FACTORS AFFECTING THE ADOPTION OF IMPROVED MANAGEMENT PRACTICES OF MANDARIN IN GORKHA, NEPAL

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ABSTRACT

Gorkha is one of the leading mandarin producing districts located on the Hilly ecological belt in the north south of Nepal. The general objective the research was to assess adoption level of improved orchard practices of mandarin recommended through PMAMP which has high scope to improvise farming practices and mandarin productivity. Household survey was conducted at the major citrus producing wards of Gorkha Municipality and Sahid Lakhan Rural Municipality of Gorkha. Primary data were collected by the use of pretested interview questionnaire from 120 respondents selected at random to represent farmers of mandarin zone area. Data were processed and analyzed by using descriptive and inferential statistics through Ms-excel and SPSS. Chi-square tested the significant difference between independent and dependent variables. The analysis showed that majority of the respondents were middle age group, male, literate, had medium family size and medium level of income. Majority of them were affiliated to the farmers' groups but lacked training. Majority of the respondents had medium level adoption of improved orchard management practices of mandarin. Among the socio-demographic parameters observed, significant relationship was found in case of age, education, membership in farmer's group/organization, training and extension contact. Lack of knowledge and irrigation facility, insect-pest and disease problem and climatic uncertainty are the major problems in mandarin production. The medium scale farmers should be intervened by planners and extension agents for improving farming practices and productivity of mandarin provided with input resources.

Keywords: mandarin, socio-dynamics, knowledge, market-oriented farmers, constraints

INTRODUCTION

Agriculture is still the mainstay of economy in Nepal. Agriculture alone contributes 35% of the Gross Domestic Product (GDP). About 65% of the population are engaged in this sector. Among other crops, fruits contribute about 7% of the total agriculture gross domestic product (MoAD, 2016). Among these, 53 countries grow citrus commercially with a total production of more than 115 million mt while Nepal produces only 0.22 million tons (National Citrus Development Program, 2015/16). Citrus fruit is indigenous to Nepal and is an important fruit tree in the home gardens of the mid-hills of the country contributing about 26.84 % of the total fruit production (Agribusiness Promotion and Marketing Development Directorate, 2014/15), but commercial cultivation of citrus in Nepal was initiated only after 1970 (NCRP, 2010). The Eastern and western mid-hills are the major citrus producing area of Nepal with altitude ranging from 1000-2000 m, mean annual temperature being 17-20^{0}C and annual rainfall ranging from 1000-2800 mm (Srivastava & Singh, 2002). Mandarin locally called "suntala" was produced in surplus amount for export to India (Budathoki & Pradhanang, 1992).Out of 60 districts is cultivated in commercial scale in 42 districts (Adhikari, 2016/17). Mandarin orange (*Citrus reticulata* Blanco) cultivation is one of the major economic activities in the mid-hills (550-1300 m) of the western development region (Lohar, 1995).

The area covered by citrus fruits in FY 2015/16 was 40554 ha. The productive area of citrus is estimated to be 24,854.3 ha and the fresh fruit production of citrus is 21,8447.2 Mt,

implying that the productivity is 8.79 Mt/ha. Citrus production area in Nepal is in increasing trend while productive are is in decreasing trend. Total area ranges to 40554 ha in 2015/16 while productive area is only 24854.3 ha only. In Nepal, mandarin contributes to around 67 % of total citrus fruit production followed by sweet orange with gross production of 16 % while area under production for mandarin is 65 % and for sweet orange is 13% (National Citrus Research Program, 2016). The total production of Citrus plant in the FY 2072/73 was 2313838 from 197 Nursery. The produced plant number is 33.2% higher than the number in demand showcasing the need of increase in quality and export (National Citrus Research Program, 2016). Major citrus fruit crops, specifically, mandarin, sweet orange, acid lime and lemon constitute enormous potential to generate income and employment in the mid-hills of Nepal highlighting the greater scope for export, and including nutrition to rural people in the marginal lands. Mandarin contributes about 0.97 % to the agriculture gross domestic product (MoAD, 2016).

Gorkha is one of the commercial citruses producing districts of mid-hills of Nepal but the production and productivity of Mandarin in Gorkha are decreasing every year despite the fact that the cultivated area has increased in recent years (DADO, 2016). The productivity of citrus in Gorkha is 12.45mt/ha with the production of 8632 Mt. Mandarin orange in Gorkha solely occupies an area of 988 hectare with the productive area of 829 hectare with production of 8521mt.ton and productivity of 12mt/ha (DADO Gorkha, 2016). Mandarin production area and productive area is increasing in Gorkha and current area is 988 ha and productive area is 878 ha. Production and productivity are in decreasing trend where production is 7220.4 mt and productivity is 8.9 mt/ha. Demand and price are increasing every year (DADO Gorkha, 2016). Although lists of orchard management practices that ought to be adopted by the farmers for optimum production have been recommended, they have not been adopted by farmers. However, there is wide scope of increasing productivity of citrus fruits crops in Nepal, which can be achieved by utilizing improved orchard management practices (NCRP, 2010). The status of adoption of orchard management practices will provide basis to develop efficient programs that are must for commercialization in mandarin. Identification of problems in the way of production practices and developing a solution seems to be pre-requisite for commercialization of mandarin (Panth & Dhakal, 2019). The study is done with the motive of helping farmers and entrepreneurs involved into this sub-sector. It will enable concerned stakeholders for appropriate resource allocations so that improved cultivation practices can be adopted by farmers overcoming the traditional one. The major objective of the research was to assess the adoption of improved orchard management practices and identify problems pertaining to mandarin production.

MATERIALS AND METHODS

The research was conducted in the Gorkha Municipality and Sahid Lakhan Rural municipality which were purposively selected as they are the command area of the PMAMP-PIU, Citrus zone, and represented as highest potential production in the Gorkha district. A list of mandarin growing farmers from both Gorkha Municipality and Sahid Lakhan Rural Municipality was prepared separately which was provided by Citrus zone, Gorkha. Pre-survey field visits were conducted to gather preliminary information regarding the demographic, socio-cultural, and topographical settings of the site which was used for preparing questionnaire and sampling design. Total 120 farmers were selected through random sampling methods; 40 respondents from Gorkha Municipality and 80 from Sahid

Lakhan Rural Municipality and were surveyed through household surveys. This information was used in preparing questionnaires and designing a sampling framework. To develop further idea of the study site, informal discussion and interview with key informant was carried with model farmers, teachers, villager elders, co-operative staff and other knowledgeable persons. One comprehensive Focus Group Discussion (FGD) with inclusive participation was conducted at the study area after completing the questionnaire survey with help of the checklist to verify the result obtained from field survey, to assess the level of adoption of selected practices on mandarin orchard management and to discuss about the strategies to increase the adoption of those practices in citrus zone area of Gorkha. Secondary data was obtained from DADO annual reports, newsletters, bulletins and relevant articles, libraries and information office, and reports of agricultural department and ministries. The local political leaders, working agencies, and local government were sources of secondary data. The collected primary data were coded, entered, cleansed, and put forward for analysis. SPSS and MS-EXCEL was used to get the analyzed result. Descriptive statistics such as frequency and percentage were calculated to determine distribution of the study variables. Chi-square was used to test the significance difference between variables under investigation.
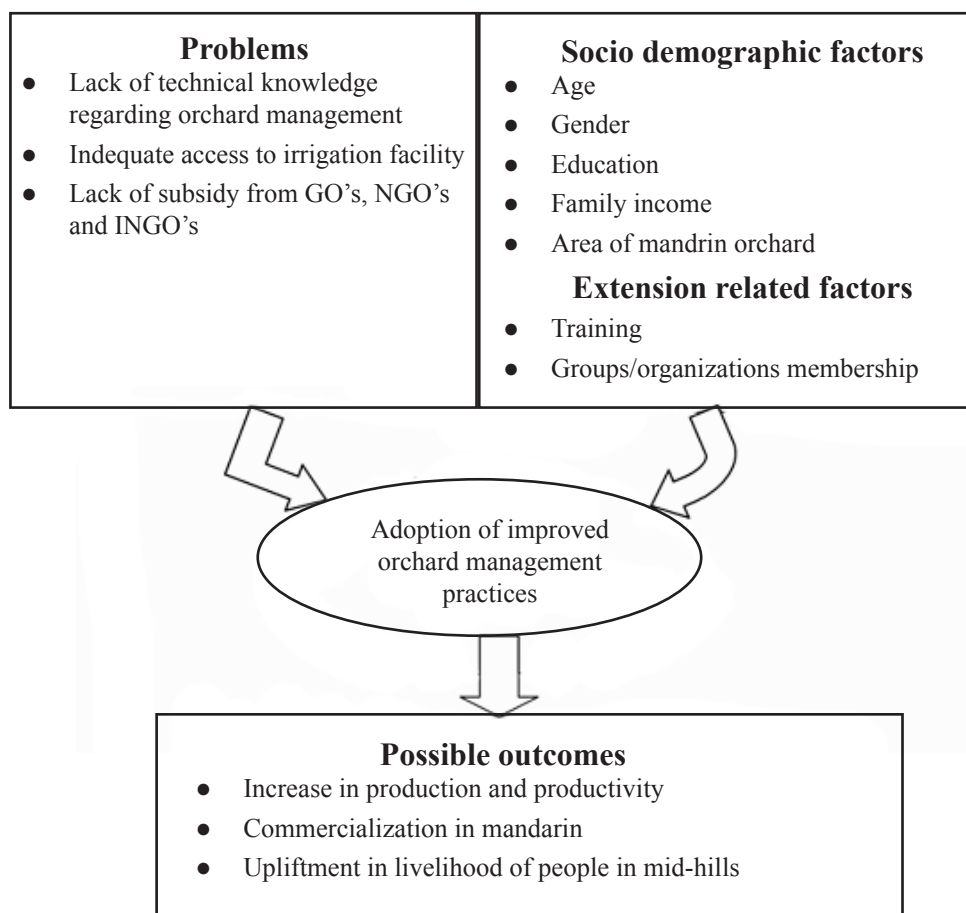
Problems
- Lack of technical knowledge regarding orchard management
- Indequate access to irrigation facility
- Lack of subsidy from GO's, NGO's and INGO's

Socio demographic factors
- Age
- Gender
- Education
- Family income
- Area of mandrin orchard

Extension related factors
- Training
- Groups/organizations membership

Adoption of improved orchard management practices

Possible outcomes
- Increase in production and productivity
- Commercialization in mandarin
- Upliftment in livelihood of people in mid-hills

FIGURE 8. CONCEPTUAL framework on adoption of Mandarin orchard management practices

Categorization of adopters

Farmers are categorized as low adopter, medium adopter and high adopter on the basis of practices they adopt. Arbitrary values are assigned for measurement; 0 for no adoption of practice and 1 for adoption of the practice. Adoption score was calculated by adding score they get for each practice. Then adoption index was computed. Farmers were categorized in three categories i.e. low adopter, medium adopter and high adopter using statistical tools like mean and standard deviation.

Table 1. List of different improved adoption practices selected for analysis

Variables	Description
Soil amendment	Soil amendment needed to be done in acidic soil having pH 4.5-5.0 by applying 100 g of lime/plant once in 3 years.
Training and pruning	Training and pruning should be done after harvesting of the fruits (Poush/Magh) before new flushing starts once a year.
Manures and fertilizer application	The recommended dose of manures and fertilizers in orchard should be 30 kg compost or FYM, 450 gm of urea,250 gm DAP, 350 gm potash per tree which are fruiting. Split dose of nitrogen is to be provided; first split in Magh/Falgun and second split in Jesth.
Irrigation	Irrigation at regular intervals for improved orchard management practices.
Bordeaux paste and mixture application	Bordeaux Paste and mixture application should be done after harvesting of the fruits (Poush/Magh) once a year. Bordeaux paste should be applied up to 1 m height and 1% concentration of bordeaux mixture should be sprayed to protect the trees from fungal diseases.
Micro nutrients application	The recommended dose of micronutrient in mandarin orchard should be 100 gm Zinc sulphate, 60 gm copper sulphate,40 gm of each magnesium sulphate, ferrous sulphate and manganese sulphate, 180 gm lime in 20 liters of water.
Weed management	Weed management either manually or chemically were selected for improved practices.
Insect control measures	Insect control measures i.e. cultural, chemical, IPM etc. measures according to the insect pest infestations. No precise insect control was found
Disease control measures	Disease control measures i.e. application of Bordeaux mixture, chemicals, etc. measures according to the disease problems. No precise disease control was found.
Mulching	Mulching should be done in the dry period when the moisture content in soil is low which is in the month of Poush-Jestha after harvesting and fertilization.

RESULTS AND DISCUSSION

It was found that majority of the respondents (70%) of study area were in the middle-aged group. The number of males dominated respondent population (75.8%). The study area totally dominated by Hindu religion (96.7%) and Janajati ethnic groups (60.8%). The average

family size was 6.38 which is greater than district as well as national average. Majority of the respondents of the study area were literate (82.5%). Majority of the respondents had NRs. 240,000 to 595,000 annual income. The average land holding size of the study area was 0.886 hectare while average area occupied by mandarin was 0.55 hectare. Similarly, Agriculture was found to be the main source of income/livelihood of farmers i.e., of 70 % in the study area. Majority of the respondents (72.5%) were affiliated to the farmers' groups and other organizations. Similarly, majority of the respondents had not received training related to mandarin production technology from different organizations. Also, majority of the respondents (39.2%) had never contact with extension workers. Only, 22.5 % farmers have followed soil amendment practices and all of them used lime for amendment. Majority of respondent (87.5 %) have performed training/pruning in the study site. Almost all the farmers were found using FYM in orchards but only 30.8% of farmers used recommended dose of manures and fertilizers. Minority (22.5%) of farmers used micronutrients in their orchard and majority among them stated its use was due to availability from government as subsidy. In the study area, only 6.7 % of farmers irrigate their orchard while other stated that irrigation of orchard is not feasible as they do not even have access to surplus drinking water. Only 43.3% of farmers used Bordeaux mixture and paste regularly on yearly basis. Weed control was done by all the farmers and among them 93.3% used manual method while 6.7% used manual and chemical method. The farmers adopting insect management measure were 55% of the respondents while those performing disease management measures were 43.3% and disease control method was application of Bordeaux mixture and paste. 58.3% of farmers perform mulching and among the farmers performing mulching dry leaves, weeds, plastics were used as mulching materials according to availability.

Adoption of improved orchard management practices of mandarin

Sociodemographic factors and extension related factors were assessed for analysing adoption of the improved management practices which are presented below.

Table 2. Distribution of respondents according to their age and adoption of improved orchard management practices (N=120)

	Age of respondents			Total
	less than 37	37-63	above 63	
Low Adopter	3(6.2)	31(25.9)	3(4.9)	37(37.0)
Medium Adopter	11(9.8)	35(41.3)	13(7.9)	59(59.0)
High adopter	6(4.0)	18(16.8)	0(3.2)	24(24.0)
Total	20(20.0)	84(84.0)	16(16.0)	120(120.0)

Figures in parentheses indicates expected frequency
Chi-Square (χ^2 Cal) = 15.127 (χ^2 tab) = 9.49 P value 0.004; df=4 Significant at 0.05 level of significance*

This result signified that the association between age of farmer and improved orchard management practices used by them was statistically significant. Farmers belonging to low age groups were high adopters compared to other ages. This might be due to the fact that old age farmers have almost fixed mindset behavior patterns, so middle aged, and especially young farmers must be targeted for imparting skill trainings in mandarin production technologies (Meena, Geanger, Meena, Bhatnagar, & Meena, 2017).

Table 3. Distribution of respondents according to their gender and adoption of improved orchard management practices (N=120)

	Distribution of respondents		Total
	Male	Female	
Low adopter	24(28.1)	13(8.9)	37(37.0)
Medium adopter	46(44.7)	13(14.3)	59(59.0)
High adopter	21(18.2)	3(5.8)	24(24.0)
Total	91(91.0)	29(29.0)	120(120.0)

Chi-Square (χ^2 Cal) = 4.358 (χ^2 tab) =5.99   P value 0.113   df = 2 Non-Significant at 0.05 level of significance.

This shows that there was no association between gender of farmers and adoption of improved orchard management practices. It posits that adoption of the technology did not depend on whether the farming is carried out by a male or a female. This might be because of the equal participation of all gender in trainings and equal access of resources and opportunities.

Table 4. Distribution of respondents according to their level of education and adoption of improved orchard management practices (N=120)

Level of adoption	Education status				Total
	Illiterate	Literate	Below SLC	SLC and above	
Low Adopter	11(6.5)	8(9.2)	9(10.8)	9(10.5)	37(37.0)
Medium Adopter	10(10.3)	17(14.8)	19(17.2)	13(16.7)	59(59.0)
High-adopter	0(4.2)	5(6.0)	7(7.0)	12(6.8)	24(24.0)
Total	21(21.0)	30(30.0)	35(35.0)	34(34.0)	120(120.0)

Figures in parentheses indicates expected frequency
*Chi-Square (χ^2 Cal) = 16.543** (χ^2 tab) = 12.592   P value 0.011; df = 6   Significant at 0.05 level of significance*

This result signified that there was significant association between education level of farmer and level of adoption. These findings were in conformity with the finding of (Choudhary, Bangarva, & Singh, 2011) and (Yadav, Choudhary, & Saran, 2013). This might be due to the fact that educated people have access and ability to connect to new articles, internet and resources that aid them to have knowledge about mandarin orchard management practices and encourage them in adoption. It was expected that educated respondents can make better decision to adopt recommended production practices than non-educated ones. With high level of education, most farmers in the study area are likely to adopt recommended mandarin production practices.

Table 5. Distribution of respondents according to their total annual income and adoption of improved orchard management practices(N=120)

Level of adoption	Distribution of respondents			Total
	Low Income	Medium Income	High Income	
Low adopter	5(3.7)	28(26.5)	4(6.8)	37(37.0)
Medium adopter	7(5.9)	41(42.3)	11(10.8)	59(59.0)
High adopter	0(2.4)	17(17.2)	7(4.4)	24(24.0)
Total	12(12.0)	86(86.0)	22(22.0)	120(120.0)

Chi-Square (χ^2 Cal) = 8.172 (χ^2 tab) = 9.49   P value 0.085   df = 4 Not significant at 0.05 level of significance

This shows that there was no association between annual income of farmers and level of adoption. In the case of high-income family, as the farming cannot be used as a primary source of income so the farmers earning money from other eternal sources who did not want to invest on the mandarin orchard. This might be the reason why income did not have any effect on the level of adoption.

Table 6. Distribution of respondents according to area covered by mandarin and adoption of improved orchard management practices (N=120)

Level of adoption	Distribution of respondents			Total
	Small	Medium	Large	
Low adopter	4(2.8)	30(29.6)	3(4.6)	37(37.0)
Medium adopter	4(4.4)	48(47.2)	7(7.4)	59(59.0)
High adopter	1(1.8)	18(19.2)	5(3.0)	24(24.0)
Total	9(9.0)	96(96.0)	15(15.0)	120(120.0)

Chi-Square (χ^2 Cal) = 2.818 (χ^2 tab) =9.49 P value 0.589 df = 4 Non-significant at 0.05 level of significance.

The result implied that there was no significant association or relationship between the area of mandarin orchard and level of adoption. Findings of this result was similar to the findings of (Ashraf, Khan, Ali, & Iftikhar, 2015) which state and contradicts to the findings of (Anarvat, 2015) showing positive and significant association between mandarin acreage and level of adoption.

Table 7. Distribution of respondents according to their farmer group membership and improved orchard management practices (N=120)

Level of adoption	Distribution of respondents		Total
	Membership	Non-Membership	
Low adopter	21(26.8)	16(10.2)	37(37)
Medium adopter	45(42.8)	14(16.2)	59(59)
High adopter	21(17.4)	3(6.6)	24(24)
Total	87(87.0)	33(33.0)	120(120.0)

Figures in parentheses indicates expected frequency
*Chi-Square (χ^2 Cal) = 7.729** (χ^2 tab) =5.99 P value 0.021 df = 2 Significant at 0.05 level of Significance*

This result signifies that the association between respondent involved in farmer's group and mandarin orchard management practices used by them are statistically significant. This means that mandarin growers having membership in farmer's group possessed higher level of adoption. This might be because of the involvement of members in different events and communication media where they get idea and help from other technical personnels. The findings of study were in contradicts with the finding of (Yadav, Choudhary, & Saran, 2013) and (Choudhary, Bangarva, & Singh, 2011) which showed a non significant association with these two variables.

Table 8. Distribution of respondents according to their participation in trainings and adoption of improved orchard management practices (N=120)

Level of adoption	Distribution of respondents		Total
	Training received	Training not received	
Low adopter	10(15.7)	27(21.3)	37(37.0)
Medium adopter	23(25.1)	36(33.9)	59(59.00
High adopter	18(10.2)	6(13.8)	24(24.0)
Total	51(51.0)	69(69.0)	120(120.0)

Figures in parentheses indicates expected frequency
Chi-Square (χ^2 Cal) = 14.297** (χ^2 tab) =5.99   P value 0.001 df = 2 Significant at 0.05 level of significance

This result signified that the association between farmer's participation in training and improved orchard management practices used by them is statistically significant. This means that mandarin growers having training opportunities possessed higher level of adoption This finding was supported by (Mathur, 1996). He reported that training as an important part of the extension strategy followed in the entire agricultural development projects. Be it the training of the farmers of that of extension professionals that training is imperative for better performance.

Table 9. Distribution of respondents according to the level of extension contact and adoption of improved orchard management (N=120)

Level of adoption	Distribution of respondents			Total
	Frequent	Occasional	No	
Low adopter	6(11.4)	8(11.1)	23(14.5)	37(37.0)
Medium adopter	17(18.2)	22(17.7)	20(23.1)	59(59.0)
High adopter	14(7.4)	6(7.2)	4(9.4)	24(24.0)
Total	37(37)	36(36)	47(47)	120(120.0)

Chi-Square (χ^2 Cal) = 19.155** (χ^2 tab) =9.49   P value 0.001   df = 4 Significant at 0.05 level of significance

This result signified that the association between extension contact and mandarin orchard management practices used by them is statistically significant. This means that mandarin growers having higher extension contact possessed higher level of adoption. These findings are supported by the finding of (Kumar, Shehrawat, & Khan, 2017). This might be likely due to the dissemination of knowledge from the expertise to the local farmers and positive influence and attitude.

Major problems faced by farmer on mandarin cultivation
There are many problems pertaining to mandarin production. This study attempted to find some of them as perceived by the farmers. The following were the major problems associated with the mandarin production. Although, knowledge on management practices was found as minor problem provided with latest trainings but technical knowledge intervention in mandarin field was poor.

Table 10. Constraints pertaining to mandarin production by the farmers

S. N	Constraints	Index	Rank
1	High price of inputs	0.618	VI
2	Lack of good quality saplings	0.525	VII
3	Insufficient irrigation	0.946	I
4	Insect infestation	0.809	II
5	Disease problems	0.787	III
6	Climatic factors	0.743	IV
7	Labor shortage	0.468	VIII
8	Poor knowledge of management practices	0.641	V

Constraints perceived by the farmers are due to lack of regular water supply, lack of technical knowledge, disease infestation, labor intensive affairs, high cost of insecticide and pesticides and costly plant material (Yadav, Choudhary, & Saran, 2013) which lines up with the data obtained in this research. In other study, (Poonia, 2002) also found the same result in her study pointed above.

CONCLUSION

Mandarin farmers in Gorkha are mainly medium level adopters for improved management practices of mandarin. The adoption of improved management practices of mandarin was significantly associated with socio-demographic factors age, education, membership in farmer's group/organization, training and extension contact although trainings were limited. Lack of knowledge and irrigation facility, insect-pest and disease problem and climatic uncertainty are the major problems in mandarin production. The productivity would improve provided with regular extension services provided regarding improved practices and upgrade it with inputs and adequate irrigation facilities. It is recommended that farmers should follow yearly crop management calendar and perform recommended production practices in order to optimize the production of mandarin. Policy should be made flexible for assurance of quality planting materials, fertilizers, irrigation facility, and effective program implementation. The commercialization would be efficient and beneficial accessing different socio-factors and addressing the knowledge on different improved mandarin management practices. The medium scale farmers have high potential for improvement in farming practices, and policy makers, development workers, and extension agents should utilize them efficiently and effectively for improving farming living standards through agricultural development.

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