

Factors Influencing the Adoption of Improved Production Technology: Evidence from Mandarin Growers of Northeast Himalayan Region

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Abstract

In this in-depth examination of mandarin cultivation in the upper Subansiri district of Arunachal Pradesh, key demographic, educational, and experiential factors impacting growers are elucidated. The study encompassing data from a diverse respondent pool, reveals a predominant middle-aged group (70.00%) between 37.2-56 years. Educational patterns underscore that 33.33% completed high school, 30.00% reached higher secondary levels, while only 5% graduated. The majority of respondents (44.17%) owned 0.5-1.5 ha of land and 78.33% exhibited medium level of information source utilization. Survey results expose a wealth of experiential data with 66.67% of respondents having 13-27 years of mandarin cultivation experience. Training needs analysis discloses 83.33% with medium-level demands, and knowledge levels unveil 81.67% possessing a medium overall knowledge of improved mandarin cultivation methods. Factor analysis reveals innovativeness (84.17%), achievement motivation (89.17%), risk-taking ability (88.33%) and management (100%) and production orientation (98.33%). Marketing orientation is reported by 92.5%. An entrepreneurial behavior index of 48.86 emphasizes the medium level. 82.50% of respondents exhibited a medium level of technology adoption influenced by factors like area under Mandarin, income, family type, and training exposure. Constraint analysis revealed severe challenges in critical inputs (66.67%), unavailability of healthy seed saplings (50%), lack of skilled labour (58.33%), credit facility (75%), proper information (54.17%), technical knowledge (58.33%), training programs (54.17%), supply of electricity (58.33%), and of lack of regular visits by agricultural personnel (41.67%). In nutshell this study is a combination of rich demographic, educational, experiential, and constraint-related data, offering a nuanced perspective on the dynamics of Mandarin cultivation in the region. The findings serve as a tangible foundation for informed policy interventions and targeted support mechanisms.

Key words: Technology adoption, Mandarin, Entrepreneurship, Influencing factors, Constraints

Mandarin cultivation in India is done in selected pockets. Mandarin orange (*Citrus reticulata*) is one of the most demanding citrus fruits grown in India that occupies nearly 42% of the total agricultural lands used for citrus cultivation in the Country [1]. The leading contributing States involved in growing Oranges are Maharashtra, Tamil Nadu, Madhya Pradesh, West Bengal, Orissa, Rajasthan, Nagaland, Arunachal Pradesh, and Mizoram. One advantageous point of mandarin cultivation is that they can be successfully grown on plains as well as over the slopes of hills. Orange production in India takes 3rd position after mango and banana while it has a stake of 1.72% in mandarin export market. Some of those exporting countries are Bangladesh, Sri Lanka, Nepal, Canada, USA, UK, in UAE. In the lush landscapes of Arunachal Pradesh, a silent revolution is underway, orchestrated by the humble Mandarin orange (*Citrus reticulata*). Struggling against low production, scarce planting materials and the absence of essential infrastructure, these custodians of the land find themselves compelled to part with their harvests at meager prices. In this backdrop, our exploration delves deep into the Upper Subansiri district, aiming not just to study Mandarin cultivation but to

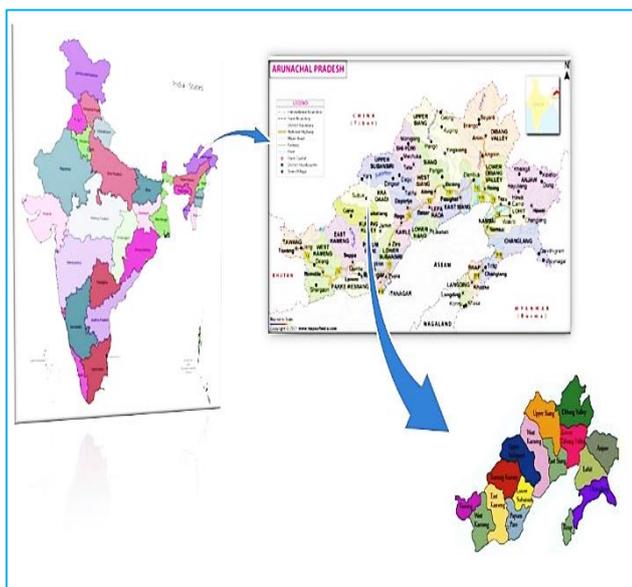
decipher the factors influencing the adoption of improved production technology.

Mandarin cultivation occupies a substantial portion, nearly 42%, of the total agricultural lands used for citrus cultivation in India. The mandarin orange (*Citrus reticulata*), also known as Mandarin or Mandarine, is a small citrus tree fruit grown commercially in almost all the region of Arunachal Pradesh. Tangerines are a group of orange-coloured citrus fruit consisting of hybrids of Mandarin orange with some pomelo contribution. Mandarin (*Citrus reticulata*) is one of the most challenging citrus fruits grown in India. The leading contributing states involved in growing Mandarin are Maharashtra, Tamil Nadu, Madhya Pradesh, West Bengal, Orissa, Rajasthan, Arunachal Pradesh and Mizoram. In north east, Khasi Mandarin from Meghalaya accounts for 43.6 per cent of total citrus fruits in India. The Khasi Mandarin has high nutritional value, distinctive quality and taste, vibrant golden fruit color and sweet tanginess. It ranks amongst the most loved Mandarin in the world and considered as the king of oranges [2]. The Mandarin is grown almost in every part of the state of Arunachal Pradesh. Main producing places and districts are

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Wakro-Lohit, Daporijo-Upper Subansiri, Roing, Dambuk-Lower Dibang Valley, Mebo – East Siang, Basar–West Siang. During the year of 2018-19, the area under Mandarin cultivation was 32841.45 ha, with a production of 74986.44 Mt and average productivity of 2.283Mt/ha [3]. College of Horticulture and Forestry (CHF), Central Agricultural University, Pasighat has developed various technologies for scientific production and management of Khasi Mandarin [4]. Socio-technical factors have been identified as playing a major role in determining adoption and use of information sources and technology [5-7]. Farmers of the state are facing various challenges like low production, non-availability of quality planting materials, lack of storage facilities and inadequate post-harvest processing units, forcing the producers to sell their produce just after harvest freshly at very less price. Therefore, it is crucial to give attention to all aspects of cultivation and management to improve the status of Mandarin cultivators in the study area. Keeping in view of these perspectives, the present study was conducted in the Upper Subansiri district of Arunachal Pradesh to study the current status of the Mandarin cultivation in the particular area and examining the factors influencing adoption status of improved production technology of Mandarin.



MATERIALS AND METHODS

The study was conducted in four rural development blocks of Upper Subansiri district of Arunachal Pradesh viz, Daporijo, Dumporijo, Gite Ripa and Maro as they have intensive mandarin cultivation practices having a tremendous potential for high production. Arunachal Pradesh covers an area of approximately 83,743 km² with population of about 1.5 million. Some of the districts include Tawang, West Kameng, East Kameng, Papum Pare, West Siang, East Siang, etc. Arunachal Pradesh has a predominantly agrarian economy and agriculture is the mainstay for the majority of the population. In the present study a total of 12 villages viz. Aya Nirin, Yudik, Hali, Digbak, Marde, Belo Dulom, Yekar, Nima, Maro, Ropuk, Ronya were selected purposively to analyze the factors influencing adoption status of improved production technology of Mandarin growers. 120 respondents were randomly selected with 10 respondents chosen from each village. Interview schedule included the variables age, gender, marital status, family size, family type, education, land holding, income, experience in mandarin cultivation, extension contacts, sources

of information, training exposure, training needs and was developed for collection of data from the selected respondents. The primary data were collected through face-to face interviews with respondents using a pre-tested structured interview plan developed for the purpose of the study. On the other hand, the secondary data were collected from the concerned departments, various publications, journals, magazines relevant text books and internet sources etc. The data collected from the respondents were scored, tabulated and analyzed to calculate frequency, percentage, mean, standard deviation correlation and factor analysis.

RESULTS AND DISCUSSION

Profile of the Mandarin growers

The data in (Table 1) revealed that majority of the respondents (70.00%) belonged to the middle-aged group of 37.2-56 years followed by 17.5 per cent and 12.5 per cent of the respondents who belonged to more than 56 years (old aged) and less than 37.2 years (young aged) categories respectively. This finding was in line with the findings of Chauhan *et al.* [8] where majority (48.33%) of farmers were middle-aged between 35 and 40 years. It also revealed that 33.33 per cent of the respondents had education up to high school followed by higher secondary (30.00%), primary school (20.83%), illiterate (10.83%), graduate (6%). The majority of respondents studied up to high school level (class 8-10) to acquaint themselves with the education system and to improve their skills, aligning with the results as reported by Mishra and Ghadei [9]. Further, it was also found that majority of the respondents (66.67%) had 13-27 years of experience in mandarin cultivation followed by 19.17 per cent of the respondents who had less than 13 years of experience while 14.17 per cent of them had more than 27 years of experience in mandarin cultivation. The reason that majority of the respondents had 13-27 years of experience could be attributed to farmers who were mostly middle aged between 35-55 years. It was also found that majority of the respondents (44.17%) had 0.5 – 1.5 ha land while (26.67%) had land of 1.5 -2.5 ha followed by (18.33%) with less than 0.5 ha of land holding and minimum percentage of (10.83%) land more than 2.5 ha under mandarin cultivation. Majority (78.33%) of the respondents had medium information sources utilization; followed by 15.83% and 5.83 per cent of the respondents who had low and high information sources utilization respectively. This finding was in accordance with the findings of [10] where majority (68.13%) of the respondents possessed medium level of information sources utilization [11].

In case of training needs 83.33% of respondents had medium-level of training demands, while 13.33% had high training needs and only 3.33% had low training needs.

In case of knowledge level, it was revealed that majority (81.67%) of the respondents had overall knowledge of medium level in improved method of mandarin cultivation which was followed by low (13.33%) and high (5.00%) overall level of knowledge. The reason for high knowledge of mandarin cultivation could be due to long experience through trial and error as well as knowledge passed down from ancestors. Also, the trainings conducted so far could have added to their knowledge on its cultivation practices. This finding was in line with the findings of Jamir and Jha [12] where 84.16 per cent of the respondents had medium level of overall knowledge. Majority of respondents (80%) had a positive attitude toward adopting improved techniques in mandarin development, followed by 18.33 percent of respondents with an extremely positive attitude however, only 1.67 percent with a less positive attitude [13-14].

Table 1 Socio-economic characteristics, attitude and technical knowledge of Mandarin growers

Variables	Category	Frequency	Percentage
Age Mean = 46.43, SD=9.17	Young age (<35 years)	15	12.50
	Middle age (35 – 55 years)	84	70.00
	Old age (>55 years)	21	17.50
Education Mean=1.98, SD=1.07	Illiterate/No formal education	13	10.83
	Primary school (up to 5 th)	25	20.83
	High school (up to 10 th)	40	33.33
	Higher secondary (up to 12 th)	36	30.00
	Graduate	6	5.00
	Post graduate	0	0.00
Experience in Mandarin cultivation Mean=20.09, SD=6.91	Low experience (<13 years)	23	19.17
	Medium experience (13 – 27 years)	80	66.67
	High level experience (>27 years)	17	14.17
Size of land under Mandarin cultivation Mean=1.28, SD=0.93	<0.5 ha	22	18.33
	0.5 – 1.5 ha	53	44.17
	1.5 – 2.5 ha	32	26.67
	≥2.5 ha	13	10.83
Level of information sources utilized Mean=2.13, SD=0.87	Low (<1.26)	19	15.83
	Medium (1.26-3.0)	94	78.33
	High (>3)	7	5.83
Training needs Mean=9.0, SD=0.88	Low (<8.12)	4	3.33
	Medium (8.12-9.88)	100	83.33
	High (>9.88)	16	13.33
Knowledge level Mean=9.61, SD=1.81	Low (<7.8)	16	13.33
	Medium (7.8-11.42)	98	81.67
	High (>11.42)	6	5.00
Attitude Mean=30.64, SD=1.01	Less favourable (<29.63)	2	1.67
	Favourable (29.63-31.65)	96	80.00
	Highly favourable (>31.65)	22	18.33

Table 2 Correlation between independent variables and adoption of improved cultivation practices of Mandarin

Independent variables	Coefficient of correlation (r)	p-value
Age	0.050	0.590
Gender	0.002	0.985
Marital status	-0.083	0.365
Family size	0.177	0.054
Family type	-0.022	0.815
Education	0.445*	0.011
Total area	-0.165	0.071
Area under Mandarin	0.178*	0.045
Total income	-0.167	0.068
Income from Mandarin	-0.169	0.066
Extension contacts	0.179*	0.044
Source of information	0.445*	0.011
Experience in Mandarin cultivation	0.480**	0.001
Training exposure	0.221*	0.018
Training needs	0.395*	0.014
Knowledge level	0.193*	0.045
Attitude	0.181*	0.040
Entrepreneurial behaviour	0.196*	0.034

*Significant at 5% level of probability

**Significant at 1% level of probability

Data depicted in (Table 2) revealed the correlation coefficients (r) associated with various autonomous factors. Each row compares to a specific variable and the coefficients demonstrate the quality and heading of the relationship with the dependent variable. Critical discoveries incorporate a noteworthy positive relationship between education (coefficient = 0.445, p = 0.011) comparative discoveries were more over detailed by Liezietsu [15] in her study uncovered that larger part (40.83%) of the Naga king chili producers had education up to

high school level followed by middle school level (16.67%). In another variable area mandarin cultivation (coefficient = 0.178, p = 0.045). Kharlukhi and Jha [16] through their research they uncovered that the majority of respondents (58.76%) had minimal total land holding sizes followed by little total land holding sizes (33.12%), medium total and holding sizes (5.6%) and big total and holding sizes (2.5%). Majority (85.83%) of the respondents had 1–2-acre sized land holding beneath ginger cultivation while 11.6 per cent with less than 1 acre and 15.83 per cent had more than 2 acres [17]. Expansion contact (coefficient = 0.179, p = 0.044), source of information (coefficient = 0.445, p = 0.011) had positive and critical affiliation with appropriation on mandarin cultivation at 5% level of connotation [18]. In experience in mandarin cultivation (coefficient = 0.480, p = 0.001). Prashanth *et al.* [19] in their study found that the majority (60.83%) of respondents had average agriculture involvement, compared to 28.33% who had destitute cultivation involvement and 10.84% who had high cultivation involvement. Training exposure (coefficient = 0.221, p = 0.018). Chouhan *et al.* [20] in their study on adoption dynamics of progressed sugarcane cultivation found that majority (90%) of the sugarcane cultivators never attended training and only 10 per cent of them had received any training. As far as training needs is concerned (coefficient = 0.395, p = 0.014). Shahjar *et al.* [21] from their study on relationship between socio economic profile and perceived training needs of dairy ranchers concluded that majority of the respondents (55.00%) had not attended any trainings followed by 45.00 per cent respondents who taken an interest in training programs. Besides, factors such as knowledge level (coefficient = 0.193, p = 0.045) had also positive correlation with adoption these findings are also aligned with Chigadoli *et al.* [22] through their research they concluded that the majority (48.33%) of the respondents had good comprehension of better knowledge of cultivation practices. Moreover, attitude was also found

significant at (coefficient= 0.181, p=0.040) this findings is also align with Thorat *et al.* [23] through their study on knowledge, selection of the banana cultivators about the banana cultivation innovation concluded that majority (68.66%) of the respondents had favorable followed by exceedingly favorable (16.67%) and least favorable (14.67%) towards banana cultivation innovation and entrepreneurial behavior (coefficient = 0.196, p = 0.034) exhibit noteworthy positive correlations, demonstrating potential compelling components within the context of the dependent variable. Kumari *et al.* [24] in their study found that high (24.37%) and low (17.50%) levels of economic inspiration were followed by medium (58.13%) and low (24.37%) levels of economic inspiration. These discoveries offer profitable insights into the connections between the desired factors and the dependent variable, advising advance investigation and discourses within the research context. However, conversely, age, gender, marital status, family size, family type, education, total area, total income and income from mandarin and training need were found non-significant, which implied no measurably critical correlation, with independent variable.

Innovativeness: The data classifies respondents based on their perceptions of innovation into three distinct categories: Low, Medium, and High. A small percentage (4.17%) of respondents perceived the low level of innovation, indicating a subset with a potentially critical view of the current state of innovation, likely influenced by factors such as limited exposure may be conservative attitudes. The majority (84.17%) categorizes the innovation level as medium suggesting a widespread acknowledgment of innovation but with the chances of improvement. On the other hand, a noteworthy group (11.67%) perceives the innovation level as high, reflecting a positive perception and likely indicating a favorable view of advancements within the specified context. This distribution provides valuable insights into the varied perspectives on innovation within the surveyed population, pointing towards potential areas for further exploration and understanding [25-26].

Achievement motivation: The data shows that a few people (4.17%) have low achievement motivation, meaning they might not be as driven to achieve things in the given

situation. Most people (89.17%) have a medium level of achievement motivation, suggesting a common baseline level of motivation. There's also a small group (6.67%) with high achievement motivation, indicating they have a strong drive to accomplish things. This information gives us a glimpse into the different levels of motivation among the surveyed people, providing a starting point for understanding what factors might influence achievement motivation in this context [27].

Risk taking ability: On the basis of categorization of data as low, medium and high. Small portion (4.17%) falls into the low category, indicating this group having the low level of risk-taking ability in his present situation. The majority of respondents (88.33%) fit into the medium category, indicating an acceptable place to start for risk-taking ability. Additionally, 7.50% of respondent exhibited high level of risk-taking abilities expressing a group with a more pronounced inclination for taking risks [28-29].

Decision taking ability: Table depicts that a small proportion (10.00%) falls into the Low category, indicating a group with a lower proficiency in decision-making within the given context. The majority (85.83%) falls under the medium category which shows a common level of decision-taking ability. Additionally, 4.17% of respondents exhibit a high level of decision-taking ability, denoting a more pronounced proficiency in making decisions.

Management orientation: Majority (100%) of the respondents indicated a medium level of management orientation, whereas 0.00 percent had high and low levels, respectively.

Production orientation: The majority of respondents (98.33%) had a medium degree of production orientation, followed by high (1.67%) and low (0.00%) levels, according to the findings on production orientation.

Marketing orientation: In contrast, the majority of respondents (92.5%) reported a medium level of marketing orientation, followed by 6.67.8% and 0.83 percent with low and high levels of marketing orientation, respectively [30-31].

Table 3 Distribution of respondents based on their entrepreneurial attributes

S. No.	Entrepreneurial attributes	Level	Frequency	Percentage
1.	Innovation Mean=11.2, SD=1.04	Low (<10.16)	5	4.17
		Medium (10.16-12.24)	101	84.17
		High (>12.24)	14	11.67
2.	Achievement Motivation Mean=12.7, SD=1.29	Low (<11.41)	5	4.17
		Medium (11.41-13.99)	107	89.17
		High (>13.99)	8	6.67
3.	Risk taking ability Mean=14.03, SD=1.00	Low (<13.03)	5	4.17
		Medium (13.03-15.03)	106	88.33
		High (>15.03)	9	7.50
4.	Decision taking ability Mean=6.60, SD=1.04	Low (<5.56)	12	10.00
		Medium (5.56-7.64)	103	85.83
		High (>7.64)	5	4.17
5.	Entrepreneurial competencies Mean=8.50, SD=0.64	Low (<7.86)	2	1.67
		Medium (7.86-9.14)	95	79.17
		High (>9.14)	7	5.83
6.	Entrepreneurial intensions Mean=6.20, SD=0.63	Low (<5.57)	13	10.83
		Medium (5.57-6.83)	105	87.50
		High (6.83)	2	1.67
7.	Management orientation Mean=15.8, SD=0.37	Low (<15.43)	0	0.00
		Medium (15.43-16.17)	120	100.00
		High (>16.17)	0	0.00

8.	Production orientation Mean=13.3, SD=0.49	Low (<12.81)	0	0.00
		Medium (12.81-13.79)	118	98.33
		High (>13.79)	2	1.67
9.	Marketing orientation Mean=9.8, SD=0.82	Low (<8.98)	8	6.67
		Medium (8.98-10.62)	111	92.50
		High (10.62)	1	0.83

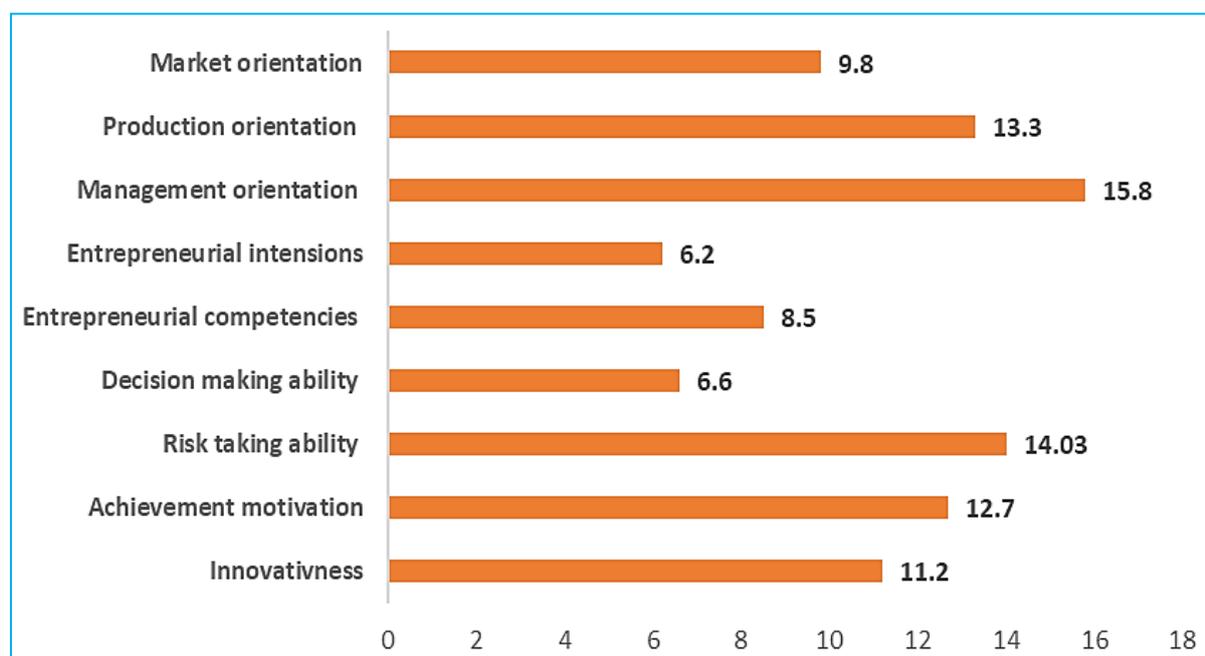


Fig 1 Attributes of entrepreneurial behaviour of Mandarin growers

Table 3.1 Distribution of respondents based on their overall entrepreneurial behaviour

S. No.	Category	Frequency	Percentage	Entrepreneurial Index
1.	Low (<10.04)	10	8.33	48.86
2.	Medium (10.04-11.78)	99	82.50	
3.	High (>11.78)	11	9.17	

Mean = 10.91, SD = 0.87

Data depicted in (Table 3.1) revealed that the majority of respondents (82.50%) had an overall medium level of entrepreneurial behavior followed by 9.17 and 8.33 percent with high and low levels, respectively. This might be brought on by a moderate level of inventiveness, accomplishment motivation, risk taking aptitude, and management orientation. The Entrepreneurial index was found to be 48.86 [32-34]. The observed pattern could be attributed to several factors. Firstly, respondents may possess a moderate level of inventiveness, indicating a propensity for generating new ideas or solutions. Secondly, they may exhibit a reasonable level of accomplishment motivation, driving them to pursue and achieve goals related to entrepreneurial endeavors. Thirdly, the willingness to take risks, an essential trait in entrepreneurship, might also be present at a moderate level among the respondents. Lastly, a management orientation, implying an ability to organize and oversee entrepreneurial activities effectively, could contribute to the observed distribution of entrepreneurial behavior.

The (Table 4) presents the outcomes of a factor analysis, a statistical technique designed to uncover underlying patterns in a dataset. The analysis identified distinct factors, each associated with specific variables and contributing to the overall variance in the dataset.

Factor- 1, explaining 23.140% of the variance is characterized by high factor loadings for variables such as area under

mandarin (X_8), income from mandarin (X_{10}), total income (X_9) and total area (X_7).

Factor- 2, explaining 17.935% of the variance, is influenced by variables like age (X_1), gender (X_2), total area (X_7), area under mandarin, total income, income from mandarin variables.

Factor- 3 (8.544% variance) involves marital status (X_3), family size (X_4), education (X_6), total area and area under mandarin variables.

Factor- 4 (7.891% variance) continues to emphasize marital status (X_3), family size (X_4), education (X_6), total area (X_7).

Factor- 5 (6.753% variance) includes age (X_1), gender (X_2) and family type (X_5).

Factor- 6 (6.312% variance) exhibits moderate loadings for gender (X_2) and family size (X_4).

Factor- 7 (5.872% variance) is characterized by a moderate loading for total area (X_7) only.

In essence, these factors provide a structured representation of the relationships between variables, simplifying the understanding of complex data patterns. The cumulative percentages indicate the proportion of total variance

collectively explained by each factor and also aiding researchers in identifying key factors influencing the dataset. In

this study we can see that Factor 1 and Factor 2 were relatively more important in explaining the variances.

Table 4 Factor analysis showing variables influencing entrepreneurship

Factors	Variables	Factor loading	Percent (%) of variance explained	Cumulative (%) of variance explained
Factor- 1	Area under Mandarin (X ₈)	0.974	23.140	23.140
	Income from Mandarin (X ₁₀)	0.974		
	Total income (X ₉)	0.972		
	Total area (X ₇)	0.970		
	Family type (X ₅)	0.159		
	Attitude (X ₁₇)	0.124		
	Training exposure (X ₁₄)	0.112		
	Entrepreneurial behaviour (X ₁₈)	0.018		
Factor 2	Age (X ₁)	0.914	17.935	41.075
	Gender (X ₂)	0.886		
	Total area (X ₇)	0.160		
	Area under Mandarin (X ₈)	0.159		
	Total income (X ₉)	0.142		
	Income from Mandarin (X ₁₀)	0.158		
Factor 3	Marital status (X ₃)	0.451	8.544	49.618
	Family size (X ₄)	0.233		
	Education (X ₆)	0.096		
	Total area (X ₇)	0.077		
	Area under Mandarin (X ₈)	0.076		
Factor 4	Marital status (X ₃)	0.067	7.891	57.509
	Family size (X ₄)	0.477		
	Education (X ₆)	0.230		
	Total area (X ₇)	0.059		
Factor 5	Age (X ₁)	0.107	6.753	64.262
	Gender (X ₂)	0.079		
	Family type (X ₅)	0.156		
Factor 6	Gender (X ₂)	0.066	6.312	70.574
	Family size (X ₄)	0.127		
Factor 7	Total area (X ₇)	0.026	5.872	76.446

The data depicted in (Table 5) reveals the distribution of respondents based on constraints faced by respondents in terms of cultivation and management of Mandarin as discussed:

Lack of credit facility

It was revealed that 75 per cent of the respondents faced severe constraints in view of lack of credit facility and 23.03 per cent of the respondents had moderate constraints.

Post-harvest loss

Majority (58.33%) of respondents reported a moderate constraint on the availability of electricity, while 37.50% reported a severe constraint.

Fluctuations in prices

It was found that majority (66.67) per cent of the respondents had severe constraint on fluctuation of prices of Mandarin.

Costly critical inputs, seed budded seedling and fertilizer and lack of proper resource and capital

It was evident from (Table 5) that majority (66.67%) of the respondents had faced severe problem in costly critical inputs, seed budded seedling and fertilizer due to lack of financial support from the government for cultivation of Mandarin. whereas 25% of the respondents had moderate constraint and least 8.33% had no constraint. The findings underscore the critical role of government support in addressing challenges related to costly inputs for agricultural activities like Mandarin cultivation.

Poor transport facilities

Majority (62.50%) of the respondents faced severe constraint on poor transport facilities and only 29.17 per cent of the respondents had moderate constraint.

Lack of training programs related with improved practices

Majority (54.17%) of the respondents had severe problem in lack of training programs related with improved practices followed by 44.17 per cent with moderate constraint.

Lack of technical knowledge

It was evident from (Table 5) that 58.33 per cent of the respondents had severe constraint in lack of technical knowledge.

Lack of proper market facilities

Majority (63.33%) of the respondents faced severe constraint on lack of proper market facilities whereas 20 per cent of the respondents had moderate constraint on market facilities.

Unavailability of healthy seed sapling at the time and lack of proper information

It was found that 50 per cent of the respondents had a severe constraint in unavailability of healthy seed saplings at time and 45.83 per cent of the respondents had moderate constraints and they also not getting the information of availability of inputs.

Lack of availability of improved varieties

Majority (54.17%) of the respondents had severe constraint with lack of availability of improved varieties and 33.33 per cent of the respondents had moderate constraint. The findings emphasize the importance of interventions aimed at improving the availability, quality, and accessibility of seed

saplings, as well as enhancing communication mechanisms to provide farmers with necessary information and support for their agricultural activities. Such measures are crucial for enhancing agricultural productivity and livelihoods in the context of Mandarin cultivation and beyond.

Table 5 Distribution of respondents based on constraints faced by respondents in terms of cultivation and management of Mandarin

S. No.	Constraints	Category			Mean score	Rank	Measures suggested by the respondent
		Severe	Moderate	No constraints			
1.	Lack of credit facility	90.00 (75.00)	25.00 (20.83)	5.00 (4.17)	1.71	I	Proper knowledge regarding the credit facility under various schemes of mandarin cultivation practices should be made aware.
2.	Post-harvest loss	85.00 (70.83)	32.00 (26.67)	3.00 (2.50)	1.68	II	Knowledge to reduce the loss of post-harvest techniques should be taught.
3.	Fluctuation in prices	80.00 (66.67)	35.00 (29.17)	5.00 (4.17)	1.63	III	Prices of mandarin should be stable in order to reduced their risk in cultivation.
4.	Costly critical inputs, seed budded seedling and fertilizer and lack of proper resource and capital	80.00 (66.67)	30.00 (25.00)	10.00 (8.33)	1.58	IV	Reduced costs in the seed budded seedling and fertilizer Subsidies to be provided for the mandarin seedlings and fertilizer
5.	Poor transport facilities	75.00 (62.50)	35.00 (29.17)	10.00 (8.33)	1.54	V	Transportation facility should be smooth in order to reduced their cost.
6.	Lack of training programs related with improved practices	65.00 (54.17)	53.00 (44.17)	2.00 (1.67)	1.53	VI	Various training should be conducted on the improved cultivation practices should be done.
7.	Lack of technical knowledge	70.00 (58.33)	40.00 (33.33)	10.00 (8.33)	1.50	VII	Knowledge regarding the technical knowledge of cultivation should be taught.
8.	Lack of proper market facilities	76.00 (63.33)	24.00 (20.00)	20.00 (16.67)	1.47	VIII	Proper marketing facility should be made available for better accessibility for selling their product.
9.	Unavailability of healthy seed saplings at time and lack of proper information	60.00 (50.00)	55.00 (45.83)	5.00 (4.17)	1.46	IX	Availability of healthy seedlings prior to cultivation and proper information mechanism should be developed
10.	Lack of availability of improved varieties	65.00 (54.17)	40.00 (33.33)	15.00 (12.50)	1.42	X	The improved varieties of mandarin should be made available.

Note: Figure in parenthesis is the percentage to the total

CONCLUSION

The study sheds light on the intricate dynamics of Mandarin cultivation in the Upper Subansiri district of Arunachal Pradesh. The demographic profile underscores the dominance of a middle-aged grower population, aligning with educational patterns where a significant proportion has achieved high school levels. Correlation between age and education signifies the importance of educational exposure in agricultural practices. Landholding patterns reveal a diverse distribution, emphasizing the need for tailored support mechanisms based on farm size. Experiential insights highlight the crucial role of hands-on experience, with a substantial portion of growers boasting significant years of engagement in Mandarin cultivation. The interplay of age, education, and experience provides a nuanced understanding of the agricultural landscape. Factor analysis unveils the entrepreneurial behavior of growers, emphasizing the medium level prevalent in the community. The adoption of improved practices is influenced by multiple factors, including innovativeness, achievement motivation, and orientation toward management, production, and marketing, wherein management orientation and risk-taking ability has the highest potential to influence the

entrepreneurial behaviour of mandarin growers. This multifaceted approach underscores the need for holistic interventions that consider the diverse facets influencing growers' decision-making. Constraint's analysis reveals the complex challenges faced by Mandarin growers, ranging from financial constraints to the unavailability of healthy seed saplings and a lack of skilled labor. These constraints present critical touchpoints for targeted policy interventions, extension services, and capacity-building programs to bolster the resilience of Mandarin cultivation in the region. In navigating the path forward, policymakers, researchers, and extension services must leverage these findings to formulate context-specific strategies. Tailored educational programs, financial support mechanisms, and infrastructural development are imperative to address the identified constraints and capitalize on the existing strengths within the Mandarin cultivation community. By doing so, we can pave the way for sustainable and resilient agricultural practices, ensuring the prosperity of Mandarin growers and contributing to the overall agricultural development of the region.

Conflict of interest:

In this research, there was no conflict of interest by authors.

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