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Exploring the entrepreneurial behavior of vegetable growers: influential factors and implications for agricultural development

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Introduction: Entrepreneurship in agricultural sector is a key enabler of rural development and economic growth. This research delves into the entrepreneurial behavior of vegetable growers involved in polyhouse protected farming and focuses on the factors that influence their entrepreneurial pursuits.

Methods: The research employed a mixed sampling methodology and the data collection was done by personally interviews. Whereas, data were analyzed using various statistical techniques including Entrepreneurial behavior index computation and Kendall's tau correlation.

Results: The results of the study reveal noteworthy associations between factors such as farm income, experience in protected cultivation, area allocated for polyhouse cultivation and extension contact with entrepreneurial behavior. Notably, income consistently demonstrated a positive correlation with all aspects of entrepreneurial behavior, while experience and extension contact also exhibited significant positive relationships. Conversely, education level displayed a negative correlation with risk-taking ability but a positive correlation with other dimensions such as cosmopolitanism and innovativeness. However, family size and gender did not demonstrate significant associations with entrepreneurial behavior.

Discussion: The findings underscored the intricate nature of entrepreneurial behavior among vegetable growers which necessitate tailored interventions to foster entrepreneurship in this sector. The research recommends policy measures like financial incentives, enhanced access to extension services and promoting collaboration among polyhouse cultivators to encourage entrepreneurship. These initiatives aim to overcome financial barriers, improve technical knowledge and address structural challenges, ultimately fostering sustainable entrepreneurship and agricultural development.

KEYWORDS

entrepreneurship, protected cultivation, entrepreneurial behavior index, Kendall's tau correlation, vegetable farming, dimensions of EBI

1 Introduction

Entrepreneurship is significantly catalyzing economic growth in most of the developing nations. It involves individuals striving for economic prosperity through innovative endeavors within conditions marked by uncertainty and scarcity of physical factors of production (Mitchell et al., 2002). Although definitions of entrepreneurship vary across literature, it is commonly described as the ability of a person to turn conceptions into profitable new endeavors. Consequently, economic development is fundamentally accelerated by entrepreneurship (Welsh et al., 2016), bringing a significant impact on society. Entrepreneurs launch new ventures not just to make money for themselves but also to foster economic growth at local and national levels. There is considerably less understanding of entrepreneurship within agriculture as well as allied fields like horticulture (Hilmi, 2018; Nukpezah and Blankson, 2017). Nevertheless, these sectors dominate the economies of many rural regions, which are often impoverished and disadvantaged (Yusoff et al., 2016). Therefore, it is thought that entrepreneurial growth is essential to lowering rural poverty and promoting wealth generation (Smit, 2004). Traditionally, the agricultural industry has been perceived to be low-tech and under the control of a significant number of local family-run businesses (Pindado and Sanchez, 2017). This has altered significantly in recent times, in part due to modernization, and these developments have allowed for the entry of fresh, creative entrepreneurs. According to recent studies, agriculture entrepreneurship significantly affects a business's capacity to survive and grow (Lans et al., 2020; Wongnaa and Seyram, 2014; Mossie et al., 2020). However, internet technology and networks are crucial for small-scale rural businesses to thrive (Zhao and Li, 2021; Khazami et al., 2020). These are social connections that illustrate the flow of knowledge, identities, and resources involved in the development of rural production in particular and communities in general (Lee et al., 2005).

Entrepreneurship plays a vital role in enhancing farm productivity in agriculture by involving risk-taking, innovation, decision-making and information sharing to provide superior agricultural goods and services that satisfy the wants and needs of customers (Tebeka et al., 2017; Mukhtar et al., 2018). Agriculture-related entrepreneurial endeavors produce jobs and financial gain, reduce poverty and improve the standard of living (Wongnaa et al., 2019). In countries undergoing development like India, research on entrepreneurship and entrepreneurial behavior has primarily focused on small scale enterprises (SMEs) (Adom et al., 2018; Afreh et al., 2019; Obeng et al., 2014; Quaye and Acheampong, 2013). Entrepreneurial behavior has a major role in agriculture as a whole, especially in the food business sector, where proprietors of enterprises choose to take measured chances and opt wisely to create and sell premium food items (Bairwa et al., 2014; Fitz-Koch et al., 2018). The farm's flourishing enterprises hinges upon farmers' behavior, encompassing traits such as risk-taking ability, proactivity, self-assurance, self-efficacy, drive, high level of initiative, individual accountability, innovative thinking, and ability to make decisions (Wanose et al., 2018; Lazar et al., 2020; Thakur et al., 2020). In contrast to farmers with lower entrepreneurial behavior, individuals with higher entrepreneurial behavior likely to succeed by embracing new agricultural

practices and technologies alongwith investigating new market opportunities (Kumar, 2014; Onyeneke, 2017; Olomu et al., 2020).

Protected cultivation, an advanced agricultural technique, involves controlling the microclimate around plants to shield them from adverse weather conditions such as extreme temperatures, hail storms, and heavy rains (Thakur et al., 2023a). This method, acknowledged for its ability to overcome environmental challenges, provides various benefits including improved product quality, increased yield, efficiency, and achieving fair market prices (Singh et al., 2005; Singh et al., 2007). Vegetable production has significantly increased in India over the past decades, there is a pressing need to expand vegetable production to meet rising domestic demand (Thakur et al., 2023a). Various methods, including expanding the area under vegetable crops and utilizing new agro-techniques, have been proposed to achieve this goal (Singh and Sirohi, 2008). Vegetable cultivation is essential globally, ensuring nutrition, economic resilience, and food security while also fostering environmental sustainability and offering farmers diversified income opportunities (Thakur et al., 2024). Protected cultivation emerges as a contemporary approach to address the increasing demand for vegetables and shrinking land holdings, enabling quality produce and efficient resource utilization (Santosh et al., 2017). This technique not only enhances production and productivity but also facilitates diversification and year-round supply of vegetables, particularly benefiting marginal and small farmers (Dixit, 2007). In India, the adoption of protected cultivation is relatively low compared to other countries, yet its potential to revolutionize vegetable production and address challenges such as disguised unemployment and land scarcity makes it a promising avenue for modern agriculture. Moreover, protected cultivation offers greater employment opportunities for hired and family labor, contributing to socio-economic development. As the population continues to increase and land availability decreases, the adoption of protected cultivation becomes increasingly important for sustaining agricultural production and livelihoods (Ameta et al., 2019; Thakur et al., 2023b). The objective of the present research is to explore the entrepreneurial behavior of vegetable growers in the mid hills of Himachal Pradesh, situated in the Indian Himalaya. By examining the influential factors shaping entrepreneurial behavior in this specific agricultural context, the study aims to provide valuable insights into the dynamics of entrepreneurship in the agriculture sector, particularly focusing on protected cultivation practices. Moreover, this research seeks to identify the key determinants of entrepreneurial behavior among vegetable growers and assess their implications for agricultural development. Therefore, by understanding the role of entrepreneurship in enhancing farm productivity, reducing poverty and promoting economic growth, this study aims to contribute to the formulation of policies and strategies aimed at fostering entrepreneurial initiatives, ultimately fostering sustainable agricultural development in the region.

The subsequent sections of this paper are structured as follows: The following section provides an overview of the literature reviewed, followed by an explanation of the data and methodology. In this section, we delve into the nature and sources of the data, the research design, the different stages of analysis and the techniques employed. The results and discussions are presented in subsequent sections. Finally, the last sections offer conclusion and policy implications.

2 Background and empirical evidences

This section presents the theoretical background and empirical evidence related to entrepreneurship and agri-entrepreneurial behavior of farmers. Along with this, the studies related to the factors influencing entrepreneurship and therefore the implications for agricultural development are also discussed.

2.1 Entrepreneurship

Entrepreneurship has emerged as a significant driver of economic growth across various nations, sparking sustained research interest within academia (Fitz-Koch et al., 2018; Kuratko et al., 2015). Given its interdisciplinary nature, entrepreneurship has been defined in various ways by scholars. Even small family business ventures, even on a modest scale, have a substantial impact by generating employment, fostering innovation, and shaping economies (Naminse and Jincai, 2015). Contemporary theories or entrepreneurial notions cover a wide range of perspectives, and studies on the resilience of entrepreneurs employ insights from fields including anthropology, management, finance and others (Kuratko et al., 2015). It is acknowledged that entrepreneurship promotes socioeconomic development and growth, impacting both developed and underdeveloped countries globally (Chouhan, 2015). Entrepreneurial undertakings play a crucial role in fostering innovation, thereby catalyzing economic transformation and progress. A thorough framework suggested and outlined the five fundamental components of entrepreneurship that are company concept, entrepreneurial resources, entrepreneurial environment, entrepreneurs, and organizational context (Kuratko et al., 2015). Farmers in developing nations frequently encounter issues as a result of low levels of education, a poor sense of entrepreneurial opportunities, and a lack of awareness of new products and innovations in technology, branding, and other business operations, as well as supply chain collaboration and marketing (Alsos et al., 2011; Qing et al., 2021). Thus, enhancing farmers' entrepreneurial survival rates hinges on improving their cognitive understanding and competencies (DeTienne, 2010).

2.2 Entrepreneurship in agriculture

Agripreneurship, also known as agricultural entrepreneurship is person's ability to identify profitable agricultural business opportunities and establish ventures that integrate inventiveness for profitable agricultural ventures (Otache, 2017; Yusoff et al., 2016). Agripreneurship has certain characteristics that are exclusive to the agricultural sector, even if it shares similarities with entrepreneurship in that both require opportunity recognition, self-motivation, taking calculated risks, and a desire for success (Díaz-Pichardo et al., 2012; Shane, 2007). Understanding the agribusiness process, taking into account the special qualities of the agricultural industry, and investigating the methods and motivations of agripreneurs for spotting possibilities are essential (Shane, 2007). Furthermore, Agripreneurs frequently display fewer entrepreneurial abilities than traditional entrepreneurs (Bannor et al., 2021; Dias et al., 2019). The workers in the agriculture associated industries get affected by a variety of conditions, and agripreneurs are influenced by a range of institutional and socioeconomic variables in their entrepreneurial

behavior (Dias et al., 2019; Morgan et al., 2010). Therefore, without relying on extensive research, uniform policies and programs aiming at boosting agripreneurship may have unanticipated or detrimental consequences on farmers (Alsos et al., 2003). However, despite its importance, compared to studies on business entrepreneurship, which frequently concentrate on large, small, and microenterprises in the manufacturing and services sectors, agripreneurship has garnered barely any research attention (Fitz-Koch et al., 2018; Díaz-Pichardo et al., 2012; Alsos et al., 2003; Dias et al., 2019).

Inventiveness, ability to make decisions, accomplishment drive, seeking out information capacity, their willingness to take risks, coordination potential, and ability to lead were the seven components of entrepreneurial conduct that were related to the socioeconomic characteristics of farmers practicing sustainable agriculture in India (Dias et al., 2019). They emphasized that successful implementation of sustainable agriculture required farmers to exhibit these qualities. The cultivating entrepreneurial traits among future agricultural researchers are proactiveness, autonomy, persistence and risk-taking (Rukiko and Mambali, 2024). Further, the identified key components influencing entrepreneurial behavior among livestock farm women were inventiveness, drive for success and willingness to take risks (Narmatha et al., 2002). Expanding on this, highlighting additional components reported were manageability and persistence (Murali and Anitha, 2003). The primary markers of entrepreneurial behavior included the capacity for making decisions, financial incentive and market orientation (Solanki and Soni, 2004). Various variables like innovativeness, decision-making ability and leadership affected the multidimensional nature of entrepreneurship. There exists a positive relationship between factors such as education and socio-economic status with entrepreneurial behavior among potato cultivators in Kohima district (Kumar and Sharma, 2009). Agricultural extension initiatives like village meetings, seminars, and mobile messaging campaigns have effectively raised awareness among crop producers (Onesmo et al., 2024). It recommends targeted measures to encourage female participation for balanced representation and sustainable development. This literature collectively illustrates the complex interplay of personal characteristics, socio-economic factors, and agricultural contexts in shaping entrepreneurial behavior among farmers, highlighting the importance of considering a diverse range of influences in understanding and promoting entrepreneurship in agriculture.

3 Materials and methods

3.1 Study area

The study was conducted in the Indian state of Himachal Pradesh which is a part of North Western Himalayan Region, renowned for its rich biodiversity. Himachal Pradesh is spanning from 350 meters in low valleys to 6,975 meters in snow-covered mountains situated between latitudes 30° 22' 40" N to 33° 12' 40" N and longitudes 75° 45' 55" E to 79° 04' 20" E. There are four agro-climatic zones in the state, based on elevation and climate. Zone-I is Sub-mountainous low hills-subtropical, covering areas up to 1,100 meters. Zone-II is Mid-hills sub-humid, spanning elevations from 1,100 to just under 2,000 meters. Zone-III is High hills temperate wet, encompassing elevations from 2,000 to just under 3,000 meters. Zone-IV is High hills temperate dry, including elevations exceeding 3,000 meters. These agroclimatic zones reflect the diverse environmental conditions, each

influencing agricultural practices and productivity in unique ways. The Zone-II, i.e., mid-hills sub-humid zone was selected for present research because it exhibits the greatest extent of protected vegetable cultivation among all the agro-climatic zones (DA and FW, 2023), as shown in Figure 1.

3.2 Selection of sampled respondents

Mixed sampling technique, comprising of purposive sampling and multistage random sampling was used for collecting the desired

sample of respondents. Purposively, from the zone II, two major districts having maximum proportion of vegetable cultivated area were selected. Further, a multistage random sampling methodology was used to finalize a sample of vegetable growers (respondents engaged in vegetable cultivation under protected and open conditions). A list of vegetable grower practicing protected cultivation was procured from the agriculture or horticulture department and other agencies. In order to get a final sample, to gather the necessary data and information, growers were chosen at random. At the first stage, out of the two purposively selected districts, four blocks with more area under vegetable cultivation were

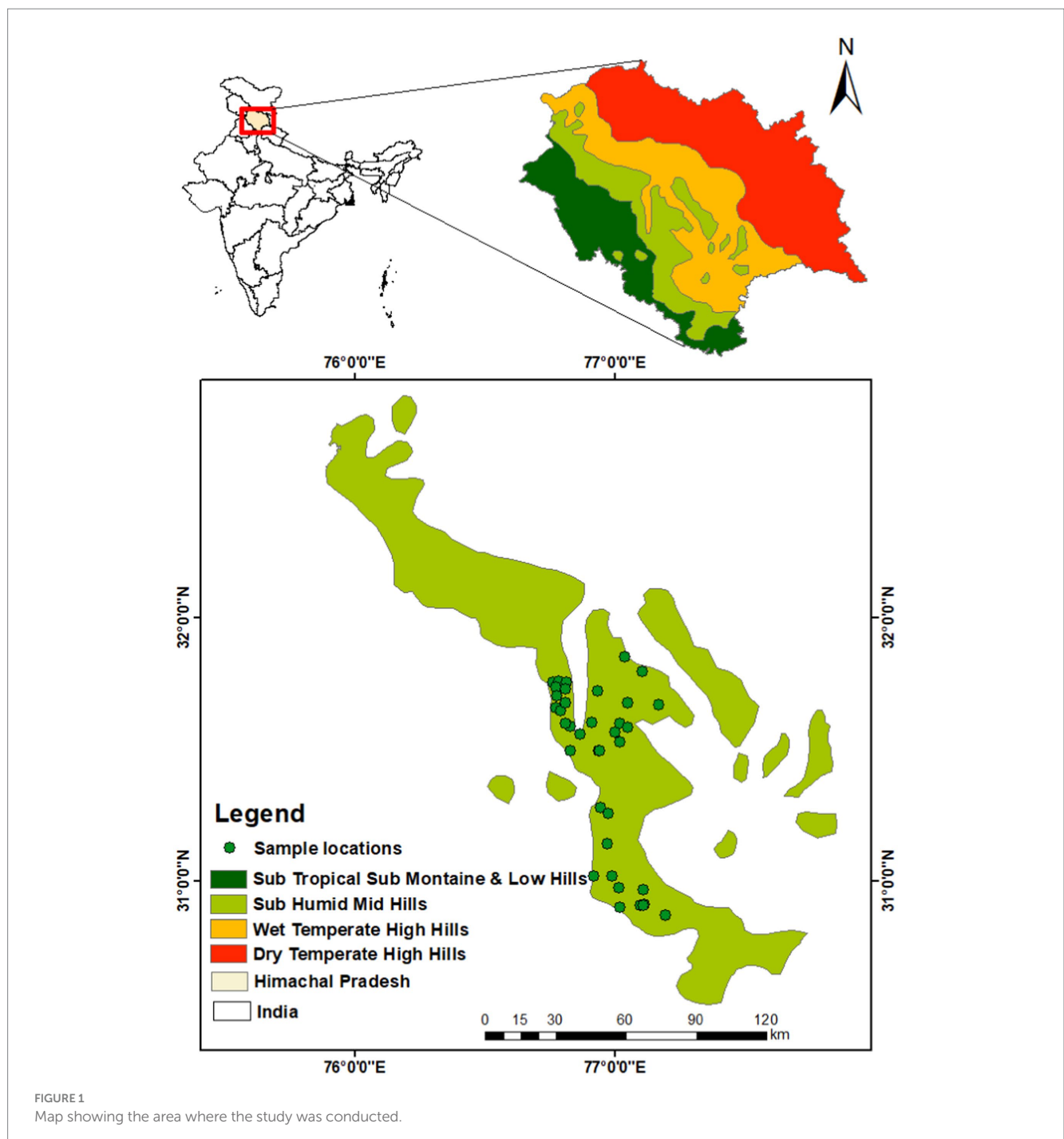


FIGURE 1
Map showing the area where the study was conducted.

selected. At the second stage, out of each selected blocks, three panchayats undergoing maximum vegetable cultivation were selected. At the third stage, ten farmers from each gram panchayat who were actively practicing in open as well as protected cultivation of vegetables were selected. At last, a final sample of 240 vegetable growers (120 open and 120 protected) was selected. Further, an equal number of open and protected vegetable growers were chosen as for making accurate comparison, an equal number of objects (growers) were selected. This application of stratification and randomization played a crucial role in ensuring that the sample accurately represented the broader target population in the study area.

3.3 Data collection

Primary data was collected through a well-prepared schedule by personal Interview method and Google forms. Data collection commenced with personal interviews using a pretested questionnaire, which underwent refinement before its finalization for the primary survey. The survey delved into various facets of vegetable cultivation and encompassed household demographics, socio-economic parameters, and economic variables. All the schedules were filled and later data collected was analyzed for required information. Secondary data, comprising area, production, and productivity metrics, were sourced from governmental and revenue offices, horticultural and agricultural departments, as well as from existing literature and online resources.

3.4 Analytical framework

3.4.1 Entrepreneurial behavior index (EBI)

The Entrepreneurial Behavior Index (EBI) was used to quantify the entrepreneurial behavior of protected growers which is a composite index of nine dimensions of entrepreneurial behavior. The scale used was developed using Guilford procedure using nine dimensions (Guilford, 1954). The dimensions of entrepreneurial behavior as per (Ahuja et al., 2016) viz., ability to make decisions, drive for achievement, risk taking ability, and self-assurance, cosmopolitanness, leadership ability, information seeking behavior, planning ability and innovativeness were adopted for the study. Various statements were

framed to get the response from the farmers under each dimension (Table 1).

The statement indices were computed to finally calculate the scale value for dimensions which are; ability to make decisions, drive for achievement, risk taking ability, and self-assurance, cosmopolitanness, leadership ability, information seeking behavior, planning ability and innovativeness (Patel et al., 2014). Each dimension has three to four statements and these statements were given a score of 1, 2 or 3, with the values being flipped for statements that were negative. Each statement's index was determined by adding up all of its points and formula for statement index, composite index and finally the Entrepreneurial Behavior Index EBI are as follows:

$$\text{Index of Each statement} = \frac{\text{Total score of each statement}}{\text{Maximum score of each statement}} \times 100$$

$$\text{Composite Index} = \frac{\sum x}{M \times N \times S}$$

$\sum X$ = sum of each statement's overall score.

M = highest possible score.

N = the total number of participants/ respondents.

S = the total number of assertions/ statements.

The scale values for each dimension were multiplied by the mean score (raw score / maximum possible score) that the vegetable grower received for that dimension. A composite index was created by adding together the values for each attribute to determine the entrepreneurial behavior of the vegetable growers.

$$EBI = \frac{\sum_{i=1}^n \frac{\text{Actualscore of } Di \times \text{Scale value of } Di0}{\text{Maximum score of } Di}}{\sum \text{scale of } Di} * 100$$

Where, i = number of dimensions taken.

3.4.2 Factors affecting the entrepreneurial behavior of vegetable growers

The association between the entrepreneurial behavior and socio-economic and personal characteristics viz., age, farm experience, annual income, education, size of the land holding, etc. was calculated and studied (Table 2).

TABLE 1 The dimensions and statements used for calculating entrepreneurial behavior index.

Dimensions	Symbol	State-ments	No. of responses	Scale of responses (3-2-1)			Range of score
Decision making ability	D1	4	3	Rational	Less rational	Irrational	4-12
Achievement motivation	D2	4	3	Agree	Undecided	Disagree	4-12
Risk taking ability	D3	4	3	Agree	Undecided	Disagree	4-12
Self confidence	D4	3	3	Agree	Undecided	Disagree	3-9
Cosmopolitanness	D5	3	3	Always	Sometimes	Never	3-9
Leadership ability	D6	4	3	Always	Sometimes	Never	4-12
Information seeking behavior	D7	3	3	Frequently	Sometimes	Never	3-9
Ability to plan	D8	4	3	Advance	Neck time	No plan	4-12
Innovativeness	D9	2	3	Always	Sometimes	Never	2-6

3.4.3 Singh cube root method

Singh's cube root method helps to classify data into categories by considering cumulative frequencies and quartile classes, making it a useful tool for understanding the distribution of data. By applying the formula, one can calculate which class interval the data points fall into, which is particularly useful when working with grouped data such as in frequency distributions. It provides a method of organizing and interpreting data in a structured manner while offering insights into the underlying pattern of the data. The Singh's cube root approach was introduced by Singh in 1975 (Singh, 1975) as a way to classify group data into different categories using given formula:

$$s_i = L_i + \frac{3}{f_i} \frac{N_i - C_{i-1}}{3} \times h.$$

Where, i = number of category ($i = 1, 2, 3, n$)

S_i = the segment such as I, II, III

L_i = lower limit of the quartile class

C_{i-1} = the cumulative frequency of the class preceding the quartile class

f_i = frequency of quartile class

h = the quartile class's width

N = Total Cumulative Frequencies at the Cube Root

3.4.4 Kendall's tau rank correlation test

It was employed to investigate the relationship between polyhouse farmers' entrepreneurial behavior and other aspects of their socioeconomic makeup. The Kendall's rank correlation coefficient is given by:

$$\tau = \frac{\text{Actual total}}{\text{Maximum possible total}}$$

$$\hat{\sigma} = \frac{S - \text{Actual total}}{\frac{1}{2}N(N-1)}$$

Where, $S = C - D$ (C and D : the number of concordant and discordant pairs respectively)

N = the number of cases

4 Results and discussion

4.1 Dimension wise overall entrepreneurial behavior of farmers

Entrepreneurial behavior among farmers is becoming a pivotal element in boosting agricultural productivity, ensuring sustainability and securing the economic stability of rural communities (Lans et al., 2020; Bairwa et al., 2014; Fitz-Koch et al., 2018). Shifting away from the conventional view of farming as merely subsistence-based, contemporary farmers are now often regarded as proactive entrepreneurs. These entrepreneurial farmers are marked by their ability to innovate, effectively manage risks and strategically plan for the future, differentiating themselves from traditional farming methods (Thakur et al., 2023b; Solanki and Soni, 2004). The research utilized the Guilford (1954) procedure to devise a scale assessing entrepreneurial behavior through a social science lens, incorporating nine dimensions: decision-making ability, achievement motivation,

TABLE 2 The factors affecting entrepreneurial behavior index and their assessment.

Explanatory variables	Measurement
Age	The respondents' chronological age expressed in years
Farm income	The net income from protected cultivation of vegetable crops
Experience	In years
Area	Under polyhouse cultivation of vegetable crops in hectares
Education level	Years spent in formal education (years completed)
Family size	The entire number of individuals in a family
Extension contact	1 for contact, 0 for no contact
Gender	1 for male, 0 for female

risk-taking ability, self-confidence, cosmopolitanness, leadership ability, information-seeking behavior, planning ability and innovativeness (Narmatha et al., 2002; Solanki and Soni, 2004; Guilford, 1954). Table 3 illustrates the entrepreneurial behavior of polyhouse farmers, yielding a composite index of 74.58. Among these dimensions, the results of the analysis have been discussed below:

- Leadership ability:** Leadership ability is crucial in fostering entrepreneurial behavior and effective entrepreneurial leaders assist employees in recognizing and seizing opportunities. By promoting innovative solutions and valuing new ideas, the leadership cultivates a culture of innovation. It empowers employees to challenge themselves, explore new possibilities and implement creative solutions (Solanki and Soni, 2004; Kumar and Sharma, 2009). Such leadership nurtures an environment where intellectual flexibility flourishes, enabling employees to identify problems and seek solutions. This dynamic encourages a sense of ownership and responsibility, motivating employees to engage in entrepreneurial behaviors. This research shows that leadership ability attained the highest score (81.25), deemed crucial for entrepreneurial development. This outcome may be attributed to farmers' active engagement in social activities, exposure to media, contact with extension services and literacy levels. Further, it can be concluded that entrepreneurial leadership helps organizations respond swiftly to changes, introduce new products efficiently and enhance overall performance. Ultimately, leaders who support entrepreneurial behavior are crucial to create effective work environment that drives organizational success (Qing et al., 2021; DeTienne, 2010).
- Planning ability:** Planning acumen is a pivotal aspect of entrepreneurial behavior in farmers, encompassing the formulation of long-term objectives, judicious resource allocation and strategic market adaptation. This dimension ranked second with a score of 80.42, crucial for organizing farm operations and financial allocation, likely influenced by farmers' educational attainment and connection with extension agencies. Similar studies concluded that agri - entrepreneurs delineate precise goals, optimize resource utilization and perpetually pursue innovative methodologies to augment productivity. This proactive and methodical approach to planning ensures the sustainability and expansion of their

TABLE 3 Dimension wise overall entrepreneurial behavior of protected growers.

Sr. No.	Dimensions	Protected growers	
		Index	Rank
1	Decision making ability (D1)	67.78	IX
2	Achievement motivation (D2)	68.54	VIII
3	Risk taking ability (D3)	74.17	V
4	Self-confidence (D4)	79.44	III
5	Cosmopolitaness (D5)	73.15	VI
6	Leadership ability (D6)	81.25	I
7	Information seeking behavior (D7)	69.44	VII
8	Planning ability (D8)	80.42	II
9	Innovativeness (D9)	79.17	IV
Composite behavior index (Composite index)		74.58	

agricultural enterprises (Kumar and Sharma, 2009; Patel et al., 2014; Ahuja et al., 2016; Thakur et al., 2022a).

- 3 *Self confidence*: Self-confidence is critical to the success of agricultural entrepreneurs, enabling them to take calculated risks, innovate and persevere in overcoming challenges within the farming industry (DeTienne, 2010; Ahuja et al., 2016). Self confidence serves as a driving force that empowers agricultural entrepreneurs to navigate uncertainties and achieve sustainable growth. This dimension ranked 3rd with a score of 79.44 and it can be concluded that confident agripreneurs build trust in consumers, fostering partnerships and enhancing their credibility. Moreover, moderate levels of self-confidence may stem from farmers' modest income and limited technological expertise. Similar findings were reported by (Kanungo and Mendonca, 1994).
- 4 *Innovativeness*: Innovativeness is a cornerstone of entrepreneurial behavior, epitomizing entrepreneurs' adeptness in introducing novel concepts, methodologies and products. It entails their ability to discern opportunities for improvement, adopt emerging technologies and devise unique solutions that distinguish their ventures (Karat and Baby, 2020; Shivacharan et al., 2015). It has ranked 4th with a score of 79.14, among all the nine dimensions. Entrepreneurs characterized by innovativeness consistently challenge established practices, enhance operational efficiency and adeptly respond to evolving consumer demands. Many research findings showed that innovativeness not only fosters growth and competitiveness but also contributes to the sustained success of their enterprises, as evidenced in research literature (Ahuja et al., 2016; Hengde et al., 2007).
- 5 *Risk taking ability*: Risk-taking ability is an important component of entrepreneurial behavior observed among protected growers, demonstrating their capacity and preparedness to evaluate and pursue opportunities despite uncertainties and potential challenges. This dimension encompasses their skill in making informed decisions, navigating unpredictable factors and exploring new crop varieties or advanced farming methods (DeTienne, 2010; Kumar and Sharma, 2009). The results of the study showed that risk taking ability ranked 5th among the nine dimensions (with a score of 74.17). Through effective risk management strategies such as strategic planning and

adaptation, protected growers can innovate, expand their agricultural enterprises and achieve sustainable growth in the competitive agricultural sector, as documented in research studies (DeTienne, 2010; Ahuja et al., 2016).

- 6 *Cosmopolitaness*: It significantly influences entrepreneurial behavior among farmers by fostering openness to diverse ideas and technologies. It encourages farmers to adopt innovative practices from global sources, adapt to evolving consumer demands and expand their networks beyond local boundaries (Qing et al., 2021). It emerged as the 6th important dimension with a score of 73.15. Many studies corresponded to such findings and concluded that this broad perspective enables entrepreneurs to enhance their resilience in the global agricultural economy.
- 7 *Information seeking behavior*: This dimension contributes in fostering innovation, resilience and sustainable growth within agricultural enterprises. By harnessing information effectively, agricultural entrepreneurs can achieve enduring success. The results of the analysis showed that, in the realm of agriculture, information seeking behavior (ranked 7th with a score of 69.44) plays a pivotal role for entrepreneurs by enabling them to gather crucial insights into agricultural practices. DeTienne (2010), Hengde et al. (2007), Savitha et al. (2009), and Thakur et al. (2022b) in their studies also concluded that information seeking behavior empowers the farmers and agri entrepreneurs to innovate in farming methods and make informed decisions for optimizing yields and profits.
- 8 *Achievement motivation*: Achievement motivation ranked 8th with a score of 68.54, among agricultural entrepreneurs drives them to set ambitious goals for crop production and operational efficiency. These results corresponded to the findings of Karat and Baby (2020) and Savitha et al. (2009) and it can be concluded that achievement motivation fuels their pursuit of new techniques, resilience against environmental challenges such as climate variability and sustained growth while prioritizing environmental stewardship.
- 9 *Decision making ability*: Effective decision-making ranked last among all the nine dimensions with a score of 67.78. This dimension involves the evaluation of variables like weather conditions, market fluctuations and resource management involved in agriculture. Many studies contrasted the findings of this study as effective decision making stood among the prime two dimensions for success of any enterprise (Shivacharan et al., 2015; Hengde et al., 2007; Savitha et al., 2009). The contrast in findings can be attributed to the characteristics of the respondents, variation among the study areas, differences in the decision-making processes, diverse measurement approaches or limited access to decision-making tools. The inference drawn from the studies was that entrepreneurs with robust decision-making skills can adapt strategies, optimize resource allocation and capitalize on opportunities to enhance productivity and profitability in dynamic agricultural markets.

4.2 Distribution of polyhouse farmers as per the entrepreneurial behavior

The breakdown of polyhouse farmers according to their entrepreneurial behavior is summarized in Table 4. The distribution of

polyhouse farmers across Entrepreneurial Behavior Index (EBI) dimensions, categorized using the Singh cube root method, showed that most farmers fell in the medium range (61.20%), with a smaller percentage in the low (16.05%) and high (22.75%) categories. Key dimensions like leadership ability, planning and innovativeness showed a stronger concentration in the high range, indicating that successful growers tended to exhibit advanced entrepreneurial traits. Other dimensions, such as risk-taking ability and decision-making, had a more balanced distribution across the categories. Overall, the categorization highlighted a predominance of moderate to high entrepreneurial skills among polyhouse farmers. The study illustrated that a significant proportion of polyhouse farmers (61.20%) fell under the medium EBI category. Approximately 22.75% of farmers demonstrated a considerable degree of entrepreneurial behavior (scoring above 82.73, indicating high EBI), while only 16.05% exhibited a low level of EBI. Among the nine dimensions assessed, a notable portion of vegetable growers fell within the medium range (65.21–82.72 on the index) (Karat and Baby, 2020). The findings indicated a diverse distribution of entrepreneurial behavior dimensions among polyhouse farmers based on their Entrepreneurial Behavior Index (EBI) scores in the past tense. Decision-making ability (D1) had a significant proportion in the medium EBI category (47.50%), followed by the low EBI category (34.17%) and high EBI category (18.33%), suggesting potential for improvement in strategic decision-making skills. Achievement motivation (D2) showed a balanced distribution across medium (45.00%) and high (25.83%) EBI categories, with a notable segment also in the low category (29.17%). Risk-taking ability (D3) demonstrated a substantial number in the high EBI category (47.50%), with fewer in the medium (50.00%) and low (20.83%) EBI categories, indicating a tendency toward calculated risk-taking among growers. Self-confidence (D4) was predominantly observed in the medium (47.50%) and high (40.83%) categories, with a smaller percentage in the low EBI category (11.67%). Cosmopolitaness (D5) indicated a majority in the medium (58.33%) and fewer in the low (18.33%) and high (23.33%) EBI categories, suggesting opportunities for global expansion. Leadership ability (D6) was significant in the high EBI category (64.17%), with fewer growers demonstrating medium (30.83%)

and low (5.00%) EBI categories. Information seeking behavior (D7) highlighted a majority in the medium (60.84%) category, with 23.33% exhibiting low and 15.83% high EBI categories. Planning ability (D8) showed a distribution with 39.17% in the medium, 55.00% in the high, and 5.83% in the low categories, indicating an orientation toward strategic planning. Innovativeness (D9) was significant and highest in the high EBI category (62.50%), indicating a propensity for creative and innovative practices in agriculture. These findings concluded the intricate landscape of entrepreneurial behaviors among protected growers, highlighting strengths in areas like leadership, risk-taking, and innovativeness. However, there are opportunities for enhancing decision-making, information seeking and cosmopolitaness, which are critical for fostering resilience and sustainable growth. Addressing these dimensions could facilitate improved competitiveness and adaptability in agriculture especially protected cultivation, supporting long-term success in the industry.

The figure 2 illustrates the distribution of the Entrepreneurial Behavior Index (EBI) across three categories: low (less than 65.21), medium (65.22 to 82.72) and high (greater than 82.73). The overall EBI was evaluated in relation to the nine dimensions and the data revealed that a substantial portion of protected growers fell into the high EBI category, particularly excelling in decision-making, risk-taking and leadership abilities, suggesting they possessed strong entrepreneurial skills. The medium EBI group was also significantly represented, indicating moderate entrepreneurial behavior among many growers. Conversely, the low EBI category, although the least represented, displayed some variability across different dimensions, pointing to a range of entrepreneurial traits within this group. Overall, the distribution indicated that a majority of individuals exhibited notable entrepreneurial qualities, with a considerable segment demonstrating moderate to high levels of achievement motivation, planning ability and innovativeness. This highlighted the potential for these traits to foster the productivity and agricultural entrepreneurship among the growers.

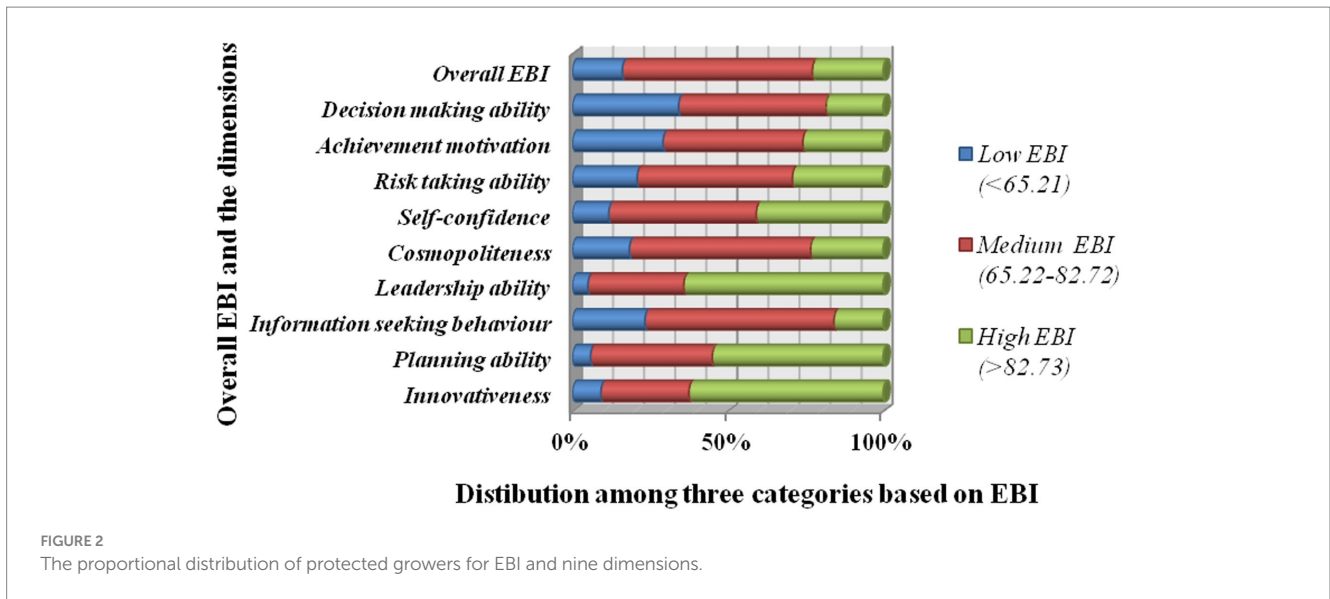
4.3 Factors influencing the entrepreneurial behavior

Using Kendall’s tau correlation, the influence of various factors on the entrepreneurial behavior of vegetable growers in polyhouses was investigated. These factors included age, gender, family size, education level, experience, area under polyhouse cultivation, farm income, and extension contact. Vegetable growers’ entrepreneurial behavior was found to be positively and statistically significantly correlated with farm revenue, experience, area under polyhouse cultivation, and extension contact, as illustrated in Table 5. Conversely, age showed no significant correlation but displayed a positive relationship with entrepreneurial behavior. However, education level, family size, and gender of the farmers demonstrated a negative and non-significant relationship with entrepreneurial behavior. These findings suggest that the age of vegetable growers does not impact their adoption of innovative technologies, which contrasts with previous studies by Shivacharan et al. (2015). Moreover, higher farm income was positively linked to the inclination to adopt new technology and upgrade farms, in line with conclusions presented by Hendge et al. (2007) and Thakur et al. (2023a). Furthermore, experience in protected cultivation emerged as a significant and positive determinant of entrepreneurial behavior, indicating that experienced growers are more proficient in making

TABLE 4 The proportion of growers in low, medium and high categories based on EBI and DI.

EBI / Dimensions	Category wise distribution of growers (EBI range)		
	Low (<65.21)	Medium (65.22–82.72)	High (>82.73)
Overall EBI	16.05	61.20*	22.75
Decision making ability	34.17	47.50*	18.33
Achievement motivation	29.17	45.00*	25.83
Risk taking ability	20.83	50.00*	47.50
Self-confidence	11.67	47.50*	40.83
Cosmopolitaness	18.33	58.33*	23.33
Leadership ability	5.00	30.83	64.17*
Information seeking behavior	23.33	60.84*	15.83
Planning ability	5.83	39.17	55.00*
Innovativeness	9.16	28.34	62.50*

*Indicates the maximum proportion of sampled growers.



informed decisions. Similarly, a larger area under polyhouse cultivation facilitated farming activities and boosted profitability. Extension contacts played a pivotal role in providing growers with valuable information and enhancing their cosmopolitaness, enabling them to stay abreast of advanced technologies. These results are consistent with previous studies conducted by Savitha et al. (2009). Overall, these findings underscore the significance of various factors in shaping the entrepreneurial behavior of polyhouse vegetable growers and emphasize the necessity for tailored interventions and support mechanisms to promote entrepreneurial activities in this sector.

4.4 Factors influencing the dimensions of entrepreneurial behavior of vegetable growers

The analysis employed Kendal’s tau correlation to explore the relationship between different dimensions and factors, detailed in Table 6. Notably, the age of the growers exhibited a non-significant correlation with the Entrepreneurial Behavior Index (EBI) across all nine dimensions, encompassing decision-making ability, achievement motivation, risk-taking ability, self-confidence, cosmopolitaness, leadership ability, information-seeking behavior, planning ability and innovativeness. Conversely, the income of the growers displayed a significant and positive association with all dimensions, indicating a positive rapport with EBI. Experience in vegetable cultivation demonstrated significance for decision-making ability, achievement motivation, risk-taking ability, self-confidence, cosmopolitaness, planning ability and innovativeness, while lacking significant correlation with leadership ability and information-seeking behavior. The area under polyhouse cultivation emerged as non-significant for all dimensions except achievement motivation, where it exhibited a significant and positive relationship. Planning ability, cosmopolitaness and innovativeness were shown to be significant and positively correlated with education, whereas, risk-taking capacity was found to be significant and negatively correlated. Moreover, extension contact was found significant with self-confidence, suggesting growers gain confidence through active participation in social events. Nonetheless,

TABLE 5 Kendall’s tau correlates between independent variables and entrepreneurial behavior.

Sr. No.	Explanatory variables	Correlation coefficient (r)
1.	Age	0.089
2.	Farm income	0.961**
3.	Experience in protected cultivation	0.530**
4.	Area under protected cultivation	0.144*
5.	Education level	-0.049
6.	Extension contact	0.264**
7.	Family size	-0.004
8.	Gender	-0.038

**.*Significant at 1 and 5% level of significance, respectively.

family size and gender depicted no significant relationship with any of the nine dimensions of EBI. These findings underscore the intricate interplay between various factors and dimensions of entrepreneurial behavior among polyhouse vegetable growers, emphasizing the need to consider multiple factors in enhancing entrepreneurial activities within this sector. Figure 2 represents the various significant factors affecting the EBI and its nine dimensions. It clearly depicts that neither EBI nor its dimensions have any significant relation with age, family size and gender of the respondents (Figure 3).

5 Conclusion

Entrepreneurship within agriculture, notably through advancements such as protected cultivation, boosts farm productivity by addressing environmental challenges and enhancing crop quality and yield. Such techniques are essential for meeting increasing global demands for vegetables, ensuring food security and providing economic opportunities, particularly for small-scale farmers. Despite the potential to revolutionize agriculture, adoption of technology in agriculture remains limited in India, presenting an opportunity for substantial growth and socioeconomic development through improved agricultural

TABLE 6 Kendall’s tau correlates between independent variables and dimensions of EBI.

Explanatory variables	D1	D2	D3	D4	D5	D6	D7	D8	D9
Age	0.122	-0.021	0.900	0.023	-0.042	-0.002	0.038	0.090	0.019
Income	0.273**	0.229**	0.323**	0.334**	0.167*	0.313**	0.306**	0.341**	0.258**
Experience in protected cultivation	0.165*	0.179*	0.209**	0.252**	0.164*	0.126	0.131	0.203**	0.150*
Area under protected cultivation	0.128	0.203**	0.114	0.062	0.054	-0.067	0.011	0.087	0.074
Education	-0.078	0.027	-0.147*	-0.002	0.167*	-0.049	0.013	0.158*	0.138*
Extension contact	0.148	-0.028	0.043	0.338**	0.124	0.049	0.156	0.022	0.106
Family size	-0.070	-0.063	0.054	-0.048	0.093	-0.049	0.043	-0.054	0.074
Gender	-0.132	-0.054	0.037	-0.039	0.032	-0.106	0.084	0.037	-0.007

** *Significant at 1 and 5% level of significance, respectively.

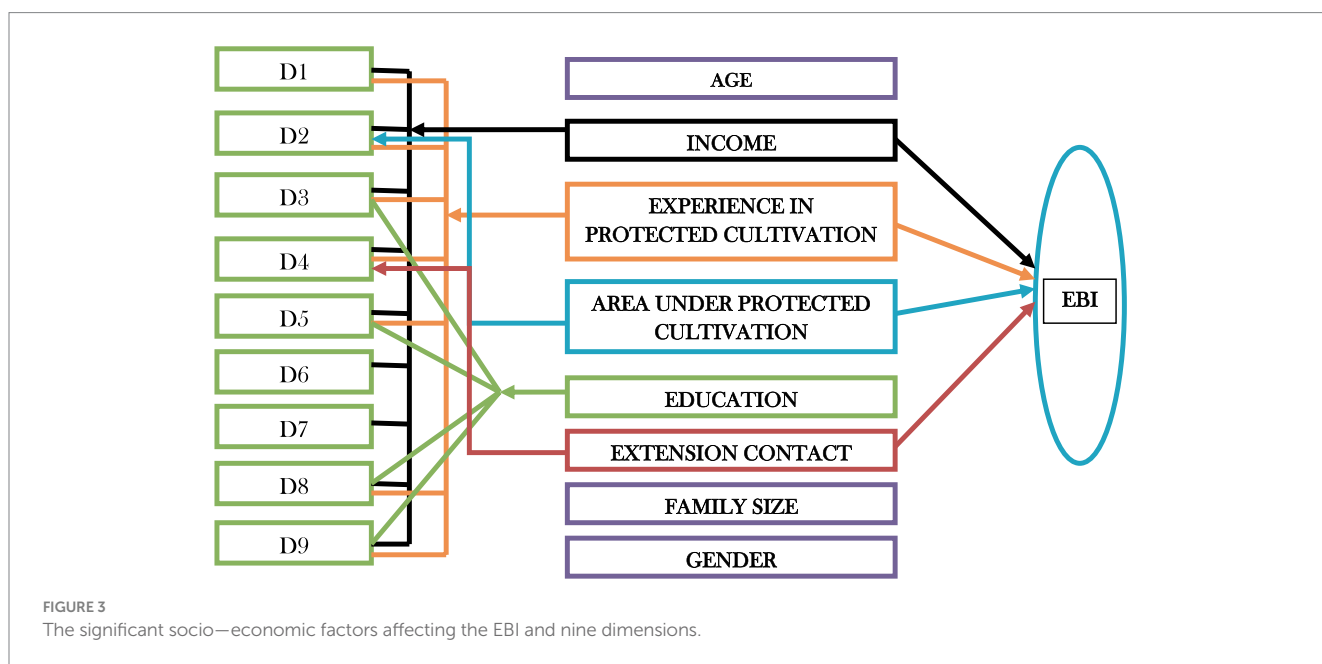


FIGURE 3 The significant socio-economic factors affecting the EBI and nine dimensions.

methods. A critical understanding of the factors influencing the approach of polyhouse vegetable growers toward agricultural entrepreneurship by examining their entrepreneurial behavior was done in the study. The Guilford procedure, which assessed nine dimensions of entrepreneurial behavior, underscored the complexity of agricultural entrepreneurship. Notably, the composite index reflecting entrepreneurial behavior among polyhouse farmers revealed a significant level of entrepreneurship, with leadership ability ranking highest and planning ability closely following, indicating its importance in farm management. Additionally, when categorizing polyhouse farmers based on their entrepreneurial behavior, a majority operated at a moderate level, with a considerable portion demonstrating high levels of entrepreneurship. Furthermore, the analysis identified key factors such as farm income, experience in protected cultivation, polyhouse area and extension contact, all playing a significant role in shaping entrepreneurial involvement. A strong positive relationship was observed between farm income and entrepreneurial behavior, highlighting the critical influence of financial resources in encouraging entrepreneurial activities. Similarly, practical experience in protected cultivation showed a positive correlation with entrepreneurial behavior, emphasizing the importance of hands-on expertise in driving innovation and growth. The analysis

also revealed a complex interaction between socio-economic factors and various aspects of entrepreneurial behavior, demonstrating how factors like income, education, and resource access influence farmers’ entrepreneurial decisions. These findings emphasize the importance of financial support, practical knowledge, and external assistance in fostering entrepreneurship, particularly in the context of protected farming. While age did not exhibit a significant correlation, factors such as income, experience, education, and extension contact showed notable associations with specific dimensions. Particularly, education displayed a significant positive relationship with innovativeness, cosmopolitanism and planning ability, indicating its role in nurturing entrepreneurial traits. These findings highlighted the pivotal role of financial stability, practical expertise, scale of operation and access to resources and information in fostering entrepreneurship among polyhouse producers. Moreover, it can be concluded from the results that there is importance of customized interventions and support mechanisms to nurture entrepreneurial activities among polyhouse vegetable growers. By taking into consideration financial stability, resource accessibility, education and extension services, the stakeholders can empower growers to enhance their entrepreneurial capabilities, thereby fostering sustainable agricultural development in agriculture sector.

6 Policy implication

The outcomes of this research offer significant policy implications for nurturing entrepreneurship among polyhouse vegetable cultivators. The research suggests that primarily, governmental strategies should target providing specific financial incentives and assistance programs, like subsidies or grants, to encourage investments in polyhouse infrastructure and technology adoption. This would alleviate financial hurdles for growers and stimulate the expansion of polyhouse farming, thus enhancing productivity and competitiveness in the agricultural sector. Secondly, initiatives should focus on improving access to tailored extension services and agricultural education programs for polyhouse farmers. By enhancing technical knowledge and providing insights into market trends and best practices, extension services can empower growers to make informed decisions and adopt innovative techniques. The study further stressed that collaborative efforts among government bodies, academic institutions, and agricultural organizations can facilitate the dissemination of these services to a broader audience. Moreover, policies should emphasize promoting collaboration and networking among polyhouse cultivators to facilitate knowledge exchange, resource sharing, and joint endeavors (Thakur et al., 2023c,d). Whereas, establishing farmer cooperatives or producer groups can enable growers to benefit from economies of scale, negotiate better terms for inputs and outputs, and access shared resources and infrastructure. Furthermore, governmental backing for the formation and management of such collective ventures can bolster the resilience and bargaining power of small-scale cultivators amidst market uncertainties. Additionally, efforts should address structural barriers to entrepreneurship, including limited access to credit, land tenure issues, and regulatory complexities. Simplifying administrative processes, providing tailored credit facilities, and ensuring secure land tenure rights can create a conducive environment for entrepreneurial activities. However, reducing administrative hurdles and promoting transparency in governance can enhance the business environment for polyhouse cultivators and encourage investment and innovation in agriculture. The study emphasizes the crafting and implementing supportive policy initiatives are crucial for unleashing the entrepreneurial potential of polyhouse vegetable growers and leveraging agriculture as a driver of economic development and rural prosperity. By addressing identified barriers and fostering opportunities for collaboration and innovation, policymakers can foster an enabling ecosystem conducive to sustainable entrepreneurship and inclusive agricultural growth. In conclusion, policymakers should prioritize financial support, improved education and the promotion of collaborative platforms to empower polyhouse vegetable growers. Facilitating access to credit, simplifying regulations, and fostering farmer cooperatives will create a more supportive environment for innovation and growth. By addressing these key areas, governments can drive sustainable agricultural development, enhance entrepreneurship and contribute to rural prosperity.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the [patients/ participants OR patients/participants legal guardian/ next of kin] was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

NT: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Writing – original draft, Writing – review & editing. RS: Conceptualization, Data curation, Methodology, Supervision, Validation, Writing – review & editing. PT: Conceptualization, Data curation, Methodology, Validation, Writing – original draft, Writing – review & editing. S: Conceptualization, Data curation, Methodology, Supervision, Validation, Writing – review & editing. AC: Conceptualization, Formal analysis, Methodology, Validation, Writing – review & editing. RK: Conceptualization, Methodology, Software, Validation, Visualization, Writing – review & editing. SP: Conceptualization, Methodology, Validation, Visualization, Writing – review & editing. VY: Software, Visualization, Writing – review & editing. AKS: Visualization, Writing – review & editing. AjS: Data curation, Formal analysis, Methodology, Software, Supervision, Validation, Visualization, Writing – review & editing. PS: Data curation, Supervision, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Adom, K., Asare-Yeboah, I. T., Quaye, D. M., and Ampomah, A. O. (2018). A critical assessment of work and family life of female entrepreneurs in sub-Saharan Africa: some fresh evidence from Ghana. *J. Small Bus. Enterpr. Dev.* 25, 405–427. doi: 10.1108/JSBED-02-2017-0063
- Afreh, B., Rodgers, P., Vershina, N., and Williams, C. C. (2019). Varieties of context and informal entrepreneurship: entrepreneurial activities of migrant youths in rural Ghana. *Int. J. Entrep. Behav. Res.* 25, 996–1013. doi: 10.1108/IJEBR-02-2018-0109
- Ahuja, R., Singh, S. P., Sanghwan, S. S., and Gautam, G. (2016). Entrepreneurial behavior of dairy farmers in Haryana. *Haryana Vet.* 55, 6–11.
- Alsos, G. A., Carter, S., Ljunggren, E., and Welter, F. (2011). The handbook of research on entrepreneurship in agriculture and rural development. Cheltenham and Northampton: Edward Elgar.
- Alsos, G. A., Ljunggren, E., and Toril Pettersen, L. (2003). Farm-based entrepreneurs: what triggers the start-up of new business activities? *J. Small Bus. Enterpr. Dev.* 10, 435–443. doi: 10.1108/14626000310504747
- Ameta, K. D., Kaushik, R. A., Dubey, R. B., and Rajawat, K. S. (2019). Protected cultivation: an entrepreneurship for modern agriculture. *Biotech Today* 9, 35–40. doi: 10.5958/2322-0996.2019.00003.6
- Bairwa, S. L., Lakra, K., Kushwaha, S., Meena, L. K., and Kumar, P. (2014). Agripreneurship development as a tool to upliftment of agriculture. *Int. J. Sci. Res. Publ.* 4, 1–4.
- Bannor, R. K., Ros-Tonen, M. A. F., Mensah, P. O., Derkyi, M., and Nassah, V. M. (2021). Entrepreneurial behavior among non-timber forest product-growing farmers in Ghana: an analysis in support of a reforestation policy. *Forest Policy Econ.* 122:102331. doi: 10.1016/j.forpol.2020.102331
- Chouhan, R. (2015). Enterprise resource planning: Alexis Leon, book review. *J. Appl. Manag.* 7:67.
- DA and FW. (2023). Department of Agriculture & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India. Available at: https://www.agriwelfare.gov.in/Documents/AR_English_2023_24.pdf.
- DeTienne, D. R. (2010). Entrepreneurial exit as a critical component of the entrepreneurial process: theoretical development. *J. Bus. Ventur.* 25, 203–215. doi: 10.1016/j.jbusvent.2008.05.004
- Dias, C. S., and Rodrigues, R. G. (2019). Agricultural entrepreneurship and the financial crisis. *Glob. Bus. Econ. Rev.* 21, 500–518. doi: 10.1504/GBER.2019.099390
- Dias, C. S. L., Rodrigues, R. G., and Ferreira, J. J. (2019). Agricultural entrepreneurship: going back to the basics. *J. Rural. Stud.* 70, 125–138. doi: 10.1016/j.jrurstud.2019.06.001
- Diaz-Pichardo, R., Cantú-Gonzalez, C., Lopez-Hernandez, P., and McElwee, G. (2012). From farmers to entrepreneurs: the importance of collaborative behavior. *J. Entrep.* 21, 91–116. doi: 10.1177/097135571102100104
- Dixit, A. (2007). Performance of leafy vegetables under protected environment and open field condition. *Asian J. Hort.* 2, 197–200.
- Fitz-Koch, S., Nordqvist, M., Carter, S., and Hunter, E. (2018). Entrepreneurship in the agricultural sector: a literature review and future research opportunities. *Entrep. Theory Pract.* 42, 129–166. doi: 10.1177/1042258717732958
- Guilford, J. P. (1954). Psychometric methods. New Delhi: Tata McGraw- Hill Publishing Co. Ltd.
- Hendge, Y. G., Patil, S. S., Kadam, R. P., More, S. S., and More, P. S. (2007). A study on entrepreneurial behavior of banana growers in Nanded district. *J. Soil. Crop.* 17, 153–157.
- Hilmi, M. (2018). Entrepreneurship in farming: what is the current status of knowledge in the Kurdistan region of Iraq? *Middle East. J. Agric. Res.* 7, 858–875.
- Kanungo, R. N., and Mendonca, M. (1994). Fundamentals of organizational behavior. Iowa: Kendall Hunt Publishing Company.
- Karat, S., and Baby, S. (2020). Entrepreneurial behavior of polyhouse farmers in Kerala. *Intern. J. Agric. Sci. Res.* 10, 29–40.
- Khazami, N., Nefzi, A., Jaouadi, M., and Crociata, A. (2020). The effect of social capital on the development of the social identity of agritourist entrepreneur: a qualitative approach. *Cogent Soc. Sci.* 6, 1–17.
- Kumar, A. V. (2014). Norm entrepreneur, catalyst or challenger? India in the nuclear non-proliferation narrative. *South Asian Surv.* 21, 90–111.
- Kumar, S., and Sharma, G. (2009). Entrepreneurial behavior of vegetable growers, Indian. *J. Ext. Educ.* 45, 125–127.
- Kuratko, D., Morris, M. H., and Schindehutte, M. (2015). Understanding the dynamics of entrepreneurship through framework approaches. *Small Bus. Econ.* 45, 1–13. doi: 10.1007/s11187-015-9627-3
- Lans, T., Seuneke, P., and Klerck, L. (2020). "Agricultural entrepreneurship" in Encyclopedia of creativity, invention, innovation and entrepreneurship. ed. E. G. Carayannis (New York: Springer Science+Business Media LLC), 1–7.
- Lazar, M., Miron-Spektor, E., Agarwal, R., Erez, M., Goldfarb, B., and Chen, G. (2020). Entrepreneurial team formation. *Acad. Manag. Ann.* 14, 29–59. doi: 10.5465/annals.2017.0131
- Lee, J., Arnason, A., Nightingale, A., and Shucksmith, M. (2005). Networking: social capital and identities in European rural development. *Sociol. Rural.* 45, 269–283. doi: 10.1111/j.1467-9523.2005.00305.x
- Mitchell, R. K., Busenitz, L., Lant, T., McDougall, P. P., Morse, E. A., and Brock Smith, J. (2002). Toward a theory of entrepreneurial cognition: rethinking the people side of entrepreneurship research. *Entrep. Theory Pract.* 27, 93–104. doi: 10.1111/1540-8520.00001
- Morgan, S. L., Marsden, T., Miele, M., and Morley, A. (2010). Agricultural multifunctionality and farmers' entrepreneurial skills: a study of Tuscan and Welsh farmers. *J. Rural. Stud.* 26, 116–129. doi: 10.1016/j.jrurstud.2009.09.002
- Mossie, H., Berhanie, Z., and Alemayehu, G. (2020). Factor affecting outlet choice of onion producers Northwest Ethiopia in multivariate probit approach. *Cogent Food Agr.* 6, 1–12.
- Mukhtar, S., Gwazawa, U. G., and Jega, A. M. (2018). Entrepreneurship development for diversification of Nigerian economy. *J. Econ. Manag. Trade.* 21, 1–11. doi: 10.9734/JEMT/2018/41679
- Murali, K., and Anitha, J. (2003). Entrepreneurial characteristics of floriculture farmers, Indian. *J. Ext. Educ.* 39, 19–25.
- Naminse, E. Y., and Jincui, Z. (2015). Does farmer entrepreneurship alleviate rural poverty in China? Evidence from Guangxi province. *PLoS One* 13, 1–18. doi: 10.1371/journal.pone.0194912
- Narmatha, N., Krishnaraj, R., and Safullah, M. A. (2002). Entrepreneurial behavior of livestock farm women. *J. Ext. Educ.* 13, 3431–3438.
- Nukpezah, J. A., and Blankson, C. (2017). Microfinance intervention in poverty reduction: A study of women farmer entrepreneurs in rural Ghana. *J. Afr. Bus.* 18, 457–475. doi: 10.1080/15228916.2017.1336915
- Obeng, B. A., Robson, P., and Haugh, H. (2014). Strategic entrepreneurship and small firm growth in Ghana. *Int. Small Bus. J.* 32, 501–524. doi: 10.1177/0266242612463946
- Olomu, M. O., Ekperiware, M. C., and Akinlo, T. (2020). Sector value chain and government policy in Nigeria: issues, challenges and prospects. *Afr. J. Econ. Manag. Stud.* 11, 525–538. doi: 10.1108/AJEMS-03-2019-0103
- Onesmo, A. R., Frida, A. N., and Alex, N. W. (2024). Assessment of aflatoxins awareness in animal feeds and fresh milk among smallholder dairy farmers in Kondoa district, Dodoma Tanzania. *J. Agric. Food Res.* 16:101051. doi: 10.1016/j.jafr.2024.101051
- Onyeneke, R. U. (2017). Determinants of adoption of improved technologies in rice production in Imo state, Nigeria. *Afr. J. Agric. Res.* 12, 888–896. doi: 10.5897/AJAR2016.11737
- Otache, I. (2017). Agripreneurship development: a strategy for revamping Nigeria's economy from recession. *Afr. J. Econ. Manag. Stud.* 8, 474–483. doi: 10.1108/AJEMS-05-2017-0091
- Patel, P., Patel, M. M., Badodia, S. K., and Sharma, P. (2014). Entrepreneurial behavior of dairy farmers, Indian res. *J. Ext. Educ.* 14, 46–49.
- Pindado, E., and Sanchez, M. (2017). Researching the entrepreneurial behavior of new and existing ventures in European agriculture. *Small Bus. Econ.* 49, 421–444. doi: 10.1007/s11187-017-9837-y
- Qing, P., Chongguang, L., Joanne, S. H., and Shengliang, D. (2021). Farmer entrepreneurs in China: an empirical investigation of their motivations, success factors, and challenges faced. *J. Small Bus. Entrep.* 33, 349–369. doi: 10.1080/08276331.2020.1818539
- Quaye, D. M., and Acheampong, G. (2013). Are SME owner-managers entrepreneurs? Evidence from Ghana. *Eur. J. Bus. Manag.* 5, 37–47.
- Rukiko, M. D., and Mambali, E. (2024). Entrepreneurial orientation and research in sub-Saharan Africa for sustainable development: where to focus? *J. Agric. Food Res.* 16:101075. doi: 10.1016/j.jafr.2024.101075
- Santosh, D. T., Tiwari, K. N., and Singh, V. K. (2017). Influence of different protected cultivation structures on water requirement of winter vegetables. *Int. J. Agric. Environ. Biotechnol.* 10, 93–103. doi: 10.5958/2230-732X.2017.00004.3
- Savitha, C. M., Siddaramaiah, B. S., and Nataraju, M. S. (2009). Entrepreneurial behavior of rural and urban women entrepreneurs, Mysore. *J. Agric. Sci.* 43, 317–321.
- Shane, S. (2007). A general theory of entrepreneurship: The individual-opportunity Nexus. Cheltenham, UK: Edward Elgar.

- Shivacharan, G., Rani, V. S., and Reddy, K. M. M. (2015). Entrepreneurial behavior of rural young Agri – entrepreneurs and relationship between entrepreneurial behavior and profile characters. *Res. J. Agric. Sci.* 6, 1089–1091.
- Singh, R. (1975). An optimum stratification for proportional allocation. *Sankhya* 37, 109–115.
- Singh, B., Kumar, M., and Sirohi, N. P. S. (2007). Protected cultivation of cucurbits under low-cost protected structures: a sustainable Technology for Peri- Urban Areas of northern India. *Acta Hort.* 31, 267–272.
- Singh, A. K., Shrivastava, R., Gupta, M. J., and Chandra, P. (2005). Effect of protected and unprotected conditions on biotic stress, yield and economics of spring summer vegetables, Indian. *J. Agric. Sci.* 75, 485–487.
- Singh, B., and Sirohi, N. P. S. (2008). Protected cultivation of vegetables in India: problems and future prospects. *Acta Hort.* 710, 355–359.
- Smit, A. B. (2004). Changing external conditions require high levels of entrepreneurship in agriculture. *Acta Hort.* 655, 167–173.
- Solanki, K. D., and Soni, M. C. (2004). Entrepreneurial behavior of potato growers, Indian res. *J. Ext. Educ.* 40, 32–33.
- Tebeka, Y. A., Katungi, E., Rubyogo, J. C., Serunkuuma, D., and Kidane, T. (2017). Economic performance of community-based bean seed production and marketing in the central rift valley of Ethiopia. *Afr. J. Crop Sci.* 25, 189–205. doi: 10.4314/acsj.v25i2.5
- Thakur, P., Mehta, P., Devi, C., Sharma, P., Singh, K. K., Yadav, S., et al. (2023a). Marketing performance and factors influencing farmers choice for agricultural output marketing channels: the case of garden pea (*Pisum sativum*) in India. *Front. Sustain. Food Syst.* 7:1270121. doi: 10.3389/fsufs.2023.1270121
- Thakur, P., Mehta, P., Dhiman, R., and Kumar, K. (2020). An assessment of awareness level and modern farm business management practices adopted by vegetable farmers in mid-hills of Himachal Pradesh. *Ind. J Extension Educ.* 56, 143–148.
- Thakur, P., Mehta, P., Guleria, A., Divyanshu, S., Sharma, P., Tiwari, R. K., et al. (2023b). Determinants of farmers' choice for agricultural output marketing channels of tomato (*Solanum lycopersicum*): an empirical evidence from North-Western Himalayan region. *Environ. Dev. Sustain.* doi: 10.1007/s10668-023-04319-1
- Thakur, P., Mehta, P., Guleria, A., Singh, P., and Sharma, P. (2022b). Farmers' choice for output marketing channels of cauliflower in Himachal Pradesh, India: A multinomial logit model analysis. *Econ. Aff.* 67, 731–738. doi: 10.46852/0424-2513.5.2022.6
- Thakur, P., Mehta, P., and Kumar, K. (2022a). Determinants of farmers' adoption behavior towards farm business management practices for vegetable farming in Mid-Hills of Himachal Pradesh, India. *Econ. Aff.* 67, 117–122. doi: 10.46852/0424-2513.2.2022.19
- Thakur, P., Mehta, P., Lal, P., Chaudhary, R., Pani, S. K., Singh, A. G., et al. (2024). Agricultural produce supply chain network of Capsicum: empirical evidence from India. *Economies* 12, 1–24. doi: 10.3390/economies12010024
- Thakur, N., Sharma, R., Giridhar, B. J., Kumar, S., Shilpa, S., and Klata, A. (2023c). Socio economic impact assessment of protected cultivation: income, employment and livelihood advancements for farmers. *J. Agric. Dev. Pol.* 33, 138–145. doi: 10.63066/23220457.33.2.002
- Thakur, N., Sharma, R., Kumar, K., Shilpa, S., and Sharma, A. (2023d). Evaluation of the socio-economic status of open and protected vegetable growers in mid hill zone of Himachal Pradesh. *Prog. Hort.* 55.
- Wanose, S. N., Bande, K. D., Holkar, S. C., and Mardare, R. G. (2018). Relational analysis of entrepreneurial behavior of banana growers. *Int. J. Chem. Stud.* 6, 2407–2411.
- Welsh, D. H. B., Memili, E., and Kaciak, E. (2016). An empirical analysis of the impact of family moral support on Turkish women entrepreneurs. *J. innov.* 1, 3–12. doi: 10.1016/j.jik.2016.01.012
- Wongnaa, C. A., Adams, F., Bannor, R. K., Awunyo-Vitor, D., Mahama, I., Osei, B. A., et al. (2019). Job creation and improved consumer health through commercialisation of tiger nut yoghurt: A willingness to pay analysis. *J. Glob. Entrep. Res.* 9, 1–22.
- Wongnaa, C. A., and Seyram, Z. K. A. (2014). Factors influencing polytechnic students' decision to graduate as entrepreneurs. *J. Glob. Entrep.* 2:2. doi: 10.1186/2251-7316-2-2
- Yusoff, A., Ahmad, N. H., and Halim, H. A. (2016). Tailoring future agropreneurs: the impact of academic institutional variables on entrepreneurial drive and intentions. *J. Entrep. Educ.* 19, 156–182.
- Zhao, J., and Li, T. (2021). Social capital, financial literacy, and rural household entrepreneurship: a mediating effect analysis. *Front. Psychol.* 12:12. doi: 10.3389/fpsyg.2021.724605