This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

An assessment of mandarin (*Citrus reticulata* Blanco.) orchard management practices in Dailekh, Nepal

Ansu Adhikari[1*] iD , Pankaj Raj Dhital[2], Sambat Ranabhat[1] and Shilpa Koirala[1]

[1]Agriculture and Forestry University, Rampur, Chitwan, NEPAL
[2]Department of Agricultural Extension and Rural Sociology, Agriculture and Forestry University, Rampur, Chitwan, NEPAL
*Corresponding author's E-mail: ansu2054@gmail.com

ABSTRACT

A study was carried out in Dailekh, Nepal with an objective to assess the mandarin orchard management practices and their level of adoption by mandarin growers of Dullu municipality. All together 60 respondents were selected for the household survey in major citrus-producing wards of Dullu by following the simple random sampling technique. Primary data were collected by administering the pretested questionnaire and; descriptive and inferential statistics were computed using Ms-Excel and SPSS. The result showed that the majority of the respondents were from Brahmin ethnicity (43.3%), middle-age group i.e. 35-49 years (53.3%), and male (70.0%). Furthermore, most of them belonged to medium size family of 5-8 members (60.0%) and were earning most of their income through agriculture (80.0%). The result of the study revealed the variation in the scale of adoption of different management practices. Most of the households had adopted pruning and applied farmyard manure (FYM) while the least of them had adopted mulching and applied chemical fertilizer. Chi-square test revealed that the factors such as age (p=0.042), education level (p=0.007), family size (p=0.029), and training exposure (p=0.001) were significantly associated with the level of adoption of these practices. Incidence of insect-pests and diseases (I=0.88), frequent occurrence of climatic hazards such as hailstorms (I=0.71), and limited irrigation facility (I=0.70) were the major problems of mandarin growing households. It is recommended that improving access to irrigation facilities, use of certified planting material, mulching application and use of appropriate dose of manure and fertilizer must be prioritized in the study area.

©2021 Agriculture and Environmental Science Academy

INTRODUCTION

Citrus is a major cultivated fruit in Nepal grown in 62 districts covering 29% (44424 ha) of total fruit growing area (NCFD, 2017). It is cultivated on terraces at hill in semi-commercial to commercial level. (PIU, Annual Progress Report, 2018). Mandarin (*Citrus reticulata*), Sweet Orange (*Citrus sinensis*) and Lime (*Citrus aurantifolia*) are the major cultivated citrus species in commercial scale in Nepal. Dailekh district, having an area of 1502 sq. km, is situated in Karnali province and lies within both hilly and Himalayan ecological region. The approximate rainfall of this area is 1700 mm with the temperature of 5°C to 34°C (DADO,

2016/17). In Dailekh, only 28.24% of the total cultivated land has facilities for irrigation. Here, mandarin is grown within the area of 1492 ha having productivity of 6.72 mt/ha (PIU, Annual Progress Report, 2018).

In Nepal, Mandarin is cultivated within an altitude range of 800masl to 1600masl (PIU, Mandarin Production Guide, 2018). Nepal has huge comparative advantage in the cultivation of mandarin, which has been found much more profitable compared to other field crops (MoF, 2019). Moreover, for the successful cultivation and sustainable production of mandarin, consideration of different factors are essential, however, orchard management is the most crucial among all. Management

operations carried out timely and in an appropriate manner helps to promote physiological functions of the plants with the final result of economic efficiency in terms of resource usage (Dorji *et al.*, 2016). Due to increasing demand of mandarin in local market, markets in Surkhet and Banke as well as in national and international markets, the production of mandarin oranges has stimulated the interest of many farmers. Despite the fact that lists of orchard management strategies that farmers should follow for optimum productivity have been proposed, they have not been adopted by mandarin growers. Likewise, inefficient practice of orchard management is the vital cause of citrus decline in Nepal (Panth and Dhakal, 2019). As the current status of orchard management practices adopted by mandarin growers will be known through this study, it will serve as a foundation for designing efficient programs that are essential for mandarin commercialization. In addition, the target group for information dissemination can be identified and technology transfer can be strengthened through the assessment of the relationship between socio demographic characteristics and level of adoption.

MATERIALS AND METHODS

Site selection and sampling technique
The research was carried out in Citrus zone, Dailekh specifically in Dullu Municipality. A preliminary study was carried out prior the main survey to collect various socio-economic, demographic and geophysical conditions of the study sites. Altogether 60 mandarin growing farmers were selected by using simple random sampling technique.

Research Instruments/design
Household survey was conducted in the major citrus producing wards of Dullu. Primary data was collected by administering the pretested questionnaire, focus group discussions (FGDs) and Key-Informant Interview.

Data and data types
The primary data was collected from the farmers of the respective site and secondary data was collected from publications of AKC, MoALD, DOA as well as other relevant international journals and articles.

Data analysis techniques
Both qualitative and quantitative data obtained from survey were analyzed by using SPSS (Statistical Package for Social Science) and Microsoft excel. To establish the distribution of the research variables, descriptive statistics such as frequency and percentage were computed. The Chi-square test was conducted to determine the significance of the difference between the variables under study.

Operational variables
The selected characteristics of the farmers which were taken as operational variables were age, gender, level of education, family size, primary income source, training received and altitude of the

orchard. Similarly, adoption of nine orchard management practices were taken into study; these were pruning, FYM application, chemical fertilizer application, micronutrients application, irrigation, mulching, adoption of pest control method, application of bordeaux, and intercropping of non-exhaustive intercrop.

RESULTS AND DISCUSSION

Socio-demographic characteristics
The socio-economic and demographic characteristics of respondents is presented in Figure 1. These characteristics include age, gender, ethnicity, level of education, primary income source, and family size. The respondents were divided into three categories based on their age. The majority of respondents (53.3 percent) were between the ages of 35 and 49 followed by 25% of respondents being under the age of 35. The remaining 21.7 percent of those surveyed were over the age of 50. Among the sampled population, the majority of the respondents (70%) were male. The predominant groups of the society were Brahmin and Chhetri. Most of the sampled households were Brahmin (43.3%) followed by Chhetri (41.7%), Dalit (13.3) and Janajati (1.7%). The majority of the respondents (36.7%) had a secondary level of education i.e. below SLC. The occupation structure illustrates the features of the local economy as well as various commercial and work possibilities available to the residents in the area. The study revealed that agriculture was the primary occupation in the study area (80.0%) which is higher than the national scenario 65.6% (CBS, 2016). Similarly, the distribution of the family size of respondents was categorized into 3 groups as small (less than 5), medium (5-8) and large family (more than 8). It was found that 60.0% of the respondents had medium family size.

The average age of the respondent was found to be 41.30 years. Similarly, the average family size of the respondent's family was 6.60 (Table 1). The findings indicated that majority of the respondents had medium size family which seem to be higher than the national average of 4.5 (CBS, 2016). However, the average economically active family member of the respondents was 3.15.

Orchard information

Number of mandarin trees: The study showed that 70.64% of total no. of trees in respondent's orchard were in fruiting stage where as 29.35% of the trees were non-fruiting. Minimum number of trees in respondent's orchard was 30 and maximum was 476 (Table 2).

Planting material: Farmers used seedling as the primary source of planting material. In 73% of orchards, seedlings were used which is less than national status. In Nepal, the share of seed propagation is 85-90 % in mandarin (FAO, 2011). Likewise, 17% orchards used both seedlings and vegetatively propagated saplings as a source of planting materials to establish the orchard however only 10% orchards used vegetatively propagated saplings alone (Figure 2).
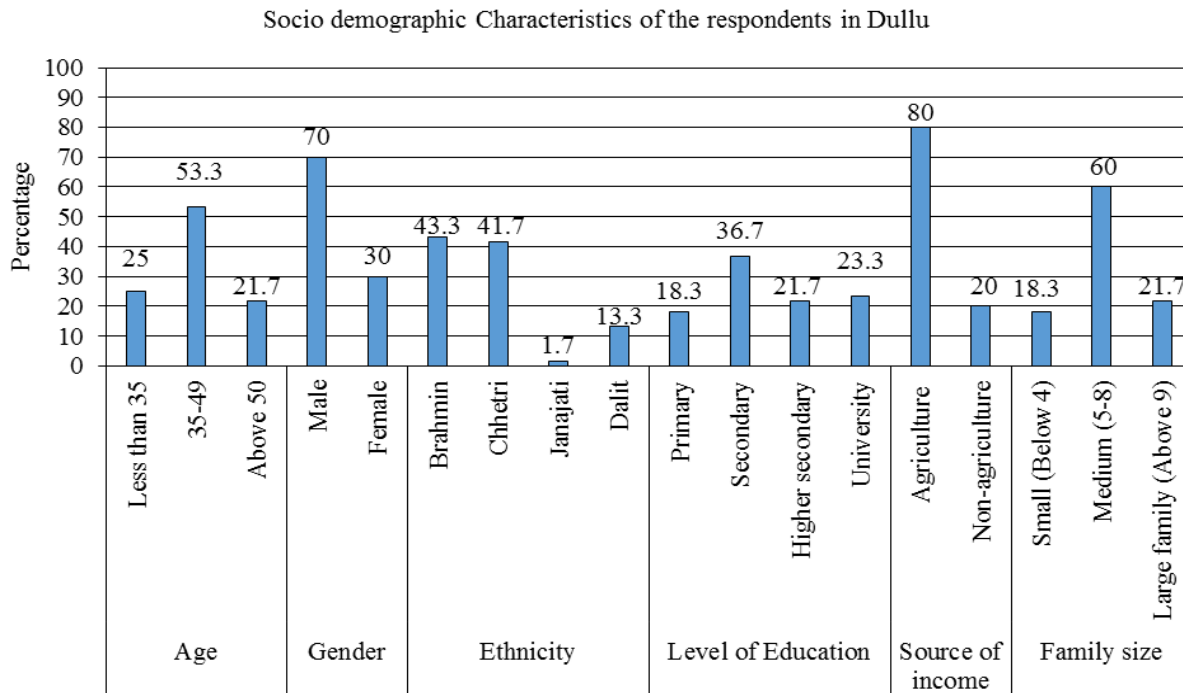
Figure 1. *Socio demographic characteristics of the respondents in the study area.*

Table 1. Socio demographic characteristics (continuous variables) of the respondents.

Variables	Mean	Standard deviation
Age	41.30	9.177
Family Size	6.60	2.271

Table 2. Sum, Mean, Minimum and Maximum number of Mandarin trees in respondent's orchard.

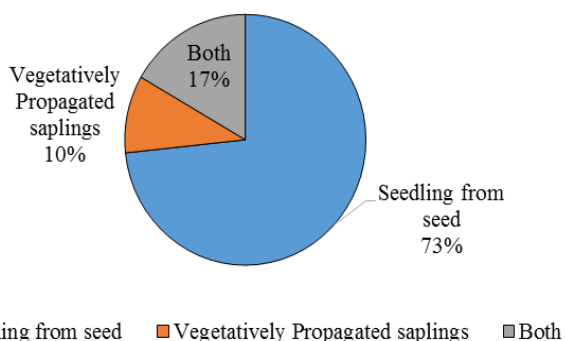|	Sum	Percentage (%)	Mean	Minimum	Maximum
Total Mandarin trees	8229	100	137.15	30	476
Fruiting trees	5813	70.64	96.88	15	350
Non-Fruiting trees	2416	29.36	40.27	0	220

Figure 2. *Planting material used by the respondents for propagation in the study area.*

Orchard management practices

The study revealed that most of the citrus growers in Dullu (71.1%) practiced intercropping in their orchard whereas 28.3% of the growers do not cultivate any other intercrop. It was found that vegetables was the most practiced intercrop (37.2%) among the respondents followed by legumes (25.6%). From the study, it was also revealed that most of the respondents (85%) practice pruning in their citrus orchard but only 1.7% of the respondents prefer training the tree. It was depicted that most of the respondents (96.1%) adapted pruning in the month of Poush and Magh. Moreover, all the respondents (100%) applied farmyard manure in their orchard however only 13.3% of them applied chemical fertilizer and 10% of them had applied micro-nutrients in their orchard. Most of the mandarin growers in Dullu are also involved in livestock production which makes easy availability of FYM thus aids manure application. Adding to this, majority of those surveyed (88.3%) applied manure and fertilizer during Poush and Magh. In contrast, more than half of the respondents (63.3) had some source of irrigation where as 36.7% practiced rain-fed irrigation only. The study reported that most of the respondents (95%) had the knowledge of Bordeaux paste and mixture but only 68.3% of them had applied it in their mandarin orchard. However, less than half of the respondents (45%) practiced mulching. From the field visit, it was found that the farmers who had more access to community forest were likely to be adapting mulching practices. Likewise, 26.7% of the total respondents adopted some sort of pest control method against pest and diseases and only about half of the total respondents (55.0%) had received extension services and trainings (Table 3).

Table 3. Status of orchard management practices and its adoption by mandarin growers in the study area.

Orchard management practices	Yes	No
Intercropping of non-exhaustive intercrop	43 (71.7)	17 (28.3)
Training of citrus tree	1 (1.7)	59 (98.3)
Pruning of citrus tree	51 (85.0)	9 (15.0)
Application of farmyard Manure	60 (100.0)	0 (0.0)
Application of chemical Fertilizer	8 (13.3)	53 (86.7)
Application of micronutrients	6 (10.0)	54 (90.0)
Irrigation	38 (63.3)	22 (36.7)
Mulching	27 (45.0)	33 (55.0)
Adoption of pest control method	16 (26.7)	44 (73.3)
Application of bordeaux paste and mixture	41 (68.3)	19 (31.7)
Extension Related Factor	**Yes**	**No**
Training received by citrus growers	33 (55.0)	27 (45.0)

Figure in parentheses indicates percentage.

Table 4. Distribution of respondents according to level of adoption of improved mandarin orchard management practices (N=60).

Adoption level	Frequency	Percentage	Mean
Low (<4.50)	28	46.7	
High (>4.50)	32	53.3	4.50 (1.732)
Total	60	100.0	

Figure in parenthesis indicate standard deviation.

Association of socio-economic and extension related factors with adoption level on improved mandarin orchard management practices

Chi-square test was conducted to measure the relationship between the operational variables i.e. socio-economic factors and extension related factors on the adoption of improved mandarin orchard management practices. The relationship was tested at 0.05 and 0.01 probability test. It included age, gender, education level, family size, primary income sources and training received. On the basis of value of adoption index, the respondents were grouped into two categories i.e., low adopters (less than average) and high adopters (more than average).

Adoption of improved orchard management practices of mandarin

It was indicated that majority of the respondents (53.3%) had higher level of adoption of improved orchard management practices and 46.7% of those surveyed had lower adoption level. Adopters were categorized as low adopter (below mean value i.e. <4.50) and high adopter (above mean value i.e. >4.50) (Table 4).

Association of socio-economic and extension related factors with adoption level of mandarin orchard management practices

Age: The study revealed that the farmers of age group less than 35 years were more likely to be high adopters compared to other ages. The result signifies that the association between the age of mandarin growers and improved orchard management practices used by them are statistically significant. Farmers belonging to low age groups were high adopters compared to other ages (Table 5). This might be because older farmers' mindsets and behavior patterns are essentially established, therefore middle-aged and especially young farmers should be targeted for skill training in mandarin production technology (Meena *et al.*, 2017).

Gender: The calculated value of chi-square (0.115) was statistically non-significant. The result depicted that there was no significant association between gender and the level of adoption of improved mandarin orchard management practices (Table 5). It might be because acceptance of the technology is not dependent on whether the farming is done by a man or a woman.

Level of education: This study showed that the farmers with a secondary and higher secondary levels of education were more likely to be higher adopters compared to others. The result implies that the association between education level and improved orchard management practices used by them are statistically significant (Table 5). This revealed that the higher the degree of education, the greater the extent of adoption. A similar result was also found by (Veeraiah *et al.*, 1997). He reported that education had positively associated with the level of knowledge of the respondents. It is expected that better decisions to adopt recommended production practices are made by educated respondents than non-educated ones.

Family size: It was found that that the farmers with large family size were more likely to be higher adopters compared to small and medium family size. The result depicts that the association between the family size of mandarin growers and improved orchard management practices adopted by them are statistically significant (Table 5). Similar finding was observed by (Wang, 1967). In his study of Korean communities, he concluded that family size is positively associated with the adoption of farming practices. It was because, the larger the family size, greater will be the availability of manpower for conducting management practices. Furthermore, this is also supported by (Asmelash, 2014). He stated; the bigger the size of the family in a household, the greater is the labor accessibility, therefore, there is a higher chance of adoption (Asmelash, 2014).

Table 5. Distribution of respondents based on socio-economic and extension related factor with level of adoption of improved mandarin orchard management practices (N=60).

Socio Economic factors	Level of adoption		Total	Chi-Square value	P-Value
	Low Adopter	High Adopter			
Age					
Less than 35	3(7.0)	12(8.0)	15(15.0)	6.364*	0.042
35-49	19(14.9)	13(17.1)	32(32.0)		
Above 50	6(6.1)	7(6.9)	13(13.0)		
Total	28(28.0)	32(32.0)	60(60.0)		
Gender					
Male	19(19.6)	23(22.4)	42(42.0)	0.115 ns	0.735
Female	9(8.4)	9(9.6)	18(18.0)		
Total	28(28.0)	32(32.0)	60(60.0)		
Education level					
Primary	9(5.1)	2(5.9)	11(11.0)	12.063**	0.007
Secondary	7(10.3)	15(11.7)	22(22.0)		
Higher Secondary	3(6.1)	10(6.9)	13(13.0)		
University	9(6.5)	5(7.5)	14(14.0)		
Total	28(28.0)	32(32.0)	60(60.0)		
Family size					
Small (Less than 5)	5(5.1)	6(5.9)	11(11.0)	7.087*	0.029
Medium (5-8)	21(16.8)	15(19.2)	36(36.0)		
Large (More than 8)	2(6.1)	11(6.9)	13(13.0)		
Total	28(28.0)	32(32.0)	60(60.0)		
Income source					
Agriculture	22(22.4)	26(25.6)	42848.0)	0.067 ns	0.796
Non-agriculture	6(5.6)	6(6.4)	12(12.0)		
Total	28(28.0)	32(32.0)	60(60.0)		
Participation in training					
Training received	9(15.4)	24(17.6)	33(33.0)	11.082**	0.001
Training not received	19(12.6)	8(14.4)	27(27.0)		
Total	28(28.0)	32(32.0)	60(60.0)		

Figures in parentheses indicates expected frequency. *indicates significant at 0.05 level of significance; *indicates significant at 0.01 level of significance; ns indicates non-significant at 0.05 level of significance.

Table 6. Ranking of major orchard management problems in the research area based on farmers' response.

Constraints	Index	Ranking
Lack of labour	0.28	V
Higher cost of inputs	0.43	IV
Lack of irrigation facilities	0.70	III
Incidence of insect-pest and diseases	0.88	I
Hailstorms	0.71	II

Primary income source: The calculated value of chi-square (0.067) was statistically non-significant. The findings revealed that there was no significant association between primary income source and the level of adoption of improved mandarin orchard management practices (Table 5).

Training received: This result signifies that the association between farmer's participation in training and improved orchard management practices used by them is statistically significant. The study showed that the farmers who were trained and have training opportunities were likely to be high adopters of improved mandarin orchard management practices (Table 5).

This finding was supported by (Mathur, 1996). He reported that training is an important part of the extension strategy followed in the entire agricultural development projects.

Problem ranking: Farmers were facing different types of problems during in their mandarin orchard. The study reported that the incidence of insect-pest and diseases (I=0.88) was a major problem in orchard management ranking first position followed by hailstorms (I= 0.71). Furthermore, lack of irrigation facilities (I= 0.70), higher cost of inputs (I=0.43), and lack of labor (I=0.28) were also the vital problems of orchard management with third, fourth, and fifth rank in the study area (Table 6).

Conclusion

Production of mandarin in the study area was affected due to various biotic, abiotic, and managerial factors. Poor adoption of management practices like exhaustive intercrop, rain-fed irrigation practices, an inappropriate dose of manure and fertilizer, the incidence of insect pest and diseases as well as lack of control method was the major cause affecting orchard management that resulted in production decline in past 3-4 years. Adding to this, the hailstorm was another major cause that affected the productivity in the study area. However, other management practices were satisfactory. Therefore, to improve productivity, these management practices must be taken into serious consideration. The depth study of insects and diseases is extremely important to get the actual benefit from mandarin cultivation. Adding to this, the irrigation facilities must be extended. While expanding the orchard or planting new trees, the use of an appropriate sources of planting material must be made mandatory. The price of mandarin is rising each year due to easy access of transportation to the large markets like Surkhet and Nepalgunj, which has a beneficial impact on mandarin production in Dailekh. Therefore, farmers should follow better management practices for the commercial production of mandarin in Dailekh.

ACKNOWLEDGEMENT

ABBREVIATIONS

AFU: Agriculture and Forestry University; AI: Adoption Index; AKC: Agriculture Knowledge Center; CBS: Central Bureau of Statistics; DADO: District Agriculture Development Office; DOA: Department of Agriculture; FAO: Food and Agriculture Organization; FYM: Farm Yard Manure; ha: hectare; masl: meter above sea level; MoAD: Ministry of Agriculture Development; MoALD: Ministry of Agriculture and Livestock development; NCFD: National Centre for Fruit Development; PIU: Project Implementation Unit; SPSS: Statistical Package for Social Science; %: Percentage.

Conflict of interest

There is no conflict of interest among the authors.

REFERENCES

Asmelash, Y. (2014). Determinants of adoption of upland rice varieties in Fogera District, South Gondar Ethiopia. *Journal of Agricultural Extension and Rural Developoment, 8*(12), 332-338.

CBS. (2016). Annual Household Survey 2014/2015. Singh Durbar, Kathmandu: Central Bureau of Statistics, National planning Secretariat, Government of Nepal.

DADO, D. (2016/17). Annual Agriculture Development Programme and Statistics. Dailekh: District Agriculture development office.

Dorji, K., Lakey, L., Chophel, S., Dorji, S. D., & Tamang, B. (2016). Adoption of improved citrus orchard management practices : a micro study from Drujegang growers, Dagana, Bhutan. *Agriculture and Food Security, 5*(1), 1-8.

FAO. (2011). Combating Citrus Decline Problem in Nepal. Food and Agriculture Organization of United Nations.

Mathur, P. (1996). Experimental learning cycle. New Delhi: Jain brothers.

Meena, R., Geanger, K., Meena, B., Bhatnagar, P., & Meena, P. (2017). Analysis of Adoption and Constraint Perceived by Mandarin Growers in Jhalawar District of Rajasthan State, India . *International Journal of Current Microbiology and Applied Sciences, 6*(4), 1465-1470.

MoF. (2019). Economic Survey 2018/19. Singh Durbar, Kathmandu: Government of Nepal.

NCFD. (2017). Horticulture Development Program Annual Progress and Statistic Report 2017. Kirtipur, Kathmandu: National Centre for Fruit Development, http://fdd.gov.np/page/24

Panth, B., & Dhakal, S. (2019). Determinants of Mandarin Productivity and Causes of Citrus Decline in Parbat District, Nepal. *Acta Scientific Agriculture, 3*(10), 14-19.

PIU, D. (2018). Annual Progress Report 2018. Dullu, Dailekh: Project Implementation Unit, Dailekh.

PIU, D. (2018). *Mandarin Production Guide.* Dailekh: Project Implemenation Unit, Dailekh.

Veeraiah, A., Daivadeenam, P., & Pandey, R. (1997). Knowledge and adoption level of farmers trained in Krishi Vigyan kindra about groundnut cultivation. *Indian Journal Extension Education, 13*(2), 1-2.

Wang, I. (1967). Relationship of Adoption of Recommended Farm Practices with Selected Variables in Three Korean Communities. The University of Wisconsin-Madison, South Korea.