under apple	1.301	(0.542)	1.71	0.120
Extension services availed	0.081	(0.121)	1.53	0.017
Distance to fruit mandi	-0.050	(0.015)	-1.89	-0.098
Pest resistance	0.132	(0.164)	0.60	0.061
Constant	-4.711	(2.121)	-3.18	
Log-likelihood	-51.710			
LR chi^2	189.261			
Prob > chi^2	0.000			
Pseudo R^2	0.653			
Correctly predicted	91.889			

and the number of extension visits between the adopters and non-adopters. The study further concluded that the factors influencing the probability of adoption are education, farm size and extension service of plant varieties.

The widespread role of extension and significant emphasis on information dissemination, extension demonstration, and grower's participatory research and training packages to popularize new apple varieties and enhanced adoption are required. Therefore, planners and decision-makers need to consider growers' preferences on varieties to be cultivated and demonstrations at growers' fields to enhance and promote the adoption of NIAVs.

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