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UNEARTHING THE SYNERGY OF ENTREPRENEURIAL SKILLS, SMALLHOLDER FARMING, AND HIGH-VALUE AGRICULTURE: A CASE STUDY FROM PUNJAB, PAKISTAN

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ABSTRACT

Entrepreneurship is a key to the improvement in the quality of individuals, households, and communities viz a viz sustained economic growth of the country. Smallholder farmers' entrepreneurship is the response to new opportunities to gain economic gains rather than subsistence agriculture. For example, to grow High-Value Agricultural (HVA) crops rather than conventional crops. The present study aims to assess the entrepreneurial characteristics of smallholders in the Punjab Province of Pakistan. For this purpose, cross-sectional data of 450 farmers were collected through a well-designed questionnaire. Data were analyzed by using simple statistics and inferential statistics. The probit model results show a positive significant impact of education, prior experience, risk aversion, knowledge and skills about crops, and self-actualization on the opportunity exploitation by the entrepreneurial HVA farmers. The finding of the factor analysis shows three important groups labeled as marketing, policy, and institutional support in the cultivation of HVA crops. Moreover, the outcomes of the multiple regression analysis reveal that emphasizing technological opportunities provides a novel viewpoint for entrepreneurial HVA farmers. Even in the absence of modern technological innovations, these farmers can still identify and capitalize on technological opportunities. Therefore, to foster entrepreneurship in HVA farming, it is suggested that the accessibility of improved seed varieties of HVA crops and access to market intelligence should be made more favorable for entrepreneurs.

Keywords: Entrepreneurship; Opportunity exploitation; High-value agricultural (HVA) crops; Smallholders; Pakistan.
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INTRODUCTION

Entrepreneurship refers to the process of identifying and exploiting new opportunities in the market, whether by introducing new goods and services, organizing markets differently, or leveraging new processes and raw materials through collective efforts (Shane & Khurana, 2003). While there is an ongoing scholarly discourse on whether entrepreneurs discover or create opportunities, an alternate perspective posits that it is the entrepreneurial initiative that compels individuals to identify and capitalize on potential avenues (Alvarez & Barney, 2007; Audretsch, 2003; Venkataraman, 2003, 2019). There are two main approaches to understanding entrepreneurship: one focuses exclusively on the individual, while the other considers the external environment and ecosystem conditions. Shane's theory emphasizes the significance of individual

traits and the nature of opportunities as the predominant factors elucidating entrepreneurship, relegating environmental influences to a secondary role (Davidsson, 2004).

This perspective is known as the disequilibrium approach, acknowledging the diverse nature of the economy and variations in the types of opportunities available to individuals. Shane argues that entrepreneurial opportunities exist autonomously within an economic system, arising from factors such as prices, inventions, and information (Venkataraman, 2003). Nevertheless, the realization of these objective opportunities requires human creativity and specific conditions. Figure 1 illustrates the entrepreneurship process in Shane's view. To stimulate entrepreneurship in this context, it is recommended to focus on improving access to specific conditions, such as improved seed varieties of high-value crops and extension information, which are more entrepreneur-friendly.

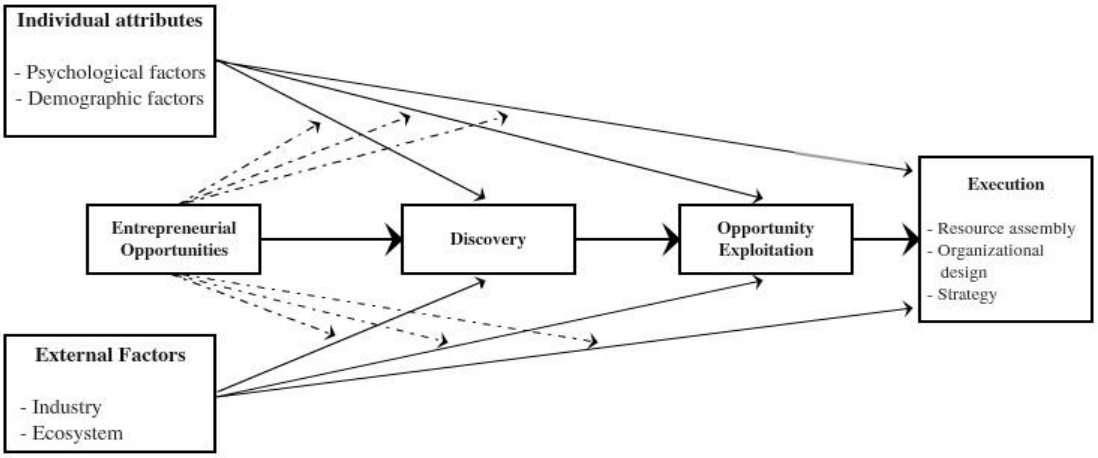

Figure 1. The model of discovery school of reference; Source: Shane (2003).

Agriculture is the lifeline of Pakistan's economy, contributing 22.9 percent to the Gross Domestic Product (GDP) and providing 37.4 percent employment to the national labor force (GOP, 2023). Although the agricultural sector has the potential to drive economic growth and reduce poverty, it has been underperforming in recent years. Specifically, the productivity of major crops has remained stagnant, resulting in a lackluster performance for the sector. Moreover, the cropped area for the five most important crops, namely wheat, rice, cotton, sugarcane, and maize, has remained largely unchanged over the past decade.

In recent years, the importance of traditional crops such as cereals and other staple food crops has been decreasing in developing countries relative to the High-Value Agricultural (HVA) commodities, which have an increasing demand (Gogh & Aramyan, 2014). HVA commodities are referred to as those commodities that have high economic returns, e.g., fruits, vegetables, milk, meat, eggs, fish, etc. Pakistan is also on the bank of agricultural transformation as the share of traditional five crops in the agricultural GDP is decreasing over time, replacing with the HVA crops such as livestock and the horticultural sector (Badar, 2015). Due to the higher potential of exports in HVA products, this sector of agriculture emerged as one of the priority areas (Siddique et al., 2018).

The government has made efforts to support farmers by providing affordable agricultural inputs and ensuring fair prices for their products. Improving domestic agricultural production through increased productivity is crucial for ensuring food security. While Pakistan has substantial production potential in agriculture, livestock, and fisheries, sustainable economic growth and prosperity require the long-term development of these sectors. To achieve this, it is important to use production resources efficiently by adopting modern technologies and establishing a realistic marketing system (GOP, 2023).

The expansion of High-Value Agricultural (HVA) crops and the establishment of institutions for vertical coordination, along with other changes in food supply chains, create both advantages and disadvantages for smallholders in developing nations. The benefits include the ability to increase their earnings by

participating in contemporary supply chains (Naseer et al., 2019a). However, there are challenges to smallholders due to the high production costs and the increased risks involved in the production and marketing of HVA products. This study is built on the premise that farmers who are growing HVA crops other than the five traditional crops are exploiting entrepreneurship opportunities and vice versa.

In light of the aforementioned challenges, the primary objective of this research was to assess the factors affecting the exploitation of opportunities among High-Value Agriculture (HVA) farmers in Punjab, Pakistan. The study encompassed three objectives: (1) assessing the entrepreneurial traits of small-scale HVA growers, (2) identifying the determinants influencing the choice to cultivate HVA crops, and (3) investigating the correlation between farmers' entrepreneurial characteristics and their motivation to cultivate HVA crops.

CONCEPTUAL FRAMEWORK

Numerous elements play a role in capitalizing on opportunities, encompassing factors such as access to financial resources, risk perception and attitude, self-efficacy coupled with over-optimism, tolerance for ambiguity, need for achievement, and the transferability of knowledge from prior employment. Past studies examining the influence of previous knowledge and cognitive factors in uncovering opportunities have predominantly concentrated on high-tech or manufacturing businesses within developing nations. This study builds on that research by examining smallholders' opportunity exploitation in Punjab, Pakistan, using the conceptual model depicted in Figure 2.

Expanding the scope of investigation, this research delves into the intricate interplay of socio-cultural factors and individual attributes in the context of smallholder farmers in Punjab, Pakistan. While previous studies have predominantly focused on high-tech or manufacturing sectors in developing nations, this study broadens the horizon to elucidate the nuanced dynamics of opportunity exploitation in the agricultural landscape. The conceptual framework illustrated in Figure 2 serves as a guiding framework, facilitating the exploration of how cultural values, community networks, and individual characteristics collectively influence the smallholders' ability to capitalize on emerging opportunities. By extending the inquiry to the agricultural sector, this research contributes valuable insights that can inform targeted interventions and policy initiatives aimed at fostering entrepreneurial endeavors among smallholder farmers in Punjab.

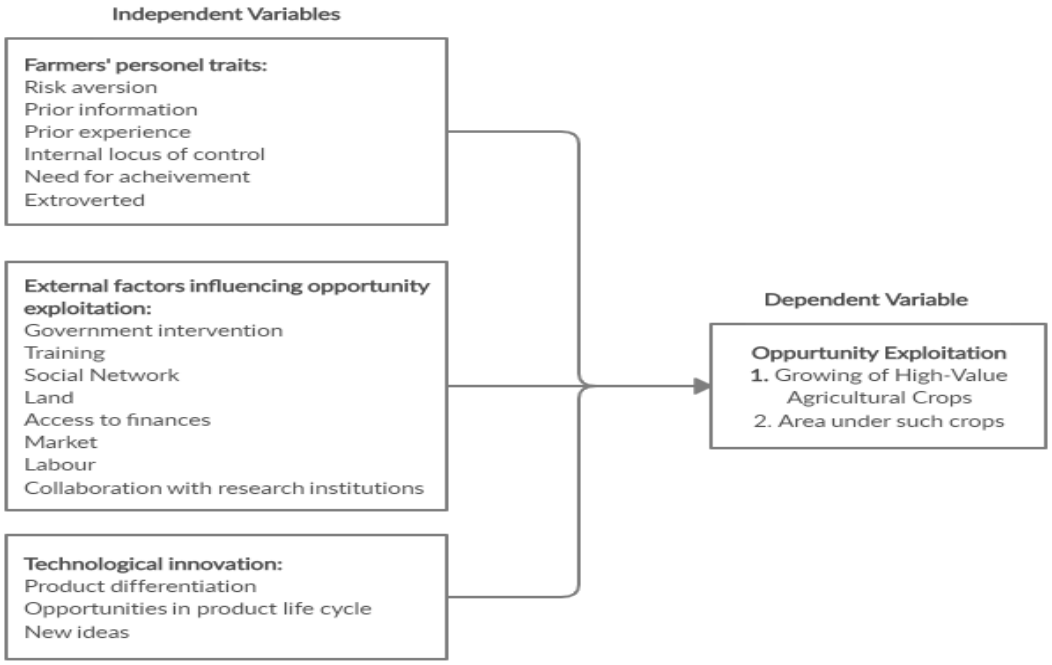

Figure 2. Conceptual framework of the study.

METHODOLOGY

Study Area and Data Description

Pakistan is an agricultural country with 17,250 thousand hectares of agricultural land. The country has diverse topography, from high mountains in the North to deep seas in the South (GOP, 2012). Punjab is the largest agricultural province, with a share of 63 percent of the total agricultural area (Naseer et al., 2016). This study was conducted in the Punjab province of Pakistan. Following Naseer et al. (2019b) and Razzaq et al. (2019), a multistage sampling technique was used for this purpose. In the first stage, Punjab province was selected due to its importance in Pakistan's agriculture. In the second stage, three districts were randomly selected from the province. In the third stage, at least one tehsil from each district was selected. In the next stage, six villages from each district were selected, and in the final stage, 25 respondents from the village were randomly selected, comprising a dataset of 450 respondents.

All these respondents were farmers and doing agricultural activities in their villages. As discussed earlier Pakistan's agriculture is largely dependent on the five traditional crops of wheat, rice, cotton, sugarcane, and rice. Therefore, farmers who only rely on these crops are termed traditional growers, and all other farmers who grow HVA crops like fruits, vegetables, fodder, and rear animals for dairy purposes are considered entrepreneurial HVA farmers.

The survey was carried out by trained enumerators, who were graduate students specializing in Agricultural Economics or Economics at the University of Agriculture, Faisalabad. A well-structured survey instrument was employed to gather demographic information and details regarding input and output utilization in the farmers' agricultural practices. Several measures were implemented to ensure the quality of data collection. Initially, enumerators underwent in-field training to enhance their comprehension of terminologies and question types. Cross-questions were incorporated into the questionnaire to verify the accuracy of the respondents' information. A pre-survey was conducted to address any potential oversights and ensure that enumerators were adequately trained before the final survey. Different interviewers selected households and conducted the interviews to mitigate the risk of interviewer bias. Before data collection, the study's objectives were explained to the respondents, and verbal consent was obtained from all participants. Participation in the survey was voluntary, and respondents were assured that their data would be treated confidentially and used anonymously.

Empirical models

Probit model

To investigate the exploitation of opportunities in growing HVA crops by entrepreneurial farmers, this study utilized probit techniques as suggested by Holloway and Ehui (2002). Probit Analysis procedure is designed to develop a regression model in which the dependent variable *'Y'* represents an event with two possible outcomes. The model applies to two types of data: one where *'Y'* is binary, denoting *0s* and *1s*, with *1* representing farmers engaged in the cultivation of HVA crops and 0 representing those who do not; and another where *'Y'* denotes the overall number of acres dedicated to HVA crops by farmers. The constructed regression model associates *'Y'* with one or more independent variables, denoted as *Xs*, which may be either quantitative or categorical. The probit function is employed to posit that the probability of an event is connected to the predictor variables.

$$P(X) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k) \quad (1)$$

Where; $\Phi(Z)$ is the standard normal cumulative distribution. P is the probability and Xs are the independent variables and βs are the coefficients.

Factor analysis

In the present study, two steps were undertaken to analyze the factors influencing the exploitation of growing HVA crops by entrepreneurial farmers. The initial step correlation analysis of the variables was

conducted to discern the key factors correlated with the exploitation of HVA crops and check for multicollinearity issues in the econometric model estimation. Secondly, the entrepreneurial orientation scale developed by Covin and Slevin (1986) underwent principal component analysis incorporating varimax rotation. This approach was employed to pinpoint the factors elucidating the exploitation tendencies among entrepreneurial HVA farmers.

The research posits that the degree of exploitation follows a linear function determined by a specific collection of farmer and opportunity characteristics. This set may or may not differ from the one represented by the covariates X_i. Specifically, using v_i, $i = 1, 2, \ldots, N$ to denote quantities, the intensity of exploitation is specified as:

$$q_i = X_i\beta + \mu_i \quad (2)$$

The second objective of the study involved using factor analysis to identify the underlying factors that explain the exploitation of the opportunity to grow HVA crops. Factor analysis is a mathematical technique that involves identifying common factors that explain the correlations among a set of observed variables. In this study, 'p' represented the number of variables, such as education, prior experience, risk aversion, knowledge and skills about crops, and self-actualization, and 'm' represented the number of underlying factors, such as marketing, policy, and institutional support. The factor analysis assumed that each observed variable is a linear function of these factors together with a residual variable and aimed to reproduce the maximum correlations among the observed variables.

$$X_j = a_{j1}F_1 + a_{j2}F_2 + \cdots a_{jm}F_m + e_j \quad (3)$$

Where, $j = 1, 2, \ldots, p$

Factor analysis is a statistical technique used to identify underlying factors that explain the interrelationships among a set of observed variables. In this study, factor analysis was employed to identify the factors that explain the exploitation of entrepreneurial opportunities in high-value agricultural (HVA) crops by smallholder farmers in Punjab, Pakistan. The factor loadings, denoted as $a_{j1}, a_{j2}, \ldots, a_{jm}$ denote the strength of the correlation between the variable and the factor. These loadings signify the extent to which each variable contributes to a particular factor, with higher loadings indicating more substantial contributions. The unique or specific factor is denoted by 'ej.' Similar to the weights in multiple regression analysis, factor loadings depict the degree of correlation between the variable and the factor.

Multiple regression analysis

To evaluate the impact of technological innovations on the extent of opportunity exploitation among entrepreneurial farmers cultivating High-Value Agriculture (HVA) crops, a multiple linear regression model was employed. The model's general form is as follows:

$$Y = \beta_O + \beta_1X_1 + \beta_2X_2 + \ldots\ldots + \beta_kX_k + \varepsilon \quad (4)$$

Description of Variables

The selected dependent variable for this study was the exploration of opportunities in the cultivation of HVA crops by entrepreneurial farmers. This variable was assessed in two distinct manners: firstly, by classifying farmers engaged in HVA crop cultivation as one and those who are not as zero, and secondly, by quantifying the cultivated area in acres dedicated to HVA crops. The independent variables included prior knowledge of pertinent entrepreneurial opportunities, individual perceptions regarding the nature of the opportunity, and the minimum efficient scale of operation required for entry and sustainability. The measurements of these independent variables are detailed in Table 1. Entrepreneurial orientation was used as a proxy for the organization of the HVA farmers. The entrepreneurial orientation scale developed by Covin and Slevin (1986) was used, which consists of nine items rated on a five-point Likert scale ranging

from strongly disagree (1) to strongly agree (5). The scale measures innovativeness, proactiveness, and risk-taking propensity, and its psychometric properties have been well established.

Table 1. Description of variables used in the models.

Dep. var.: opportunity exploitation response variable		
Variable	Description	Measurement
Growing of HVA crops	Farmers who grow HVA crops	1 = Yes, 0 = No
The area under HVA crops	Total agricultural area	Area under HVA
Individual explanatory Variable		
Gender	Male or female	1 = Male, 0 = No
Age	Since birth	No. of years
Education level	Years of schooling	Years of schooling
Prior knowledge	Yes or No	1 = Yes, 0 = No
Prior experience	Past growing experience	Years in HVA
Risk awareness	Engagements in new ideas	1 = Yes, 0 = No
Locus of control	Control of the production process of HVA	1 = Yes, 0 = No
Entrepreneurial orientation	Innovation mindset and proactive behaviors of farmers	1 = Yes, 0 = No
Ind. var. (Explanatory factors)		
Access to credit	Sources of finance for HVA crops	1 = Yes, 0 = No
Govt. interventions	Supportive policies for HVA crops	1 = Yes, 0 = No
Collaboration with research institutions	Contact with agricultural research institutions	1 = Yes, 0 = No
Support by extension services	Visits by extension staff	1 = Yes, 0 = No
Land size owned by respondent	Agricultural land	No. of acres
Technological Innovation explanatory variable		
Opportunity by product differentiation	Identification of HVA crops	1 = Yes, 0 = No
New ideas adopted at farm	Diversification among HVA crops	No. of HVA tried
Opportunities in the Life cycle of the product	Profitability	Monetary term

RESULTS AND DISCUSSIONS

Descriptive Results

Engaging in entrepreneurship often necessitates a foundation of general knowledge and formal education, and these factors typically exert a positive influence, particularly in rural areas of developing countries (Lazear, 2005). Instances abound where individuals with greater talents tend to be more educated and achieve higher levels of success (Van der Sluis et al., 2008). Figure 3 shows the survey results, which depict that most of the respondents have at least attained a secondary school level of education. About 20 percent of our respondents were illiterate, and slightly less than 20 percent were attained primary education. Only 5.8 percent of respondents attained a university education and about 17 percent have college level education.

Agriculture and related activities in rural areas are strongly dependent on the socio-economic and demographic profile of the area. These variables have a wider impact on agriculture in the developing countries. Some of these variables that might be important in the later part of this chapter are presented in Table 2. The farmer's related characteristics, such as age, farming experience, family members, and family income, are presented with their mean values. Similarly, farm-related characteristics such as farm and farm labor are of worth importance. Furthermore, the asses to input and output market are also important for agriculture.

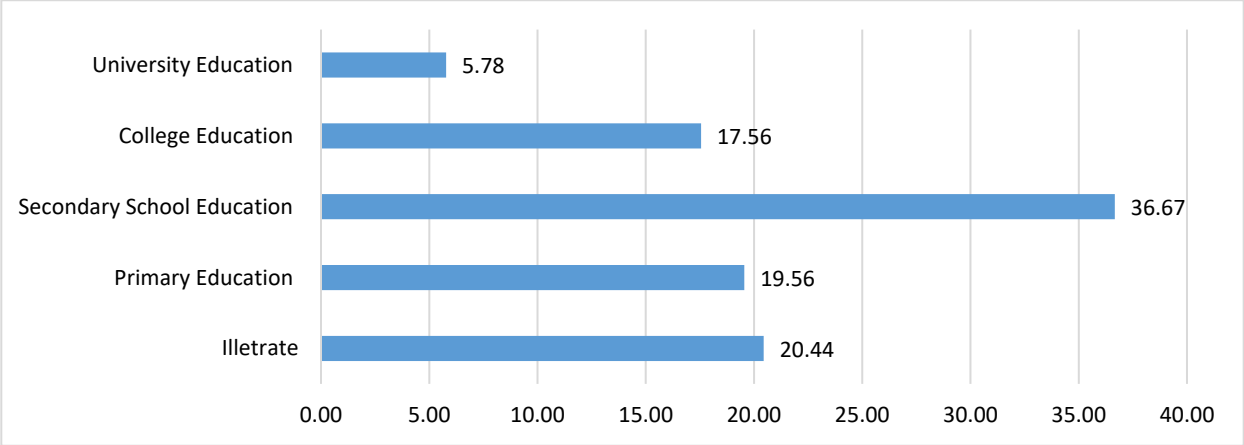

Figure 3. Percentage distribution of respondents' education level.

Table 2. Descriptive results of some important variables.

Variables	Minimum	Maximum	Mean	Std. Deviation
Farmers' Age (Years)	18	85	42.836	13.811
Farming Experience (Years)	0	65	19.718	12.478
Male Family Members (No.)	1	20	3.938	2.038
Female Family Members (No.)	0	20	3.602	2.135
Family Income (000 Rs/ Annum)	50	2500	724.138	453.286
Total Cultivated Area (Acres)	1	375	17.882	30.192
Hired Labor (No.)	0	40	2.187	4.878
Input Market Distance (Km)	0.5	30	8.149	5.120
Output Market Distance (Km)	0	1100	48.113	168.670

Relationship between Personality Traits and Growing of HVA Crops

Coon and Mitterer (2013) define that the personality traits are the most important and stable qualities of an individual in most of the situations. Various personality traits are linked to entrepreneurial opportunity exploitation, contributing to the success of entrepreneurs (Cismariu & Mocan, 2010; Stewart Jr et al., 2003). Characteristics linked to entrepreneurial orientation include a tolerance for risk, prior knowledge, previous experience, an internal locus of control, and extroversion (Covin & Wales, 2012; McElwee & Atherton, 2011). Descriptive results of these personality traits are presented in Table 3.

The term "employment of farmers" in this context refers to whether they served as professionals in other business fields before entering HVA crop production. This aspect may be influenced by their past activities or a genuine passion for pursuing a career in farming. Consequently, this study aimed to ascertain whether farmers had prior employment before embarking on HVA crop production. The findings revealed that only 31 percent of the farmers had previous employment experience before entering this line of business. The number of years dedicated to the production of HVA crops signifies the accumulated experience gained through practical involvement. Each farmer's unique background and decision-making process contribute to their choice of becoming a farmer. As indicated in Table 3, the average experience in growing HVA crops is approximately 8 years. The current body of literature upholds the idea that gaining new experiences and the development of knowledge should be regarded as a transformative process, wherein experiences evolve into knowledge (Shane & Venkataraman, 2000).

Possessing prior knowledge about the cultivation of HVA crops has demonstrated an increased likelihood of individuals exploiting opportunities. Individuals with pre-existing knowledge are seemingly more adept at recognizing new venture opportunities. Farmers participating in the study were asked to specify if they had prior knowledge regarding HVA crops. Table 3 shows that about 75 percent responded with yes and vice versa. The innovation by an individual, i.e., implementation of new technologies, is also an important personality trait, and our results showed about 78 percent of these farmers were innovative in adopting

new technologies. Freeman (1994) also observed that the nature of these experiences seems to enable more straightforward access to new knowledge and technology. Knowledge, in this context, pertains to understanding and denotes the more rational aspect of entrepreneurship.

Risk-taking propensity is characterized as an individual's inclination to embrace or steer clear of risk. To avert any kind of risk, any business needs the use of quality inputs and diversification of income sources. Hence in our case, respondents were asked about the use of improved varieties of HVA crops and the diversification of the income sources. The results in Table 3 show that more than 89 percent of farmers grow improved seeds, and about 72 percent of farmers have diversified sources of income. The results agree with Begley (1995), who noted that Entrepreneurs, in contrast to the general population, often demonstrate higher levels of risk-taking behavior. Their inclination towards an internal locus of control, driven by the desire to directly influence outcomes, is well-documented (Eckhardt & Shane, 2003; Korunka et al., 2003) due to their aspiration to directly influence outcomes (Eckhardt & Shane, 2003). The connection between this internal locus of control and the growth of ventures is noteworthy, as observed in studies such as Lee and Tsang (2001). Considering this, our study sought to evaluate whether individuals' skills and knowledge empower them to oversee the production process of enhanced HVA crop varieties. Survey results indicated that 85 percent of the respondents exhibited an internal locus of control.

The desire for independence is a personality trait motivating individuals to undertake actions independently rather than involving others. Our survey results revealed that 82 percent of farmers align with this self-actualization drive. These findings are consistent with Burke et al. (2002), who emphasized that entrepreneurship demands reliance on personal judgment rather than the judgment of others. The study also investigated the respondents' ability to evaluate the potential of growing HVA crops compared to other crops. The results, in line with Eckhardt and Shane (2003), indicate that more extroverted individuals are more inclined to exploit opportunities. Individuals with extroverted traits exhibit a superior capability to mobilize resources and coordinate activities in situations involving information asymmetry and uncertainty.

Table 3. Descriptive results of the personality traits of the respondents.

Personality Trait	Mean	Std. Deviation
Prior Experience (1 = Yes & 0 = No)	0.309	0.223
HVA crops' growing experience (Years)	7.918	8.478
Having knowledge of HVA crops (1 = Yes & 0 = No)	0.751	0.433
Implementation of new technology (Innovation)	0.778	0.416
Growing of improved seed of HVA crops (1 = Yes & 0 = No)	0.891	0.312
Diversified farm income (1 = Yes & 0 = No)	0.720	0.449
Internal locus of control (1 = Yes & 0 = No)	0.853	0.354
Need for independence (1 = Yes & 0 = No)	0.820	0.775
Extroverted (1 = Yes & 0 = No)	0.104	0.306

Factors Influencing Opportunity Exploitation

The Probit model was employed in this study, wherein the endogenous variable Y symbolizes an event with only two conceivable outcomes. Two types of data were considered for modeling: firstly, data where Y comprises a set of 0s and 1s, with 1 indicating the occurrence of one of the two outcomes, specifically the cultivation of HVA crops. Secondly, the data involve instances where Y signifies the proportion of time one of the two outcomes occurred, specifically, the number of acres under HVA crops. The constructed regression model relates Y to one or more independent variables, which can be either quantitative or categorical. In this procedure, it is assumed that the probability of an event is linked to the predictors through the Probit function. Probit analysis was employed to examine how farmers exhibit entrepreneurial personality traits in their decision to cultivate HVA crops. The results of the model are shown in Table 4.

The comprehensive outcomes presented in Table 4 revealed that a small p-value, specifically less than 0.05 (signifying a significance level of less than 5%), indicates that the employed model has significantly diminished deviance. This signifies the model's efficacy in predicting the probability of the factors under

examination. In our specific case, the significance level is highly pronounced, being lower than 1 percent. The positive sign on the coefficients of variables suggests that higher values of the factor contribute to an increased likelihood of deciding to cultivate HVA crops. Farmer's age has a negative impact on the production of HVA crops, but it is non-significant as the p-value is greater than 10 percent.

Education enables individuals to better utilize the available resources effectively and efficiently. As expected, higher education enhances improved business ideas, skills, innovation, and managerial ability for business sustainability. This result is in line with Osondu (2014), who found that as an individual improves their educational attainment, their entrepreneurial drive and skills also increase, thereby expanding their knowledge base and making them more attuned to new opportunities. Likewise, prior knowledge has a positive and significant impact on the cultivation of High-Value Agriculture (HVA) crops. These findings stand in contrast to Shane (2012), who suggested that an individual's increasing experience as an entrepreneur's foundation often lies in the general requirement for prior experience. Nonetheless, in this context, the result may be impacted by the possibility that farmers' prior experiences could emanate from other sectors, such as off-farm employment.

The experience of growing HVA crops significantly influenced HVA growing entrepreneurship. This suggests that entry into the profitable commercial cultivation of HVA crops might pose greater challenges for less-informed farmers. Such a scenario could lead to increased disparities in the adoption of HVA crops, with inexperienced farmers facing higher risks due to their limited exposure to HVA crop cultivation. These findings align with S. Shane and Venkataraman (2000) conclusions, who noted that farmers with augmented prior knowledge are more inclined to seize entrepreneurial opportunities. Similarly, the use of improved crop seed has also a positive impact on the cultivation of HVA crops. Table 4 shows that the probability of growing HVA crops of the farmers who use improved seed varieties is higher.

The coefficient of skills and knowledge about HVA crops (0.1268) was significant at 1 percent and positively affected farmers' decision to cultivate HVA crops. This means that farmers with skills and knowledge about the HVA crops are more likely to exploit the entrepreneurship opportunities. Furthermore, self-actualization also has a positive significant impact. The results agree with previous literature and highlight the notion that entrepreneurship necessitates trust in one's own judgment over the judgment of others (Burke, 2011; Llopis et al., 2015).

Table 4. Results of the probit analysis model.

Probit	Coeff.	Std. Err.	P > |z|
Level of Education	0.1138	0.5162	0.021
Farmers' Age (Years)	-0.0088	0.0068	0.199
Prior Experience (1 = Yes, 0 = No)	0.1977	0.0548	0.000
Degree of Risk Aversion (1 = Yes, 0 = No)	0.0704	0.0087	0.002
HVA growing Experience (Years)	0.3632	0.0506	0.081
Use of improved crops' seed (1 = Yes, 0 = No)	0.3189	0.2221	0.025
HVA improved farm income (1 = Yes, 0 = No)	0.0013	0.0006	0.311
Acquired agriculture credit (1 = Yes, 0 = No)	-0.2319	0.4219	0.219
Possession of Skills & knowledge about HVA crops (1 = Yes, 0 = No)	0.1268	0.221	0.003
Self-actualization (1 = Yes, 0 = No)	0.0029	0.0085	0.035
Extroverted (1 = Yes, 0 = No)	-0.4799	0.1044	0.231
Constant	-1.0639	0.4587	0.041
No. of Observations	450		
LR Chi^2	291.3		
Prob > Chi^2	0.000		
Pseudo R^2	0.0483		
Log-Likelihood	-1293.39		

Factor Analysis that Influences Opportunity Exploitation

Principal component analysis was also employed to represent a set of observed factors in terms of several "*common*" factors. The common factors which are also narrated as latent or grouped variables, are theoretical constructs that elucidate why various variables are interconnected. The rationale behind this is that these latent variables share one or more common factors. This study aimed to pinpoint the factors influencing the exploitation of opportunities in the cultivation of HVA crops. The descriptive results of these factors influencing opportunity exploitation are presented in Table 5.

Table 5. Descriptive statistics of the factors.

Variable	Mean	Std. Dev	Min	Max
Product quality	4.54	0.779	1	5
Environmentally safe	4.29	0.806	1	5
Trade policies	4.21	0.931	1	5
Partnership with other firms/agencies	4.12	1.35	1	5
Govt. incentives	4.04	1.115	1	5
Access to markets	4	1.122	1	5
Price fluctuations	3.91	1.021	1	5
Collaboration with NGOs	3.79	1.316	1	5
Govt. regulations	3.71	1.614	1	5
Access to finance	3.69	1.579	1	5

To validate the suitability of Principal Component Analysis (PCA), the Bartlett Test of Sphericity (BTS) and Kaiser-Meyer-Olkin (KMO) tests were employed in this study. Table 6 displays the BTS value at 432.09 and its level of significance, suggesting that the data were suitable for PCA. The KMO value is 0.83, indicating a sufficient number of items for each factor. In our analysis, we selected a total of ten pertinent variables.

Table 6. Bartlett test of Sphericity and KMO.

Bartlett Test of Sphericity Approx. (Chi2)	0.83
KMO test for sampling adequacy	432.09
Df	451
Sign	0.002

The correlation generated by the factor analysis model differs from typical correlation estimates as it assesses how well the model aligns with the correlations between items. When the covariance matrix is factored, it produces covariance residuals, which, in turn, generate correlation residuals. As depicted in Table 7, the correlation matrix reveals significant relationships among the variables. Product quality exhibits a stronger correlation with environmental safety and trade policy than other variables. Similarly, environmentally safe products have a strong positive correlation with trade policies. Moreover, govt. Incentives are highly correlated with partnerships with other firms, which is also positive. The diagonal of the correlation matrix is equal to one, which means the correlation of a variable with itself. The positive sign shows the positive correlation with the variables, and the negative sign shows the negative relationship between the two variables. The value near one shows a high correlation, and the value near zero shows a weak correlation between the said variables.

Table 7. Correlation between different factors.

Correlation	Product quality	Environmentally safe	Trade policies	Partnership with other firms/agencies	Govt. incentives	Access to markets	Price fluctuations	Collaboration with NGOs	Govt. regulations	Access to finance
Product quality	1									
Environmentally safe	0.65	1								
Trade policies	0.52	0.76	1							
Partnership with other firms/agencies	-0.04	-0.13	0.04	1						
Govt. incentives	0.02	-0.8	0.1	0.87	1					
Access to markets	0.06	0.02	-0.15	-0.52	-0.5	1				
Price fluctuations	0.13	0.09	0.05	0.01	0.02	-0.01	1			
Collaboration with NGOs	0.19	0.25	0.22	-0.05	-0.06	-0.02	0.24	1		
Govt. regulations	0.023	0.15	0.17	0.14	0.16	-0.1	0.05	0.25	1	
Access to finance	-0.19	-0.29	-0.25	0.11	0.09	0.002	0.2	0.25	0.026	1

Principal Component Analysis (PCA) aims to identify common factors, known as principal components, as linear combinations of the variables under investigation and rank them based on their significance. Table 8 presents the eigenvalues of these components. Three components have eigenvalues exceeding one, collectively explaining approximately 66 percent of the total variance. Notably, only factors with eigenvalues greater than one are retained in the analysis.

Table 8. Total variance explained by PCA.

Component	Eigenvalue	% variance	Cumulative %
1	3.34	25.53	25.53
2	2.54	23.74	51.06
3	1.90	14.8	65.86
4	0.93	9.9	75.76
5	0.7	7.05	82.81
6	0.67	6.07	88.88
7	0.51	4.97	93.85
8	0.39	3.72	97.57
9	0.18	1.73	99.3
10	0.12	0.7	100

Extraction method: Principal component analysis using Stata.

Table 9 shows the rotated component matrix in which the coefficients in Factor Component (FC); FC 1, FC 2, and FC 3. For example, results show that the variable assess to markets variable is highly rated in FC 1 (0.91), while the variable of govt. regulations were rated higher in FC 2 (0.92), and collaboration with NGOs was highly rated in FC 3 (0.67). Similarly, the variable with the highest factor loading was retained in the respective FC. The last column of Table 9 shows the labeling of the factors within a group of constraints.

The initial factor exhibits an eigenvalue of 3.34, contributing to a cumulative variance of 25.53%. Comprising four key elements—access to markets (loading factor: 0.91), product quality (loading factor: 0.91), environmental sustainability (loading factor: 0.73), and price stability (loading factor: 0.70) – this factor collectively scores 3.25. The reliability of this component is supported by a Cronbach's alpha value of 0.79, denoting a high level of internal consistency. Termed as 'Marketing,' this component underscores its significance in the agricultural sector of many developing nations, a theme previously explored in the literature (Kousar et al., 2019; Naseer et al., 2019b).

The second factor presents an eigenvalue of 2.54, contributing to a variance of 23.74%. Comprising three elements, this component encompasses constraints such as inadequate infrastructure, with the highest factor loading of 0.92, along with trade policies (0.84) and government incentives (0.78). The cumulative factor loading for this component is 2.54, and its internal consistency, reflected in Cronbach's alpha (0.718), attests to its reliability. Designated as 'Policy' (FC 2), this factor highlights the role of policy-related factors.

The final factor features an eigenvalue of 1.94, explaining 14.68% of the variance. Consisting of three items, this component incorporates factors like collaboration with non-governmental organizations (NGOs), where the highest factor loading is 0.67, alongside partnership with other firms/agencies (0.65) and access to finance (0.58). The cumulative factor loading for this component is 1.90, and Cronbach's alpha (0.735) underscores its reliability. Collectively, these three components elucidate 66% of the variability within the dataset.

Table 9. Rotated component matrix.

Factor	Component			Labeling
	1	2	3	
Access to markets	0.91			Marketing
Product Quality	0.91			
Environmentally safe	0.73			
Price fluctuations	0.70			
Govt. regulations		0.92		Policy
Trade policies		0.84		
Govt. incentives		0.78		
Collaboration with NGOs			0.67	Institutional support
Partnership with other firms/agencies			0.65	
Access to finance			0.58	

Extraction method: Principal component analysis using Stata.

Multiple Regression Analysis/ Are Farmers Becoming More Entrepreneurial by Experimenting/ Growing HVA Crops?

A multiple regression analysis was conducted to assess farmers' adoption of new innovative practices at the farm level, particularly in cultivating high-value-added crops and exploring opportunities. The findings presented in Table 10 reveal that farmers are increasingly embracing entrepreneurial behaviors, experimenting with novel ideas, and incorporating new crop varieties and farming techniques. Their active participation in learning opportunities related to the cultivation of HVA crops is noteworthy.

The analysis indicates that farmers cultivating HVA crops are more inclined to adopt improved seed varieties, with this factor being rated the highest among various considerations. Similarly, a positive correlation is observed between the extent of opportunities for product differentiation and farmers' likelihood to invest in innovation adoption. These results align with the findings of Atuahene-Gima and Murray (2007), who emphasized the importance of developing product offerings with novel ideas and distinctive features for enhanced adaptability to the market.

Furthermore, the concept of opportunity exploitation, encompassing experimentation, search activities, and testing, plays a pivotal role. It signifies a substantial departure from current practices and is linked to traits including risk-taking, creativity, and flexibility. Exploitation capabilities encompass the integration of new technological knowledge and the creation of entirely novel products to meet the evolving needs of customers.

Table 10. Impact of opportunity exploitation on innovation adoption.

Variable	Coeff.	Std. Err.	Sig.
Use of improved seed	0.378	0.515	0.012
Experiment with new ideas	-0.087	0.072	0.281
New products at the farm	-0.215	0.143	0.019
learning opportunities on improved technology	-0.891	0.123	0.721
Product differentiation	0.308	0.206	0.001
Diversification of farm income	-0.97	0.131	0.405
Hired skilled labor	0.293	0.089	0.002
Constant	1.338	0.434	0.000

Dependent variable: Area under HVA crop in acres.

Discussions

Entrepreneurship has been recognized as a significant contributor to economic growth and development at the individual, household, and community levels. In agriculture, farmers' entrepreneurship refers to their ability to recognize and pursue new opportunities for economic gains beyond subsistence farming, such as the cultivation of HVA crops. The present study aimed to evaluate the entrepreneurial traits of smallholder farmers in Punjab, Pakistan, and identify factors that affect their ability to exploit opportunities in the HVA sector.

The study collected cross-sectional data from 450 farmers using a well-designed questionnaire. The data were analyzed using both simple and inferential statistics. The probit model results indicated that education, prior experience, risk aversion, knowledge and skills about crops, and self-actualization had a positive and significant impact on the opportunity exploitation by the entrepreneurial HVA farmers. This finding is consistent with previous studies that identified these factors as important determinants of entrepreneurial success (Apata, 2015; Dong et al., 2022).

In addition to the individual characteristics of farmers, the study also identified three factors that were important for cultivating HVA crops: marketing, policy, and institutional support. These factors were identified through factor analysis and have been recognized in previous studies as important determinants of agricultural entrepreneurship (Sher et al., 2019). The study's findings suggest that policies and institutions that support farmers in accessing markets, information, and technology can help foster entrepreneurship in the HVA sector.

The study also explored the role of technology opportunities in promoting entrepreneurial behavior among HVA farmers. The multiple regression results showed that focusing on technology opportunities can provide a new perspective on how HVA farmers can discover opportunities even in the absence of modern technological innovations. This finding is consistent with previous research that suggests that technology can be a significant enabler of entrepreneurship in agriculture (Alabdali et al., 2023; Aubert et al., 2012).

Based on these findings, the study recommends that policymakers and development practitioners should focus on improving the accessibility of improved seed varieties of HVA crops and market intelligence to support HVA farmers. Additionally, they should focus on creating an enabling environment that promotes the development and dissemination of technology, which can help smallholders discover and exploit new opportunities.

In conclusion, the present study highlights the importance of entrepreneurial characteristics and factors such as education, prior experience, risk aversion, knowledge and skills about crops, and self-actualization in promoting entrepreneurship among smallholder farmers in the HVA sector in Punjab, Pakistan. The study also identifies marketing, policy, and institutional support as important determinants of agricultural

entrepreneurship. The study's findings provide insights into the factors that can help foster entrepreneurship in the HVA sector and contribute to sustained economic growth and development in the country.

CONCLUSIONS AND RECOMMENDATIONS

This study sought to evaluate the degree of opportunity exploitation by entrepreneurial farmers engaged in the cultivation of High-Value Agricultural (HVA) crops, deviating from the conventional five crops (wheat, rice, cotton, sugarcane, and maize) in Punjab, Pakistan. The research aimed to address three key inquiries: firstly, the identification of various personality traits impacting opportunity exploitation; secondly, an exploration of the environmental factors influencing this opportunity exploitation; and thirdly, an examination of the impact of innovation adoption on opportunity exploitation. The study's findings indicate that farmers involved in cultivating HVA crops exhibit specific traits such as prior knowledge, experience, and a heightened willingness to take risks compared to their counterparts. Notably, an internal locus of control, indicative of an entrepreneurial mindset, was prevalent among these farmers, reflecting an intrinsic motivation for self-actualization. The farmers demonstrated awareness of the challenges associated with venturing into HVA crop cultivation and possessed strategies to address these challenges. However, Probit analysis revealed that factors such as prior knowledge of HVA crops, command over production, individual levels of risk aversion, and farmers who embraced early adoption influenced the decision to engage in this opportunity to varying degrees. While personality traits played a role, it was acknowledged that multiple factors might contribute to farmers' decisions in agriculture.

The results of the paper recommended stimulating entrepreneurship in HVA farming. To amplify the demand for High-Value Agricultural (HVA) varieties among entrepreneurial farmers in Punjab, Pakistan, it is suggested to focus on several key aspects. These include promoting farm training programs that cater to the specific needs of entrepreneurial farmers, ensuring widespread access to pertinent information, and guaranteeing a reliable supply of improved varieties that align with the preferences of entrepreneurs. Additionally, further research is encouraged to investigate the impact of role models on the entrepreneurial opportunity exploitation of HVA farmers in the region. Understanding the influence of successful figures in the agricultural sector can offer valuable insights for future initiatives and support mechanisms.

Several environmental factors were identified as influential in the opportunity exploitation of growing HVA crops by entrepreneurial farmers in Punjab, Pakistan. Land size emerged as a critical factor, with smaller farms being more likely to engage in cultivating HVA crops due to the potential for higher returns. Access to information on new and improved crop varieties in the market facilitated farmers' involvement in exploiting opportunities. The role of extension officers was noted, although their availability was often limited. The results of the factor analysis highlighted the omission of certain variables, suggesting that some factors might not significantly impact opportunity exploitation for farmers planting HVA crops in Punjab, Pakistan. This underscores the complexity of the decision-making process in agricultural entrepreneurship, where various factors interact in shaping farmers' choices. The labeling of factor analysis shows that marketing is the most important group of factors in the production of HVA crops. Following the policy and institutional support were the important factors the entrepreneurial HVA growers faced. Moreover, the results of the adoption of innovation on the intensity of opportunity exploitation by using multiple regression analysis found that skilled labor, product differentiation, and the use of improved seeds have a significant positive impact on the intensity of opportunity exploitation.

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