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Original Research

Production Scenarios of Mango (*Mangifera indica* L.) in Harari Regional State, Eastern Ethiopia

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Abstract

Mango production covers 35% of the total acreage allotted for fruit production in Harari Regional State, eastern Ethiopia. However, there is a declining trend in yield and quality of fruits from the trees. Therefore, this study was conducted to assess the status, practices and challenges of mango production in the study area. Interviews were made taking 70 mango growers selected purposively in the major mango growing areas of the region using semi-structured questionnaire from 2012 to 2013. The results indicated that 50% of the households have few mango trees, 10-20 trees that are from seedling in origin derived from very few trees that were introduced from abroad via missionaries and traders a century ago. As a result, wide variations were observed in phenotypic features of trees within a farm as well as throughout the study area. In total, 39 distinct eco-types were recorded. Input shortage (water, fertilizer and pesticide), lack of improved technologies, pests (especially fruit fly and anthracnose), postharvest loss and poor marketing were the major problems specified by the growers. Therefore, focus should be given in improving the production, productivity and marketing of the crop in order to utilize the available and adaptable mango eco-types which are on the verge of disappearance.

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INTRODUCTION

Fruit crops play an important role in the national food security of people around the world. They are generally delicious and highly nutritious, mainly of vitamins and minerals that can balance cereal-based diets. Fruits supply raw materials for local industries and could be sources of foreign currency. Moreover, the development of fruit industry will create employment opportunities, particularly for farming communities. In general, Ethiopia has great potential and encouraging policy to expand fruit production for fresh market and processing both for domestic and export markets. Besides, fruit crops are friendly to nature, sustain the environment, provide shade, and can easily be incorporated in any agro-forestry programs (MoARD, 2009).

The mango, because of its attractive appearance and the very pleasant taste of selected cultivars, is claimed to be the most important fruit of the tropics and has been touted as 'king of all fruits'. The fruit contains almost all the known vitamins and many essential minerals. The protein content is generally a little higher than that of other fruits except the avocado. Mangos are also a fairly good source of thiamine and niacin and contain some calcium and iron (Griesbach, 2003).

According to CSA (2012/2013), about 61,972.6 hectares of land is under fruit crops in Ethiopia; mangoes contributed 14.2% of the area. Moreover, out of 479,336 tons of fruits produced in the country, mangoes accounted 14.5% fruit production.

In Ethiopia, mango is produced mainly in Harari region, west and east Oromia, Southern Nations, Nationalities, and People's Region (SNNPR) and Amhara (Dendana *et al*., 2005). Wiersinga and Jager (2007) stated that, Eastern Ethiopia (Dire Dawa and Harar areas) is well-known for production and supply of both fruits and vegetables and about 35% of the total acreage allotted for fruit production is covered by Mango (Unpublished Haramaya University Horticulture Department Survey, 1996). Ishot (2009) stated the area covered by fruit crops in Harari People National Regional State by the year 2004/2005 was about 163 ha owned by a total of 5,171 peasant holders altogether produced 30 ton. Out of this, the area occupied by mango was 115 ha. In Harari region, mango is grown dominantly in the central and lower parts of the Bisidimo and Erer River basins including in the vicinities of the Harar city.

A comparative study made between income from fruit growing and cereals (sorghum and maize) in Harar by TAM Agribusiness (2004) revealed that the annual income from fruit growing such as mango and custard apple was ETB 60,000/ha/yr compared to 2,000 for maize and only 1,000 for sorghum. Even if the farmer's livelihood is highly supplemented by the income from their mango trees,

there is a declining trend in yield and quality of the fruits from the trees. Some of the factors contributing to this include foliar diseases, old age, poor management and variability of the trees (Yeshitela and Nessel, 2003). Except the farmers' traditional naming for identification, the trees are mixed and difficult for identification. To this end, this research was initiated with the objectives of assessing the sources and naming of ecotypes, status and constraints of mango production in Harari regional state and its surroundings.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted on the major mango-producing rural *kebeles* of Harari People's Regional State, specifically: Errer-Weldia (seven sub-kebeles: *Errer-Marko, Gola-Ganda-Wedia, Itisa-Bakere, Itisa-Goro-Maskida, Kona and Melka-Hida-Gedi*), Harewe (four sub-kebeles: *Agemboy, Bereser, Harewe-Kalu and Nole*) and Bisidimo (*Bisidimo leprosy referral hospital farm*). The region is located in the eastern part of Ethiopia. The total geographical area is about 343.21 $km^2$and located between 42°03'–42°16'N and 9°11'-9°24'E.

Administratively, the region is divided in six urban and three rural *weredas* (districts). These administrative *weredas* are further divided into 19 and 17 kebeles in urban and rural, respectively. The region is mainly categorized in two agro-ecological zones, i.e. 90% of the land area of the region is mid-high land (*weynadega*), between 1400 – 2200 meter above sea level, while the remaining 10% is lowland or kola (<1500meter above sea level) (Sultan *et al*., 2011).

The climate of the region is suitable for production of diverse horticultural crops where temperature is ranging between 17.1°C-20.2°C throughout the year. The coolest season is between June and September and coincides with main rains. The average annual amount of precipitation is about 750-1,000 mm (http://hararconnection.com/hnrs.htm).

Sampling Methods, Data Collection and Analysis

The study areas were selected based on their potential of mango production. Total respondent of the survey were 70 growers selected purposively based on their experience in mango production. Both primary and secondary data were used to obtain the required information for the study. Accordingly, the primary data were collected using semi structured questionnaire and personal observation. And the secondary data were collected from different sources (reports, wereda agriculture offices and developmental agents).

The data collected were summarized and percentages, frequency distribution and arithmetic means were calculated using SPSS version 17.

RESULTS AND DISCUSSION

Mango Eco-types and Management Practices in Harari Regional State, Eastern Ethiopia

The mango ecotypes recorded were diverse across locations and farmers (Table 1). In total, 39 eco-types were recorded. The prefixes of all ecotypes in the study area were the same '*Amba*' meaning '*Fruit*' in Afan Oromo language. However, naming after prefix were different and indicate the fruit characters (appearance, taste, shape, texture, color, fiber content and aroma) and the sources of the seed or names of the person introduced into the area or owing distinct types. The different names for mango around the world today also reflect the cultures and languages spoken by people who grow them. Many of the names have common derivations, reflecting the origins and spread of the mango tree along with the spread and settlement of communities (Bally, 2006). Due to traditional naming for identification, the trees are mixed and difficult for identification. As a result, there could be two or more name for same cultivar or different types given one name (Yeshitela and Nessel, 2003). This scenario is in accord to Sennhenn *et al*. (2014) who stated the large number of local languages in Kenya lead to confusion about clear identification of mango landraces as many different names existed for the same landrace.

The number of trees per household varies from10-50, depending on size of the farm land and preference of farmers (Table 2). However, the majority (71%) of growers have less than 20 trees while few (6%) of respondents have more than 40 trees. Similar holdings by peasant growers have also been reported by Ssemwanga *et al.* (2008) in Assosa (western Ethiopia) and Seid and Zeru (2013) in Bati (northern Ethiopia). As indicated in Table 2, the entire mango trees in the study area were established from seeds. This could be the reason for the existing variability in the nature of the trees (Bally, 2006).

Regarding the sources of the existing trees, 22% of respondents indicated that their seeds were introduced from Saudi Arabia by Muslims who used to go to Mecca and probably from other countries by traders and missionaries. However, none of the respondents were able to tell names of original cultivars. From those introduced varieties that the majorities of existing trees (77%) were multiplied by the growers. Furthermore, except few growers (5.7%) who used supplemental irrigation from their bore hole, more than 90% of the respondents were dependent on rainfall.

While majority of the trees are old, only few growers have recently started planting mango. Attempt was made to assess age of the mango trees, but, almost all of the farmers responded that they did't know the exact age of their trees rather they estimated them to be more than 80 years old. This appears to hold true as mango tree is long-lived with some specimens known to be over 150 years old and still producing fruit (Griesbach, 2003).

Management Practices

Nearly the entire mango ecotypes observed were planted without any pattern and recommended spacing and also pruning of the trees was not practiced (Table 3). Due to this fact, the trees were too crowded, very tall and the undersides of the canopy of the trees were without leaves and fruits. Overcrowding results in the production of fewer fruits which are apt to be poorly colored and infected with diseases. Tall trees also present a harvesting problem and create difficulties during spraying and pruning (Griesbach, 2003). In general, well managed orchard trees require regular annual pruning to maintain an open canopy of manageable size. This allows air and sunlight to penetrate, which reduces pests and diseases and enhances fruit color (Bally, 2006).

Table 1: Identification of mango ecotypes in Harari Regional State, Eastern Ethiopia

No.	Local Name	Meaning	Kebele*
1	Amba Adi	Describing flush color	EW
2	Amba Adi Ako	Describing flush color and introduced person	EW
3	Amba Ako	Describing introduced person	EW
4	Amba Alege	Describing fiber content of fruit	EW and H
5	Amba Ali Dula	Describing introduced person	EW
6	Amba Arenchata	Describing texture and taste of fruit	EW
7	Amba Babala	Describing shape of fruit	EW, H and B
8	Amba Bare	Describing introduced person	EW and H
9	Amba Bishanoo	Describing taste and juiciness of fruit	EW and H
10	Amba Dera	Describing size of fruit	EW
11	Amba Dinche	Describing shape of fruit	EW
12	Amba Doke	Refers to origin	EW
13	Amba Dula	Describing introduced person	EW and H
14	Amba Errero	Refers to origin	H
15	Amba Forfor	Describing texture and taste of fruit	H
16	Amba Geratune	Refers to origin	H
17	Amba Gerjewi	Describes taste	H
18	Amba Guracha	Describing color of fruit skin	EW, H and B
19	Amba Guracha Gola	Describing color of fruit skin and origin	EW
20	Amba Harewe	Refers to origin	EW and H
21	Amba Huda	Describing productivity of tree	EW and H
22	Amba Hula	Refers to origin	EW
23	Amba Kawe	Describing shape of fruit	EW and H
24	Amba Kukurfa	Describing shape of fruit	EW
25	Amba Lafe	Describing size seed	EW and H
26	Amba Libanatoo	Describing pulp aroma	H
27	Amba Lilo	Describing introduced person	EW
28	Amba Meriyo	Describes fruit appearance	H
29	Amba Mucho	Describes fruit shape	EW and H
30	Amba Mujulo	Describing size	H
31	Amba Negus	Describing fruit size	EW, H and B
32	Amba Sabune	Describing color and texture of fruit	EW
33	Amba Saburugena	Refers to origin	H
34	Amba Sadiko	Describing introduced person	EW
35	Amba Shimbiro	Describing taste of fruit	EW
36	Amba Sibake	Describing taste of fruit	EW
37	Amba Teyara	Describing fruit shape	EW and H
38	Amba Umer Alisho	Describing introduced person	EW
39	Amba Umer Aso	Describing introduced person	EW

*****EW: Errer Weldia, H: Harewe and B: Bisidimo

Table 2: Mango production status in Harari Regional State, Eastern Ethiopia

Variable	Number of respondents	%
Number of trees per household		
<20	50	71.4
21-30	10	14.3
31-40	6	8.6
>40	4	5.7
Type of planting material		
Seedling	70	100
Grafted	0	0
Source of planting material		
Local	54	77.1
Imported	16	22.7
Water source		
Rain	66	94.3
Bore hole	4	5.7

Table 3: Management practices of mango trees in Harari Regional State, Eastern Ethiopia

Variable	Number of respondents	%
Plant spacing		
Recommended (7m × 7m)	3	4.3
Not recommended	67	95.7
Pruning		
Yes	19	27.1
No	51	72.9
Fertilizer application		
Organic	18	25.7
Inorganic*	3	4.3
None	49	70
Pest management practices		
Pesticide	0	0
Cultural (smoking, cleaning etc.)	70	100
Integrated	0	0

*DAP (Di-ammonium phosphate) and Urea but unknown rates of application

Nearly 70% of the growers did not supplement their trees with any form of fertilizer but some (26%) use organic fertilizers such as compost and manure. However, the rates of fertilizer required for mango trees have not yet been standardized for the study area. Mango trees are usually left unfertilized once established. This is in accord with the study by Seid and Zeru (2013) who reported that 90% of growers in northern Ethiopia did not apply neither inorganic nor organic fertilizer on their farmland.

Regarding pests and their management, the respondents pointed out that the major insect pests were fruit fly (100%), thrips (21%) and termites (10%) while diseases included powdery mildew (99%) and anthracnose (100%) (Table 4). Both diseases are known to be most common during wet weather in Ethiopia (Giuseppe De Bac, 2010). For the management of the aforementioned pests, cultural practices like smoking are used especially during flowering and sanitation measures via removing diseased branches and weeding (Table 3) due to several factors such as unavailability of pesticide, technical problems in spraying tall trees and economical issues (Table 5).

Moreover, postharvest handling problems were observed in the study area. About 91% of the growers transport their produce in synthetic fiber sacks while very few (8%) use wooden box and transport to the market by animals like donkey, car and by the farmers themselves to the nearby village market. Plastic crates, which are stackable, stable, easy to clean and reuse has been shown to reduce damage of perishable crops from an average of 30% to less than 10% (Kitnoja, 2010). Hence, the postharvest constraints mentioned by the respondents could be alleviated by demonstrating and promoting use of plastic crates with appropriate transportation methods.

Mango Production Constraints

The major production constraints indicated by the respondents in the study area were water shortage or erratic rainfall (79%) followed by pest (75.7%) problems (Table 6). Lack of knowledge and recommended production practices (nutrition, pruning, pest management etc.) and post-harvest losses were also noted as major problems of the growers. It is in agreement with CSA (2009) report that stated mango production in Ethiopia fluctuates because of occurrence of diseases and lack of proper management (CSA, 2009) and IPMS (2011) report indicated in addition to the lack of improved varieties, the development of fruit production was severely hampered by lack of knowledge and skills, in particular on the production of grafted seedlings pilot learning woredas in north and southwest of Ethiopia.

Likewise, absence of good marketing system that could benefit or attract the growers is the additional bottleneck raised (Table 6). As a result, the growers reflected their tendency towards cultivation of other cash crops like khat *(Catha edulis)* by uprooting the exiting trees. The tendency to shift to other cash generating crops is also most common in other parts of the country (Semwanga *et al*., 2008; Seid and Zeru, 2013).

Table 4: Major pests of mango in Harari Regional State, Eastern Ethiopia

Variable	Number of respondents	%
Insect pest		
Thrips	15	21.4
Fruit fly	70	100
Termite	7	10
Diseases		
Powdery mildew	69	98.6
Anthracnose	70	100
Others	2	2.9

Table 5: Mango postharvest packaging materials and transportation systems used in Harari Regional State, Eastern Ethiopia

Variable	Number of respondents	%
Materials for packing		
Plastic sack	64.00	91.4
Wooden box	6.00	8.6
Transportation means		
Human	15.00	21.4
Animals	29.00	41.4
Car	26.00	37.1

Table 6: Summarized production constraints of mango in the Harari Regional State, Eastern Ethiopia

Constraints	Number of respondents	%
Erratic rainfall (scarcity of irrigation water)	55	79.0
Insect pests and diseases	53	75.7
Lack of knowledge and skill	44	62.9
Postharvest fruit rot	35	50.0
Flowers and fruit drop	30	42.9
Shortage of fertilizer	15	21.4
Poor marketing	9	12.9

CONCLUSIONS

Mango production has a long history in eastern Ethiopia particularly in eastern Hararghe. There is remarkable variability among the existing mango trees and fruits since almost all growers propagate it sexually even though other variables like ecological, edaphic factors and crop husbandry practices could contribute to the variation. The study revealed the potentials of mango production but demands serious attention to the existing trees with regard to promotion of potential germplasm by grafting propagation method and use of appropriate husbandry practices. Moreover, maintaining as many mango varieties as possible is necessary as a basis for breeding activities, which allows the development of better adapted and pest/disease-tolerant varieties with a high value for domestic and export markets. Focus should be given in improving the production, productivity and marketing of the crop in order to utilize the available and adaptable mango eco-types which are on the verge of disappearance.

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