Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 7 ~ Issue 5 (2020) pp: 45-52
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Adoption of Tropical Fruits in the Central Rift Valley of Ethiopia at Glimpse

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ABSTRACT: *The study was conducted in four districts Adama, Ada`a, Boset and Dodota in East Shewa zone Oromia Regional state in Ethiopia. The districts were purposely selected for the study, due to their availability of irrigation water. Eleven kebeles were selected from these districts purposely based on fruit production potential. One hundred and ten fruit producers were interviewed. The respondents came from three categories rural (63.6%), semi urban (32.7%) and urban (3.6%). Female headed households constitute 12.6% of the respondents. The HHs had experience of fruit farming their holdings for a minimum of one years and maximum of 24 years with average of 8.5 (SD = 4.3) years. The minimum fruit farm land size is 20m^2 and the maximum is 7500m^{2}with mean farm size allocated for fruit was 1339.7m^2 and standard deviation is 1325.5m^2. Regarding the place where the respondents fruit crop grown most of them grown their fruit at homestead/garden (55.5%), some are grown at open field (40.9%) and the remaining 3.6% of them grown at both at homestead and open field.Most fruit growers use river as a major source of water with supplementary ponds. The study concludes that there is sufficient demand (good market) for fruit. The Major source of improved fruit seedling is from research institution. Fruit production is profitable and can develop to high income generating business for farmers. Farmers are using farmers for both home consumption and income earning. So fruit production can improve household food security. Training and follow up indicates good result to enhance technical skill problem. Producers who attended training and got supervision could increase the survival rate of their fruit seedlings and increase their production. Shortage of water, shortage of improved seedling, lack of extension services (follow up and training), disease and insects were indicated the major in tropical fruit production. Disease and insects are decreasing the production of fruits especially citrus. The study recommends that establishment and development of fruit nursery around the sites will solve the problem of lack of improved seedling. There is high need of extension works to tackle the technical skill problem and training farmers. For disease and insect problems the responsible experts (crop protection experts) should see the sites and dig for the solutions.*

***R**eceived 28 November, 2020; **A**ccepted 14 December, 2020 © The author(s) 2020.*
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I. INTRODUCTION

Tropical and subtropical fruits viz, mango (*Mangifera indica*), avocado (*Persea americana*30 Miller) and citrus (Citrus spp.) fruits have a significant direct contribution to the nutrition and livelihoods of subsistence farmers and pre-urban dwellers (Clarke et al., 2011). They have versatile products. Depending on need, can be consumed within the household or sold. Marketing fresh or processed fruit products generate income which serves as an economic buffer and seasonal safety-net for poor farm households. Fruit production and their product diversification can generate employment for youth and women in processing and marketing to complement the existing income-generating activities (Clarke et al., 2011; MoFED 2015).

Tropical and subtropical fruits do play a significant role in Ethiopia by improving income, enhancing food and nutritional security, provide inputs for agro-processing industries, and increase export revenue. Environmentally, fruits substantially contribute to maintaining ecological balance. They provide employment opportunities particularly for dwellers of peri-urban, urban and rural poor (Bezabih and Hadera, 2007).Further, it provides employment opportunities since tropical fruits are suitable for inter-cropping which is both labor intensive and land intensive. Production of these commodities is encouraged in labor abundant and capital scarce countries like ours*(Girma A.*, 2013).

As a result, intensive crop production can be a means of promoting agro-enterprise development in order to increase land productivity. Horticultural production provides an opportunity for intensive production

and increases smallholder farmers' participation in agricultural market. At policy level, the Ethiopian Rural Development Strategy paper emphases to market-ledagricultural development. Government support is growing for fruit market integration and agro-enterprise development which provides an opportunity for the horticulture growers and market actors.

Fruits are generally high in fiber, water and vitamin C. They contain various phytochemicals that are required for proper long-term cellular health and disease prevention. Regular consumption of fruit is associated with reduced risks of cancer, cardiovascular disease, stroke, Alzheimer disease, cataracts, and some of the functional declines associated with aging(Amal M., 2010).

As tropical fruits are a part of horticultural crop, production of tropical fruits and tropical fruit seedlings contribute great role on the livelihood of farmers*(Bezabih and Hadera, 2007)*. Thus, availability of favorable weather, water supply, suitable soil, abundant labor, growing demand for tropical fruits expansion of infrastructure for markets and expansion telephone network encourage development of fruit production in the Central Rift Valley of Ethiopia. On the other hand, the availability of research centers such as Melkassa Agricultural Research Center and Debre Zeyit Agricultural Research Center in the area provide opportunity that encourage expansion of fruit production. In the past decades improved tropical fruit seedlings were distributed by Melkassa Agricultural Research Center and agriculture office. However, there is a scanty of information on survival, benefit and challenges of tropical fruit production. The study was conducted to assess the survivable rate, production and opportunities and challenges of tropical fruit in the CRV of Ethiopia.

Description of the study area

The study was conducted in four districts Adama, Ada`a, Boset and Dodota in East Shewa zone Oromia Regional state in Ethiopia. The districts were purposely selected for the study, due to their proximity to research centers (Melkassa and Debrezeit), suitability of soil and availability of irrigation water. Eleven kebeles were selected from these districtspurposely based on fruit production potential.One hundred and ten fruit producers were interviewed. The respondents came from three categories rural (63.6%), semi urban (32.7%) and urban (3.6%). Female headed households constitute 12.6% of the respondents.

Data collection and analysis

Structured and open-ended questionnaires were used for data collection. The questioners were pretested before administering to the respondents. The data were collected by trained enumerators. The questionnaire consisted of thorough information about the households including administrative and socio-geographic location, land holding size, socio-demographics, type of fruit grown,labor and land tenure system, sources of planting materials, water sources, labor availability, training participation on tropical and subtropical fruits, fruit crop production expectations on prospects and challenges, and cost and benefits of the nursery production. The survey was conducted in dry season of 2014 by trained and experienced enumerators. Statistical Package for Social Science (SPSS), ver 20.0 was used for analysis. Descriptive analysis tools namely: frequencies, percentage, mean and standard deviation) to analyze the data.

II. RESULTS AND DISCUSSION

The HHs were on average 50 (SD = 13) years old with the youngest and oldest HH being 23 and 80 years old. Female household heads were on average 43 (SD = 8) years old with the youngest and oldest household head being 30 and 55 years old whereas male household heads were on average 50 years old with standard deviation of 13 years. The family size of households ranged from two to 27 persons with average number of 7.6 (SD = 3.8) members per HH. The family size of male headed households ranged from three to 27 persons with average number of 7.8 (SD = 4) per household whereas female headed households ranged from two to 10 persons with average number of 6 (SD=2) per household. The main occupation of all respondents was agriculture/farming/. The HHs had experience of fruit farming their holdings for a minimum of one years and maximum of 24 years with average of 8.5 (SD = 4.3) years.

The minimum farm land size of the respondent is 0.25ha and the maximum is 20ha. The mean of the farm land size of the respondent is 2.6 and the standard deviation is 2.6. When we see the fruit farm land size, the minimum fruit farm land size is $20m^2$ and the maximum is $7500m^2$. The mean farm size allocated for fruit was $1339.7m^2$with standard deviation is $1325.5m^2$.The maximum distance of the fruit production site from the main road is 29 km whereas the minimum is 0.1 km and the mean and standard deviation is 7.9 and 7.5 respectively. Regarding the place where the respondents fruit crop grown most of them grown their fruit at homestead/garden (55.5%), some are grown at open field (40.9%) and the remaining 3.6% of them grown at both at homestead and open field.

Major sources of water

The major sources of water for fruit production was rainwater and otherirrigation water sourceslike rivers and ponds. Sixty seven percent of respondents get water forirrigation sources was not from rain. The other 32.7%use rain as a major source of water. Theirrigation water sources are rivers, ponds, wells, lakes and dams(Table 1). All respondents who use rain as a main source of water also have other supplementary water sources with rain water. Among 36 respondents who use rain as a main source of water 58.3% of them use pond as supplementary water source and the others use well, run-off, Dam and tap water (Table 1).

Table 1sources of irrigation water

Major irrigation water sources other than rain		
	Frequency	Percent
River	45	40.9
Pond	19	17.3
Well	6	5.5
Dam	3	2.7
Lake	1	.9
Total	74	67.3
Supplementary irrigation water sources to rain N=36		
Pond	21	58.3
Well	6	16.7
Run-off	4	11.1
Dam	3	8.3
River	1	2.8
Tape Water	1	2.8
Total	36	100.0

Fruit distribution

Mango, avocado, lemon, orange papaya and banana fruits were planted by growers. Most of farmers grow grafted seedling of mango, avocado, lemon and orange. Sixty seven percent of these crop's seedlings weregrafted.Among these fruit crops mango was planted bymore number of farmers and higher amount of seedling followed by avocado.Whereas 49 respondents planted 321 grafted and 22 respondents planted 157 non-grafted avocados. 47 respondents planted 215 grafted and 18 respondents planted 46 non-grafted lemon whereas 45respondents planted 222grafted and 12 respondents planted 47 non-grafted orange. 78 respondents planted 5442 papaya and 64 respondents were planted 2185 banana from 1990-2013 (Table 2).

Table 2 Number of seedlings planted

No. of seedlings planted	**District**									
	Ada'a		Adama		Boset		Dodota		Total	
	N	No.of fruit	N	No.of fruit	N	No.of fruit	N	No.of fruit	N	No.of fruit
Grafted mango	10	86	14	90	12	144	26	172	62	492
Non-grafted mango	6	24	6	23	14	241	9	81	35	369
Grafted avocado	15	136	12	55	9	61	13	69	49	321
Non-grafted avocado	6	33	5	11	5	66	6	47	22	157
Grafted lemon	15	83	15	54	9	42	8	36	47	215
Non-grafted lemon	3	9	7	14	4	14	4	9	18	46
Grafted orange	15	90	13	23	13	87	6	22	45	222
Non-grafted orange	4	25	1	1	3	9	4	12	12	47
Papaya	11	179	23	303	18	3019	26	1941	78	5442
Banana	14	145	11	270	19	1561	20	209	64	2185

N = number of growers

Base on the available fruit trees at time of the study, the survival rate of all fruits was found higher in Adama district except lemon. Lemon fruit survival rate was good in Dodota district. Next to Adama, Ada'a district is better survival rate of fruit except orange. Orange has better survival rate in Boset district next to Adama. On the other hand, the survival rate of non-garafted seedlings was found better than the grafted seedling (Table 3). The survival rate of grafted mango was lower than other grafted seedling of fruits. Seifu (2003) documented mango seedlings died in the nursery or in the field at Merti Jeju farm and the causes of failure

expected to be method of grafting, irrigation water and pot size. The same author observed that a similar work failed at Melkassa Agricultural Research Center.

Table 3 Survival rate of fruit seedlings

	Survival rate(%)				
	Ada'a	Adama	Boset	Dodota	**Total**
Grafted mango	30.2	42	56.3	35.5	41.87
Non-grafted mango	95.8	83	78.8	43.2	72.36
Grafted avocado	75	69	36.1	75.4	66.67
Non-grafted avocado	90.9	100	80.3	48.9	74.52
Grafted lemon	69.9	80	61.9	75.0	71.63
Non-grafted lemon	77.8	71	64.3	100.0	76.09
Grafted orange	63.3	78	69	68.2	67.57
Non-grafted orange	88	100	33.3	91.7	78.72

Sources of mango seedlings

Planting materials are fundamental inputs in tropical fruit production. Their absence or presence determine the decision of growers. The major source of grafted mango seedling is Melkassa Agricultural Research Center (MARC) which provided for 77.4% of grafted mango. In addition,Agriculture development office, NGOs and local markets are the other sources of grafted mango seedlings. The major source of non-grafted mango seedling is local market which provides 35.3% of respondents who grow non- grafted mango. Next to local market Agricultural development officeand NGOsprovide non- grafted mango. In addition to these NGOs and local markets, respondents themselves are the other sources of non-grafted mango seedlings from own orchard(Table 4).

Table 4 Sources of mango seedlings for tropical fruit growers in CRV of Ethiopia

Sources of mango seedlings	**Grafted mango(N=62)**		**Non-grafted mango(N=34)**	
	Frequency	Percent	Frequency	Percent
MARC	48	77.4		
Agri. development office	6	9.7	10	29.4
local market	3	4.8	12	35.3
MARC and Agri. development office	3	4.8		
NGO	1	1.6	9	26.5
MARC and NGOs	1	1.6		
Own			3	8.8
Total	62	100.0	34	100

Sources of avocado seedling

The major source of grafted avocado seedlings is Melkassa Agricultural Research Center (MARC) which supply seedling for 85.7% of respondents. Local market and agriculturedevelopment office provide grafted avocado. The major source of non-grafted avocado seedling is Agriculturedevelopment officeand local market. From the total 20 respondents who planted non- grafted avocado NGOs provided to 25% of them.In addition to Agriculturedevelopment office, local market and NGOs, own production is the other source of non-grafted avocado seedling(Table 5).

Table 5 Source of avocado seedlings for tropical fruit growers in CRV of Ethiopia

Source of avocado seedlings	**Grafted avocado(N=49)**		**Non-grafted avocado(N=20)**	
	Frequency	Percent	Frequency	Percent
MARC	42	85.7		
Agri. development office	1	2.0	7	35
Local market	2	4.1	6	30
NGO	1	2.0	5	25
Own	1	2.0	2	10
MARC and Agri. development office	2	4.1		
Total	49	100.0	20	100

Sources of lemon seedling

From the total 110 respondents 47 respondents were planted grafted lemon. From these respondents MARC is source of grafted lemon seedling for 80.9% of them. Inaddition to MARC, agriculture officeand NGOswere the other important sources of grafted lemon seedling. From the total 110 respondents 18 respondents were planted non-grafted lemon. From these respondents, local market is source of non-grafted lemon seedling to 55.6% of them. Agriculture officeand NGOsare the other sources of non- grafted lemon seedling(Table 6). Local market is important sources of non-grafted seedling. Value addition of those suppliers market is usually competing and natural means for good provision which had to be encouraged for efficiency and effectiveness.

Table 6 Sources of lemon seedlingfor tropical fruit growers in CRV of Ethiopia

Sources of lemon seedling	Grafted orange(N=47)		Non-grafted lemon(N=18)	
	Frequency	Percent	Frequency	Percent
MARC	38	80.9		
NGO	5	10.6	4	22.2
Agriculture development office	3	6.4	4	22.2
local market	1	2.1	10	55.6
Total	47	100.0	18	100

Sources of orange seedling

Among 45 respondents who plant grafted orange 80% of them got the seedling from MARC. NGOs(8.9%)agriculture development officeand local marketare the other sources of grafted orange seedlings. Among the total 12 respondents who plant non-grafted orange 83.3% of them got the seedling from local markets. Agriculture development officeis other source of non-grafted orange seedlings(Table 7).

Table 7 Sources of orange seedlingsfor tropical fruit growers in CRV of Ethiopia

No.	Source of orange seedlings	Grafted orange(N=45)		Non-grafted orange(N=12)	
		Frequency	Percent	Frequency	Percent
1	MARC	36	80.0		
2	Agriculture development office	3	6.6	2	16.7
3	Local market	2	4.5	10	83.3
4	NGO	4	8.9		
	Total	45	100	12	100

Sources of papaya and banana seedling

Among 78 respondents who plant papaya 51.3% of them got the seedling from MARC. Agriculture development office(14.1%) is second source of papaya seedlings whereas producing seedlings own self is the third source of papaya seedlings.Among 63 respondents who plant banana 58.7% of them got the seedling from MARC. Local market is second source of banana seedlings whereas Agriculture development office is the third source of banana seedlings(Table 8).

Table 8 Sources of papaya and banana seedlings for tropical fruit growers in CRV of Ethiopia

Sources of seedlings	Papaya		Banana	
	Frequency	Percent	Frequency	Percent
MARC	40	51.3	37	58.7
Agri. development office	11	14.1	7	11.1
Local market	8	10.3	8	12.7
Own	10	12.8		
NGO	5	6.4	5	7.9
MARC and own source	1	1.3		
MARC and local market	1	1.3	5	7.9
MARC and agriculture development office	1	1.3	1	1.6
MARC, agriculture development office and NGOs	1	1.3		
Total	78	100.0	63	100

Purposes of production

Tropical fruit producers produce fruit for different purposes. The main purposes are home consumption, cash earning and for both home consumption and cash earning. Producers also have other purpose for lemon production. Four percent of the respondents produce lemon for the purpose of medicine(Table 9).

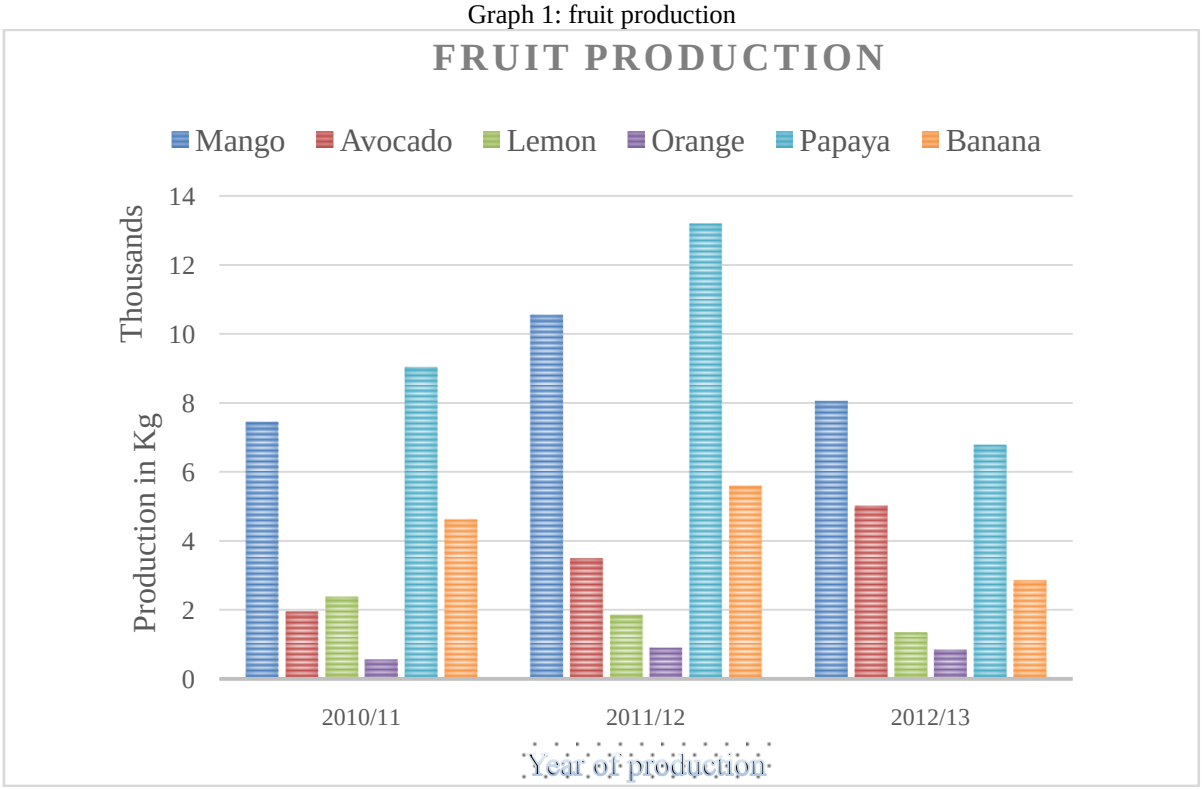
Table 9 Purposes of fruit producers for producing fruit

Purposes of production	Frequency	Percent
Home consumption	28	26.7
Cash earning	8	7.6
Home consumption and cash earning	65	61.9
Home consumption, cash earning and medical purpose	4	3.8
Total	105	100.0

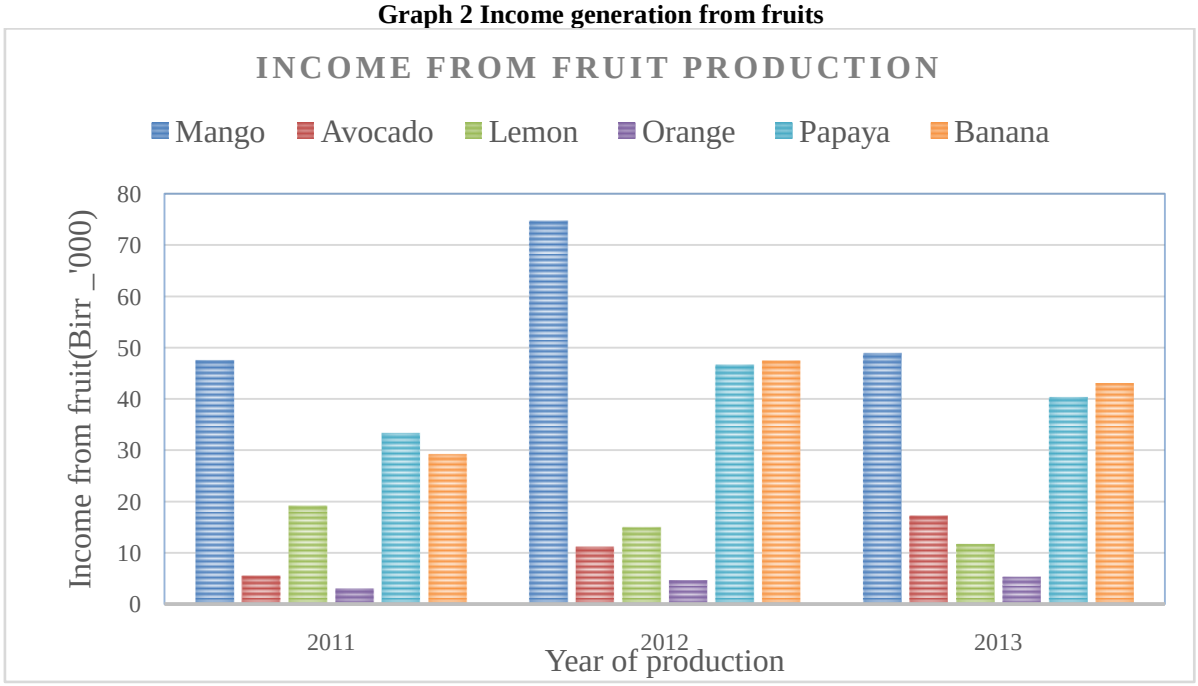
Income generated from tropical fruit production

Mango, avocado, lemon, orange, papaya and banana are the source of fruit incomefor overthree consecutive years from 2011 to 2013. The production of all fruits crops in 2012 is greater than the productions in the remaining two years except lemon. The incomes generated from all fruits also higher in 2012 (199612birr) than 2011(166590birr) and 2013(137893birr) except for orange. The Income generated from orange is higher in 2013. Papaya is the leading in production in 2011 and 2012 whereas mango is the leading in production in2013. As an income generation, mango takes the first place the whole three years (Graph 1& 2).

Graph 1: fruit production



Graph 2 Income generation from fruits



Source of information for awareness improved fruit crops

The producers obtained their awareness and information of fruit production from different sources. The sources of information and awareness are development agents, Melkassa Agricultural Research Center, NGOslike world vision and other farmers who have experience in fruit production. Development agents take the first place of the awareness creationwhereasMelkassa Agricultural Research Center is the second source of awareness and information.So, capacity building of development agents on improved fruit production can be more effective in the future. NGOs take the third stage in contribution of awareness creation of fruit production(Table 10)

Table 10 Source of information for awareness improved fruit crops

Sources of tropical fruit information	Frequency	Percent
Development agents	37	33.6
Mlkassa agricultural research center(MARC)	26	23.6
Another farmer	5	4.5
Development agent and another farmer	3	2.7
Development agent MARC and another farmer	1	.9
NGO	13	11.8
Development agent & NGOs	5	4.5
Development agent & MARC	15	13.6
Development agent, MARC& NGOs	3	2.7
MARC & NGOs	2	1.8
Total	110	100.0

Visit and follow upby development agents

Follow up and technical support is necessary after creating awareness to get successful results. This study tried to see the follow up of development agent to the respondents.Forty five percent of the respondent receive follow up more than two times per year whereas 18.2 percent of the respondents see development agents only first time of seedling provision. The availability of fruit crops was increased withthe number of follow up except for banana(Table 11).

Table 11 Frequency of development agents visit to fruit farm

Ser #	Number of visits by development agent	Frequency	Percent
1	Only during the seedling provision	49	44.5
2	Once every year	15	13.6
3	Twice a year	18	16.4
4	More than two times per year	20	18.2
5	No visit	8	7.2
	Total	110	100.0

Challenges of tropical and sub-tropical fruit production in CRV

Even though CRV is favorable for tropical and sub-tropical fruit production, there are a lot of challenges mentioned by farmers. Disease, insect, water shortage and lack of improved seedling were indicated as major challenges for tropical and sub-tropical fruit production. In addition to these challenges lack of experience, flood and market linkage problem also mentioned.

Opportunities and benefits

Respondents indicate that there are many opportunities for fruit production. Good weather condition (temperature, altitude), availability of research centers and good market demand are the main opportunities for fruit production. On the other hand, access for training on improved tropical fruits is the other main opportunity of fruit producers.Seventy one percent of the growers receive training on tropical fruit production. The first benefit of the producers are earning income(50%) and home consumption.

Conclusion and Implications

The study concludes that there is sufficient demand (good market) for fruit. Fruit production is profitable and can develop to high income generating business for farmers. Farmers are using farmers for both home consumption and income earning. So fruit production can improve household food security.

Shortage of water, shortage of improved seedling, lack of extension services (follow up and training), disease and insects wereindicated the major in tropical fruit production. Disease and insects are decreasing the production of fruits especially citrus.

Training and follow up indicates good result to enhance technical skill problem. Producers who attended training and got supervision could increase the survival rate of their fruit seedlings and increase their production.

The study recommends that establishment and development of fruit nursery around the sites will solve the problem of lack of improved seedling. There is high need of extension works to tackle the technical skill problem and training farmers. For disease and insect problems the responsible experts(crop protection experts) should see the sites and dig for the solutions.

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Truayinet Mekuriaw. "Adoption of Tropical Fruits in the Central Rift Valley of Ethiopia at Glimpse." *Quest Journal of Research in Agriculture and Animal Science*, vol. 07, no. 05, 2020, pp. 45-52.