



## Indian Research Journal of Extension Education

ISSN: 0972-2181 (Print), 0976-1071 (e-Print)

NAAS Rating : 5.22

Journal homepage: [seea.org.in](http://seea.org.in)



RESEARCH ARTICLE

[https://doi.org/10.54986/irjee/2022/apr\\_jun/126-133](https://doi.org/10.54986/irjee/2022/apr_jun/126-133)

### Adoption Behaviour of Khasi Mandarin Growers Tribal Farmers in Arunachal Pradesh

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Received on January 08, 2022, Accepted on March 10, 2022 and Published Online on April 01, 2022

#### ABSTRACT

East Siang district of Arunachal Pradesh in the North Eastern Region has tremendous potentiality for commercial cultivation of Khasi Mandarin. Despite of rich soil and favourable agro-climatic conditions, full potentialities in terms of production and productivity could not be realised by the growers. The study highlights correlates of adoption of improved practices of Khasi Mandarin and the associated problems of adoption of improved practices by the farmers. The overall level of adoption from the findings revealed that majority (64.17%) of the respondents had medium level of adoption which was followed by low adoption level (25.00%). However, only 10.83 per cent were found to be in high level of adoption category. Total land holding, area under mandarin orchard, total annual income, extension contact, training exposure, management orientation and risk bearing ability had positive and significant correlation with the level of adoption. Age, family size, occupation of the family, farming experience and farm labour availability exhibited a non-significant relationship with the level of adoption. All the variables were found to contribute 42.9 per cent of total variation in adoption ( $R^2=0.429$ ) with extension contact, management orientation and risk bearing ability having significant contribution to this variation.

**Key words:** Adoption; Khasi mandarin; Problems; Tribal farmers.

Fruits are indispensable in human nutrition. There is an increasing demand in the consumption of fruits due to the presence of high nutrient content. India is the second largest producer of fruits next to China producing 99.07 million metric tonnes of fruit (NHB, 2019-20.). Mandarin Orange (*Citrus reticulata* Blanco) is one of the most predominant and commercially cultivated table fruit belonging to the family *Rutaceae*. The fruit is native to South Eastern Asia and Philippines. It is a rich source of Vitamin C (32 %), in addition to the presence of high nutritive values and herbal medicinal properties. In India, citrus is cultivated over an area of 1034 thousand hectare with a production of 13200 thousand MT and an average productivity of 12.08 MT/ha. Mandarin alone covers an area of 437 thousand hectare with a production of 5380 thousand MT and a productivity of 12.31 MT/ha

(*Horticulture Statistics at a Glance*, 2018).

North Eastern Region of India is endowed with favourable climate suitable for the growth of horticultural crops and is considered to be the hub of many citrus species. Among the other NE States, Arunachal Pradesh alone occupies an area of 42.64 thousand hectare with a production of 217.04 thousand MT and a productivity of 5.09 MT/ha. Although, the per cent share in mandarin production by Arunachal Pradesh is only 1.37 per cent, which is comparatively less than other states like Madhya Pradesh that shares the highest (41.24 %) followed by Punjab (23.69%), Maharashtra (15.64%), Rajasthan (6.23%), Assam with 3.99 per cent (NHB, 2017-18), yet the scope of increasing mandarin cultivation is enormous. The East Siang district of Arunachal Pradesh is the second with 2125 ha of the total Khasi mandarin area (*Statistical*

*Abstract of Arunachal Pradesh, 2016-17*). The East Siang District is bestowed by nature with hilly terrains and gentle slopes which is suitable for fruit crops like mandarin. There is tremendous potentiality to commercialize this fruit crop in the region that may contribute towards the socio - economic uplift of the tribal people.

No doubt commercialization process has been introduced but it is still at the nascent stage. As per a study conducted by *Pant et al., 2019*, despite long term farming in citrus, mandarin was unproductive due to several factors that inhibited commercialization. Several factors contribute to low production and productivity of the crop and one important reason may be due to the fact that growers might be practicing with their own traditional method of farming. Probably improved cultivation practices are either yet to receive fully to the doorsteps of the farmers or may be less eagerness on the part of growers to introduce recommended technologies (*Bose, 1985*). To fulfil the market demand of the fruit, it is necessary to adopt improved cultivation practises. Moreover, in many instances, though they show their eagerness to adopt, but faced with several problems that act as blockade in the process of adoption.

Keeping in view of the above facts, the present study was undertaken with the specific objectives: (i) to study the profile of khasi mandarin growers and (ii) to determine the correlation between the profile of growers and adoption of recommended khasi mandarin cultivation practices. (iii) to identify the various problems faced by *Khasi* Mandarin growers in East Siang district of Arunachal Pradesh

## **METHODOLOGY**

The study was conducted purposively in East Siang District of Arunachal Pradesh due to greater potentiality and good scope for *Khasi* Mandarin cultivation. A total of 12 villages were selected proportionately from all the four Development Blocks based on the prevalence of Mandarin orchards. From each village, 10 tribal mandarin growers were selected randomly, thus, constituting a total sample of 120 respondents for the study. The respondents were considered as sample based on their experiences of at least 5 years with Mandarin orchard. The primary data was collected through personal interview method with

the help of a structured schedule. Extent of Adoption was measured as Fully (when all the recommended practices were adopted), Partially (When a few practices were adopted) and Non-adoption (When not a single recommended practices were adopted) with scores 2, 1 and 0 respectively. Packages of practices of *Khasi* mandarin were taken as per the advice and recommendation of Agriculture Department of Arunachal Pradesh. Based on the mean and standard deviation of the scores obtained, the adoption level of the respondent was classified into the three categories: Low ( $< X-S.D$ ), Medium (Between  $X+S.D$  to  $X-S.D$ ) and High ( $> X+S.D$ ). The tabulated data were analyzed using appropriate statistical techniques *viz.*, frequency, percentage, Mean, Standard deviation, correlation coefficient, regression and chi square test.

Altogether 33 problems grouped in to eight categories in different areas relevant to the study were identified after discussing with officials of State Department of Agriculture, Arunachal Pradesh and farmers growing *Khasi* mandarin. The respondents were asked to give their responses against each problem by choosing a given option as “very serious”, “serious” and “not so serious”. Frequencies, percentages, weighted mean scores (WMS) were used for analysis and interpretation of results.

## **RESULTS AND DISCUSSION**

*Profile of khasi mandarin growers* : As revealed by Table 1, majority (67.50%) of the respondents were in the productive age group of 39 to 58 years and only 13.33 per cent were above 58 years. It was found that most of the growers did not possess considerable level of education as (80.83%) were educated up to middle level and (4.17%) was also found to be illiterate. Majority of them (60.00%) belonged to joint family and 66.67 per cent of all the farmers had large family size with more than 8 members. *Khasi* mandarin was the main family occupation in case of 66.67 per cent of growers. Most of them (60.83 %) had 10 to 22 years of experience in mandarin and family labour was mostly (87.50%) used in orchard. Majority (64.17%) of the respondents had total land holding size of 1 to 2 ha. and 77.50 per cent of the orchard growers utilised in between 0.8-3.08 ha under *khasi* mandarin. The total annual income was found to be medium in between Rs. 56,321 to 1,63,203 for majority (55.53%) of the

**Table 1. Distribution of respondents according to their selected characteristics (N=120)**

Variables	Category	No. (%)	Mean	S.D.	C.V.
Age	< 39 years	23(19.17)	48.77	8.96	18.37
	39-58 years	81 (67.50)			
	> 58 years	16 (13.33)			
Educational level	Illiterate	5 (4.17)	22.87	4.41	19.28
	Up to Middle school passed	97 (80.83)			
	High school passed	8 (6.67)			
	Higher secondary & above	10 (8.33)			
Family type	Nuclear	48 (40.00)	6.59	1.79	27.16
	Joint	72 (60.00)			
Family size	Small (<5 members)	15 (12.50)	6.59	1.79	27.16
	Medium (5-8 members)	25 (20.83)			
	Large (>8 members)	80 (66.67)			
Occupation of family	Only mandarin cultivation	80 (66.67)	16.25	5.29	32.55
	Mandarin + allied agriculture	28 (23.33)			
	Mandarin + business	6 (5.00)			
	Mandarin + service	2 (1.67)			
	Mandarin +other activities	4 (3.33)			
Farming experience	Low (<10 years)	23 (19.17)	16.25	5.29	32.55
	Medium (10-22 years)	73 (60.83)			
	High (>22 years)	24 (20.00)			
Farm labour availability	Family labour	105 (87.50)	2.40	1.17	48.75
	Hired labour	15 (12.50)			
Total land holding	Marginal (up to 1 ha)	18 (15.00)	2.40	1.17	48.75
	Small (1.1 to 2 ha)	77 (64.17)			
	Semi medium (2.1 to 4 ha)	15 (12.50)			
	Medium (4 to 10 ha)	10 (8.33)			
Mandarin area in Orchard	Large (Above 10 ha)	-	1.94	1.14	58.76
	Low (<0.8 ha)	19 (15.83)			
	Medium (0.8-3.08 ha)	93 (77.50)			
Annual income	High (>3.08 ha)	8 (6.67)	109882.50	53321.86	48.52
	Low (Below Rs. 56,321)	22 (18.34)			
	Medium (Rs. 56,321- 1,63,203)	67 (55.83)			
Annual income from orchard	High (Above Rs. 1,63,203)	31 (25.83)	95,364.58		45.07
	Below Rs. 52,375	12 (10.00)			
	Rs. 52,375- 1,38,355	87 (72.50)			
Extension contact	Above 1,38,355	21 (17.50)	4.05	2.28	56.29
	Low (Blow 2)	26 (21.67)			
	Medium (2-6)	74 (61.67)			
Training exposure	High (Above 6)	20 (16.67)	16.25	5.29	32.55
	No training	80 (66.66)			
Management orientation	Training	40 (33.33)	22.87	4.41	19.28
	Low (Below 18)	15 (12.50)			
	Medium (18-27)	85 (70.83)			
Risk bearing ability	High (Above 27)	20 (16.67)	23.20	3.20	13.79
	Low (Below 20)	16 (13.34)			
	Medium (20-26)	85 (70.83)			
Adoption of recommended practices	High (Above 26)	19 (15.83)	29.30	4.25	14.50
	Low (below 25.05)	30 (25.00)			
	Medium (25.05-33.55)	77 (64.17)			
	High (Above 33.55)	13 (10.83)			

respondents which is supported by the findings of *Singh et al. (2011)* and 72.50 per cent earned an income of Rs. 52,375- 1,38,355 from mandarin cultivation. Around 62.00 per cent had medium level of extension contact while 66.66 per cent had no any training exposure. A greater portion of growers (70.83%) had medium management orientation and risk bearing ability. The mean score and standard deviation indicated that respondents were heterogeneous in nature.

With regard to overall adoption level of recommended technology, more than half (64.17%) of growers belonged to medium level of adoption category followed by low level (25.00%) and only 10.83 per cent were in high level adoption category (Table 1). The findings of the study are in conformity with *Bhandare et al. (2013)* and *Yadav et al. (2013)*. The reason for medium adoption level was due to the fact that the growers did not fully adopt all the recommended cultivation practices. So, there is the need to help them in realising the importance of full adoption of improved practices (*Phuse et al., 2007*).

*Correlation of growers' characters with adoption of recommended practices* : The relationship between selected profile characteristics of the mandarin growers and their extent of adoption was calculated with the help of correlation coefficient (Table 2).

It is observed from the Table 2 that variables viz. Total land holding ( $r = 0.272^{**}$ ), area under *Khasi* mandarin ( $r = 0.232^*$ ), total annual income ( $r = 0.217^*$ ),

extension contact ( $r = 0.402^{**}$ ), training exposure ( $r = 0.299^{**}$ ), management orientation ( $r = 0.361^{**}$ ) and risk bearing ability ( $r = 0.439^{**}$ ) had positive and significant correlation with the level of adoption, thereby meaning that any positive increase in total land holding, income, extension contact, training exposure, management orientation and risk taking ability of the farmers will result in more adoption of recommended practices of *khasi* mandarin by them. Age, family size, occupation of the family, farming experience and farm labour availability was not correlated with adoption of recommended practices of *khasi* mandarin.

It can be inferred that growers with more land holding could allot a part for risky proposition and also bear the risk of any eventuality in adopting recommended technology and the result is supported by the work of *Gotyal et al. (2011)*. Extension contact with various sources provided an opportunity to acquire relevant information and technical support which would influence the growers to adopt the technology. *Gedam and Singh (2012)* reported similar findings in regard to extension contact. Similarly, more exposure to training would lead to more adoption as the growers would be enriched with knowledge and skill that makes it easier to handle the technology. As higher income provides confidence for expenditure, it leads to more adoption requiring more capitals for orchard as in this present case. Similar findings was observed in the study of *Tiwari, et al. (2016)* where income has a significant influence on adoption. Scientific management helped the farmers to manage the various operation related with improved practices in a better way as the result suggest a positive correlation between management orientation and adoption. At the same time whenever there is introduction of any new technology it requires the risk bearing ability on the part of growers. So, if they had the ability to bear risk then it would lead to increase in the level of adoption. The finding of risk bearing ability is in line with *Singh. et al. (2010)*.

*Association of growers' profile characters with adoption of recommended Khasi mandarin practices* : Further analysis was done to find the association between a set of three selected socio-personal characteristics of non categorical nature and the extent of adoption. This was worked out by Chi square test and the calculated  $\chi^2$  values are depicted in Table 3. It was revealed from Table 3 that only education ( $\chi^2 = 35.504^*$ ) had

**Table 2. Correlation coefficient of profile of the respondents with extent of adoption**

Variables	'r'
Age	0.109
Family size	0.133
Occupation of the family	0.179
Farming experience	0.103
Farm labour availability	0.172
Total land holding	0.272**
Area under mandarin orchard	0.232*
Total annual income	0.217*
Extension contacts	0.402**
Training exposure	0.299**
Management orientation	0.361**
Risk bearing ability	0.439**

\*\* Significant at 0.05 level of probability;

\* Significant at 0.01 level of probability

**Table 3. Association of selected characteristics of the respondents with extent of adoption**

Variables	$\chi^2$
Family type	3.649
Occupation	5.617
Education	35.504*

\*Significant at 0.05 level of probability at n-2=118 d.f.

**Table 4. Multiple regression of selected independent variables with extent of adoption of recommended khasi mandarin cultivation practices**

Variables	B value	t value	R <sup>2</sup>	R <sup>2</sup> (adjusted)
Age	-0.027	-0.380		
Education	1.003	3.840		
Family size	0.294	1.627		
Farming experience	0.111	0.326		
Labour availability	0.271	0.360		
Total land holding	0.597	0.589		
Area under mandarin orchard	0.316	0.604		
Total Annual income	4.588	0.504	0.429	0.430
Annual income from orchard	4.206	0.396		
Extension contacts	0.354	2.305*		
Training exposure	0.617	1.738		
Management orientation	0.280	3.831*		
Risk bearing ability	0.279	2.527*		
Decision making ability	0.279	2.527*		

\*Significant at 0.05 level of probability

significant association with the extent of adoption on recommended mandarin cultivation practices.

*Multiple regressions of selected profile characteristics with extent of adoption* : The multiple regression with all the 13 predictors produced  $R^2 = 0.429$ , Adjusted  $R^2 = 0.430$ . The  $R^2$  value 0.429 clearly signifies that these independent variables taken together could explain 42.9 per cent of total variation in respondent's extent of adoption. The findings indicated that 57.10 per cent of variations in the dependent variable remained unexplained. Further analysis of "t" value of regression coefficient (b) indicated that extension contact, management orientation and risk bearing ability had significant contribution in adoption.

*Problems faced by Khasi mandarin growers* : A number of problems were being faced by mandarin growers in the adoption of khasi mandarin recommended cultivation practices which are clearly indicated in Table 5.

The foremost Personal problem was lack of feeling of self-improvement ranked I (70.00%) as very serious followed by lack of self-confidence obtained rank II (63.33%). Feeling of insecurity (60.00%) and poor self-esteem (35.83%) were ranked III and IV respectively. It might be due to the fact that they were ignorant of their own hidden potentialities in absence of any external motivating factors.

Labour unavailability along with high wage rate was ranked I (75.00%) amongst the Social problem category followed by lack of support from family members (74.17%), lack of glamour and enhancement towards Mandarin cultivation (65.83%) and lack of influence from peer groups (57.50%) ranked II, III and IV respectively as very serious problem. The problem of high cost of labour was also mentioned in the study of *Meena et al. (2017)*.

Amongst the Economic problems, inadequate loan from financial agencies (95.83%) was ranked I. Complicated loan sanctioned procedure was expressed as next very serious problem (94.17%, ranked II), delay in getting loan (90.83%), lack of own capital (85.83%) and high loan interest (81.67%) ranked as III, IV and V respectively. The finding is in conformity of the findings of *Rana et al. (2019)*. Probably the benefit of banking facilities could not percolate to all remote areas. Overall economic constraints was the major constraints as mentioned in the study of *Jaitawat, et al. (2007)*.

Under Technical problems, it was observed that less training exposure (85.83%) was a Very serious problem (rank I) followed by lack of suitable technology (81.67%), lack of adequate knowledge (69.17%) followed by poor linkage with relevant institutions (52.50%) and non-availability of extension advisory personnel in time (49.17%). It could be inferred that trainings were organized at inconvenient time or were not informed about it or may be dearth of need-based technologies prohibited the growers in exploring the facilities.

In regard to Managerial problem, their lack



**Table 5. Problems of Khasi Mandarin Growers in adoption of recommended practices of khasi mandarin (N=120)**

Problems	Very Serious No. (%)	Serious No. (%)	Not so serious No. (%)	WMS	Rank
<i>Personal Problem</i>					
Lack of self-improvement mindset	84 (70.00)	29 (24.17)	07 (5.83)	2.64	I
Lack of self confidence	76 (63.33)	30 (25.00)	14 (11.67)	2.51	II
Feeling of insecurity	72 (60.00)	33 (27.50)	15 (12.50)	2.47	III
Poor self esteem	43 (35.83)	40 (33.33)	37 (30.83)	2.05	IV
<i>Social problem</i>					
Labour unavailability and high wage rate	90 (75.00)	20 (16.67)	10 (8.33)	2.66	I
Lack of support from family members	89 (74.17)	21 (17.50)	10 (8.33)	2.65	II
Lack of glamour and enhancement	79 (65.83)	17 (14.17)	24 (20.00)	2.45	III
Lack of positive influence from peers	69 (57.50)	23 (19.17)	28 (23.33)	2.34	IV
<i>Economic problem</i>					
Inadequate loan from financial agencies	115 (95.83)	5 (4.17)	00 (0.00)	2.95	I
Complicated loan sanctioning procedure	113 (94.17)	7 (5.83)	00 (0.00)	2.94	II
Delay in getting loan	109 (90.83)	5 (4.17)	05 (4.17)	2.85	III
Lack of own capital	103 (85.83)	8 (6.67)	09 (7.50)	2.78	IV
High rate of interest on loan	98 (81.67)	16 (13.33)	06 (5.00)	2.77	V
<i>Technical problem</i>					
Less exposure to training	103 (85.83)	6 (5.00)	11 (9.17)	2.77	I
Lack of appropriate technology	98 (81.67)	13 (10.83)	09 (7.50)	2.74	II
Lack of adequate knowledge on mandarin growing practices	83 (69.17)	21 (17.50)	16 (13.33)	2.55	III
Less linkages with relevant institutions	63 (52.50)	31 (25.83)	26 (21.67)	2.30	IV
Non availability of extension personnel	59 (49.17)	24 (20.00)	37 (30.83)	2.18	V
<i>Managerial problem</i>					
Lack of knowledge on handling of plant protection equipment	106 (88.33)	8 (6.67)	6 (5.00)	2.83	I
Lack of scientific knowledge on orchard management	98 (81.67)	13 (10.83)	9 (7.50)	2.74	II
Lack of knowledge on post-harvestmanagement	77 (64.17)	23 (19.17)	20 (16.67)	2.47	III
<i>Input availability problem</i>					
Untimely supply of inputs	110 (91.67)	7 (5.83)	3 (2.50)	2.89	I
High cost of inputs	97 (80.83)	13 (10.83)	10 (8.33)	2.72	II
Non availability of inputs locally	92 (76.67)	9 (7.50)	19 (15.83)	2.60	III
<i>Marketing problem</i>					
Absence of processing units	120 (100.0)	0 (0.00)	0 (0.00)	3.00	I
Fluctuation in market price	118 (98.33)	2 (1.67)	0 (0.00)	2.98	II
Lack of storage facilities	113 (94.17)	7 (5.83)	0 (0.00)	2.94	III
Poor marketing infrastructure	111 (92.50)	8 (6.67)	1 (0.83)	2.91	IV
Poor road connectivity	98 (81.67)	18 (15.00)	4 (3.33)	2.78	V
Existence of middlemen	89 (74.17)	22 (18.33)	9 (7.50)	2.66	VI
Poor knowledge on commercialization	85 (70.83)	18 (15.00)	17 (14.17)	2.56	VII
<i>Institutional problem</i>					
Lack of need-based training	110 (91.67)	8 (6.67)	2 (1.66)	2.9	I
Lack of coordination among growersand extension agencies	89 (74.17)	11 (9.17)	20 (16.66)	2.57	II

of scientific knowledge on overall management of orchards ranked I which was followed by lack of knowledge in handling of plant protection equipment and post-harvest management which were ranked as II and III respectively. The probable reasons might be that the growers did not possess requisite skills in management practices of orchards.

As expressed by the respondents, non-availability of inputs at right time was very serious problem (91.67%). High cost of inputs and non-availability of inputs locally were mentioned as very serious problems by 80.83 per cent and 76.76 per cent respondents respectively. Probably farmers had to buy inputs at market price controlled by input dealers without any government support or subsidies, mostly had to procure from distant places.

Under marketing problem category, all respondents identified problem of lack of processing unit as the "Very serious problem". Absence of processing units for value addition definitely posed problems for the farmers for getting remunerative price. This problem was identified as one of the major problems by Phuse *et al.*, (2008) also. Other market related problems were market price fluctuation (98.33%), followed by lack of proper storage facilities (94.17%), poor marketing infrastructure (92.50 %), poor road connectivity (81.67%), involvement of middlemen (74.17%) and poor knowledge on commercialization (70.83%).

Between the Institutional problems, lack of need-based training was reported as Very serious problem by 91.67 per cent of the farmers followed by lack of coordination between the growers and Extension agencies (74.17%). This might be due to the fact that extension personnel might have made inadequate visits in terms of number and quality for which the local growers did not accept them wholeheartedly.

As a whole, the first five very serious problems

based on the weighted mean scores were found to be Absence of processing unit (wms = 3.00), Fluctuations on market price (wms = 2.98), Inadequate loan from financial institutions (wms=2.95), Complicated loan sanctioning procedure (wms = 2.94) and Lack of storage facilities (wms = 2.94).

## CONCLUSION

North Eastern Region of India is gifted with fertile soil and favorable climatic condition for the growth of agriculture. The place is the Centre of origin of many citrus species, especially, Mandarin which is widely cultivated. In Arunachal Pradesh, *Khasi* Mandarin has enormous scope to be commercially cultivated and has an economic significance to promote the lives of local mandarin growers. But it is observed that adoption of recommended practices of *khasi* mandarin is in general low. A few profile characteristics were found to be correlated with adoption. Moreover, local Mandarin growers are facing many problems in its cultivation. As a result, the production is not up to the mark. Thus, proper identification and diagnosis of the problems is the need of the hour. The government and concerned departments should thoroughly understand the characteristics of the mandarin growers before advocating any recommended technology. The research should focus to develop technology which may be best suited to the socio-economic characteristics of the growers. Moreover, frequent visit and interaction and imparting training will act as an impetus for easy adoption. Government should offer helping hand to provide all kinds of support to the growers in the adoption. Thus, proper identification and diagnosis of the problems is also the need of the hour.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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