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Evaluation of Tamarind (*Tamarindus indica*) Utilization and Production in Eastern Parts of Kenya

Mercy Liharaka Kidaha[1*], Fredah K. Rimberia[1], Remmy Kasili Wekesa[2] and Wariara Kariuki[1]

[1]Department of Horticulture, Jomo Kenyatta University of Agriculture and Technology, P.O.Box 62000-00200 Nairobi, Kenya.
[2]Institute for Biotechnology Research, Jomo Kenyatta University of Agriculture and Technology, P.O.Box 62000-00200 Nairobi, Kenya.

Authors' contributions

This work was carried out in collaboration between all authors. Author MLK carried out sampling in the four region and drafted the manuscript. Author FKR supervised field sampling, data collection analysis and corrected the manuscript. Author RKW supervised field sampling, data analysis and corrected the manuscript. Author WK supervised sampling and manuscript drafting and corrections. All authors read and approved the final manuscript.

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ABSTRACT

Tamarind is a fruit tree native to tropical parts of Africa and Asia. It is used as a source of raw material in food industry, timber and landscaping. Despite the great value of tamarind, there is no information related to how it is utilized and produced in Kenya. The objective of this study was to evaluate tamarind production and utilization in Eastern parts of Kenya. Questionnaires were used to obtain information on production systems, planting material, cultural practices, proportion of tamarind sold, time taken to maturity, maturity indices, uses and challenges in tamarind production. Results indicated that all the farmers interviewed depended on seeds as their source of planting material. Farmers reported that tamarind was mainly grown for market and subsistence use. Majority of the respondents used tamarind as fruit, an ingredient in porridge and as a source of

**Corresponding author: E-mail: mlihaaraka@gmail.com;*

herbal medicine. Cultural practices carried out in tamarind production were intercropping, weed control and harvesting. Majority of farmers were not able to determine the actual time trees take to mature but some approximated it to take 5-6 years. Most of the respondent identified fruit color and brittleness of the pod as key maturity indicators. Despite the reports that farmers had no problems on diseases they hardly harvested more than 270 Kg of fruits per plant. Challenges reported by most farmers included aphid infestation, harvesting from tall trees, marketing and transportation. Tamarind trees are of great importance in the Eastern parts of Kenya and more research should be done to improve the crop.

Keywords: Production; tamarind; utilization; challenges; questionnaires.

1. INTRODUCTION

Tamarind (*Tamarindus indica L*) belongs to family *Leguminoseae* [1]. *Tamarindus* is a monotypic genus containing only *T. indica* [2]. The fruits are either eaten fresh or the pulp is processed into juices, jams or chewing gums [3]. It is rich in carbohydrates, vitamin C, calcium, tartaric acid and potassium [4]. The leaves have also been used as vegetables and this is important is solving food security in semi-arid parts [5]. Tamarind leaves, seeds, bark and flowers have been used as food and in traditional medicine for treatment of jaundice and dysentery [4]. Tamarind tree has been used for landscaping purposes due to its evergreen habit. It provides shade on country roads, highway and homesteads [6] as it is able to resist storms and be used as wind breaks. The tree is able to control soil erosion to areas that are prone to erosion and mud slides. It provides good source of firewood and timber for construction purposes [6].

Most programmes have recognized that tamarind has many uses but it is still underutilized in Africa [6,3]. It is among top 10 prioritized for future crop diversification programme and development in the Sub-Saharan Africa [3]. In Asia tamarind domestication is in process and they have identified different properties in relation to its consumption [7]. In West Africa, the World Agroforestry Center has established a clonal orchard and supplemented it with collection of sweet tamarind from outside Africa [7]. This advance has seen the consumption and domestication rate of tamarind increase.

In Uganda, [8] studied morphological and nutritional characters of tamarind fruits. Nutritional composition analyzed was a key component in utilization of the tamarind. [9] studied species diversity in Kenya, Uganda and Tanzania. In his study he determined conservation strategies in woodlands and riverbanks. This study concentrated on species diversity and not on utilization and production.

The objective of this study was to evaluate production and utilization of tamarind in Eastern parts of Kenya. In Eastern parts of Kenya tamarind is in abundance but no studies have been carried out to determine its utilization and production so as to determine agronomic characters. Lack of this information has limited the use and improvement of tamarind.

2. MATERIALS AND METHODS

2.1 Sampling

The survey was carried out in Eastern parts of Kenya between December 2015 to August 2016. A total of 89 farmers were interviewed. Each tree surveyed was mapped using Global Positioning System (GPS) and location coordinates obtained. Coordinate information was obtained for 25 trees in Kitui that had latitude of (S01.451-S02.056), longitude of (E038.054-E038.181) and elevation of (1335-1375 MAS), 10 trees in Mwingi had latitude of (S00.865-S00939), longitude of (E037.637–E38.234) and elevation of (1365-1377 MAS), 7 trees in Masinga had latitude of (S00.846-S00.924) longitude of (E037.610-E37.681) elevation of (1130-1376 MAS), 21 trees in Embu had latitude of (S00.455-S00.470), longitude of (E037.733-E037.791) and elevation of (1328-1377 MAS) and 27 trees in Kibwezi latitude (S02.372-S02.397, longitude (E037.932-E037.996 and elevation (833-1121 MAS). Tamarind farms were identified using key informants.

2.2 Data Collection

Data was collected through personal interviews with key informants and questionnaires. Farmers

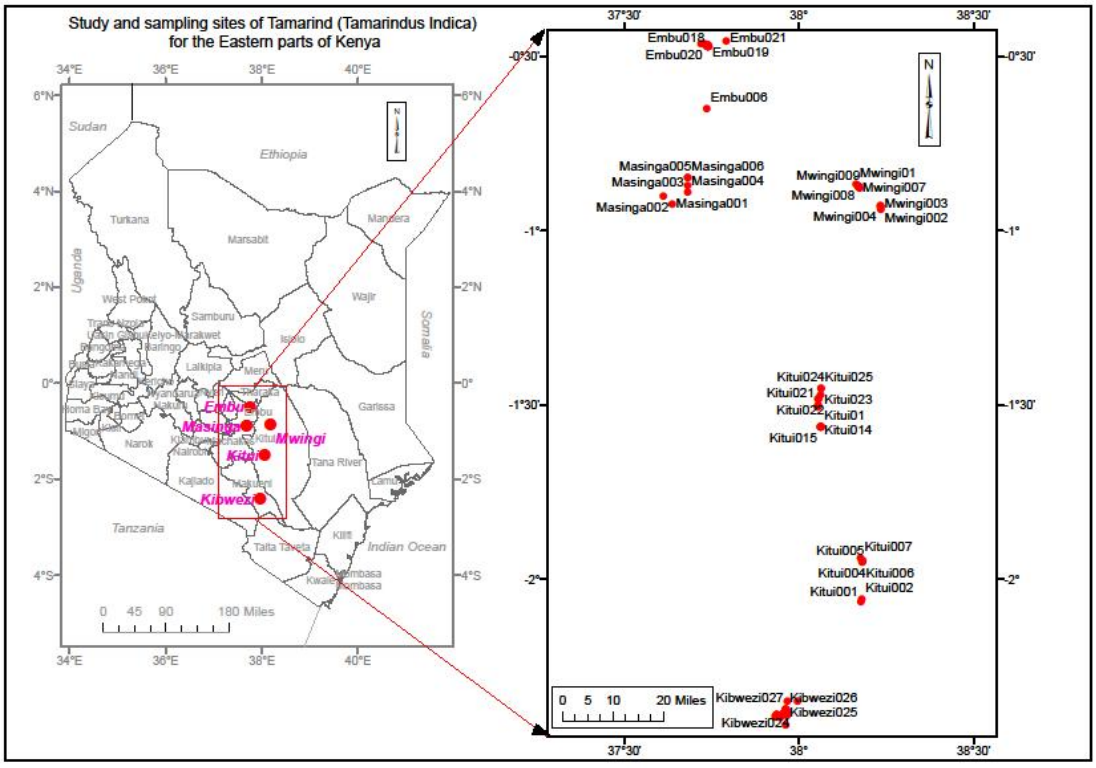

Fig. 1. Sampling and study sites in Eastern parts of Kenya

provided information on type of production system, cultural practices, source of planting material, time taken to maturity, maturity indices (indicators that show the crop is mature and ready for harvesting), fruit yield per tree per season, number of harvests per year, portion of fruit sold, uses of tamarind fruit, challenges in tamarind production: market, transport, pests, diseases and harvesting.

2.3 Data Analysis

Data collected was analyzed using SPSS.

3. RESULTS

Seeds from the same trees were used as source of planting material. Most farmers (51) produced tamarind for market and subsistence use (Fig. 2A). Most farmers (58) intercropped legumes, maize with tamarind and only a few were abandoned (Fig. 2B). Land was majorly prepared using hand tools and occasionally using animals drawn implements (Fig. 2C).

Farmers reported weed control, intercropping and harvesting as the only cultural practices in tamarind production. Weed control was only present in the intercrops with the (Fig. 3A). Farmers identified tamarind as mature when the pod color changed from green to brown and when the pod became more brittle see (Fig. 3B). Farmers were not sure how long tamarind took before it started fruiting but reported 5-8 years see (Fig. 3C). In most farms, farmers reported yield of less than 180 kg per season per tree (Fig. 3D).

The tree is of great use to this community as they are in the dry parts of Kenya. The uses included; Source of shade, source of firewood, source of timber, storage area for animal feeds, controls erosion during flash floods. The fruit was used as an ingredient in porridge preparation and eaten as fruit (Fig. 4A). Majority of farmers were conversant with it as a source of herbal medicine in curing mouth rash and fungal infections (Fig. 4B). Fruits are harvested ones in a year (Fig. 4C) and less than 25% of total production was sold see (Fig. 4D).

Challenges reported by respondents included: harvesting fruits from tall trees (Fig. 5A). Farmers reported absents of proper channels of marketing

the fruit are in place and most of the fruits rot from the tree (Fig. 5B) and transportation to the market (Fig. 5C). No diseases were identified by the farmers and the most prominent pests were weevils. Most farmers had negative opinion towards tamarind farming (Fig. 5 D).

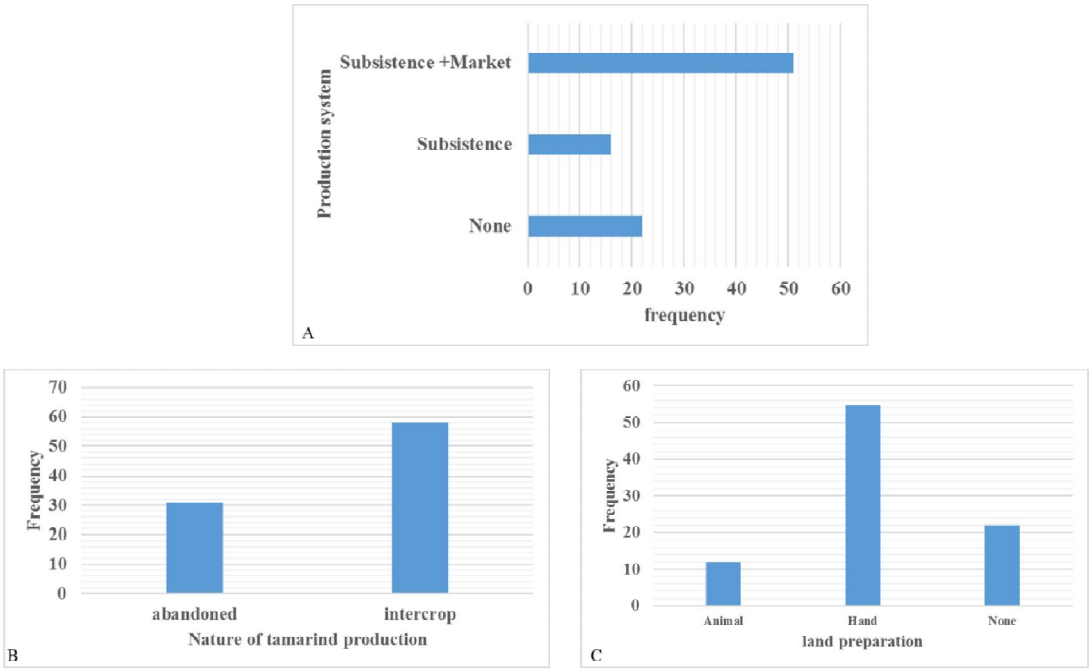

Fig. 2. Production system of tamarind (A), nature of tamarind production (B) and land preparation method (C)

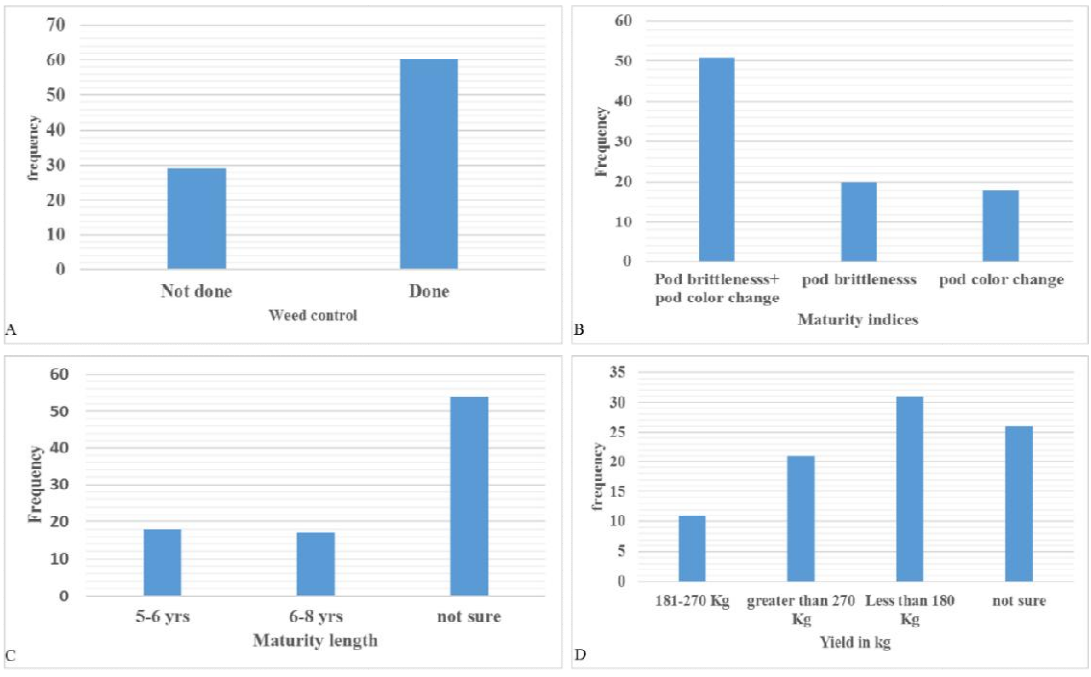

Fig. 3. Weeding as a cultural practice (A), maturity indices (B), maturity length (C) and tamarind yield per season (D)

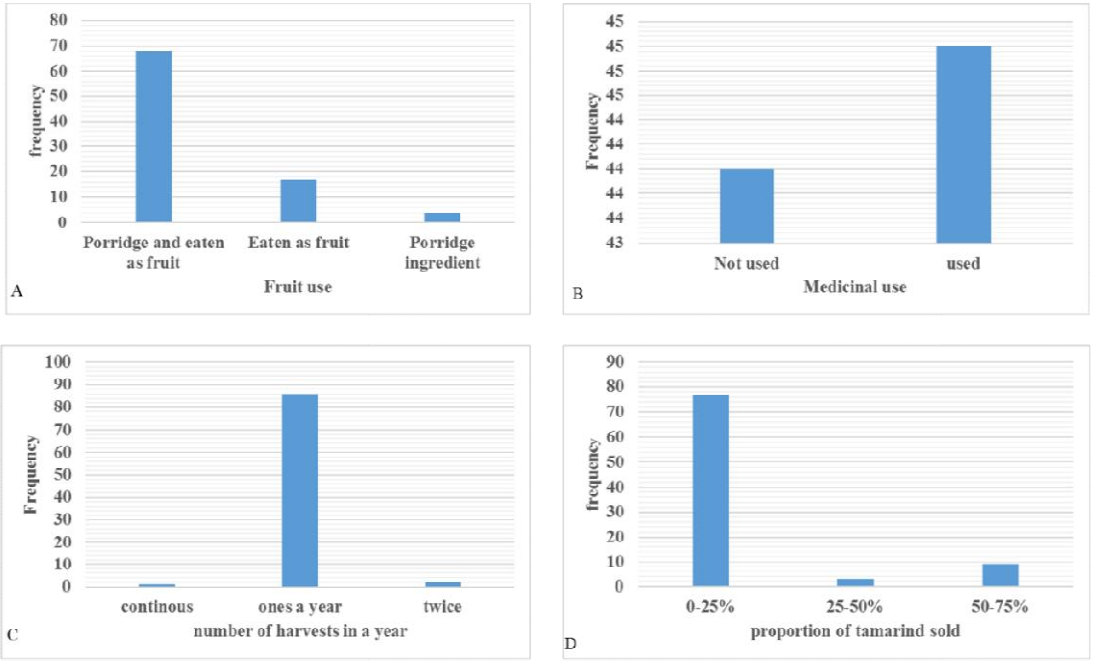

Fig. 4. Use of tamarind fruit (A), medicinal use of tamarind (B), number of tamarind harvests in a year (C) and proportion of tamarind sales (D)

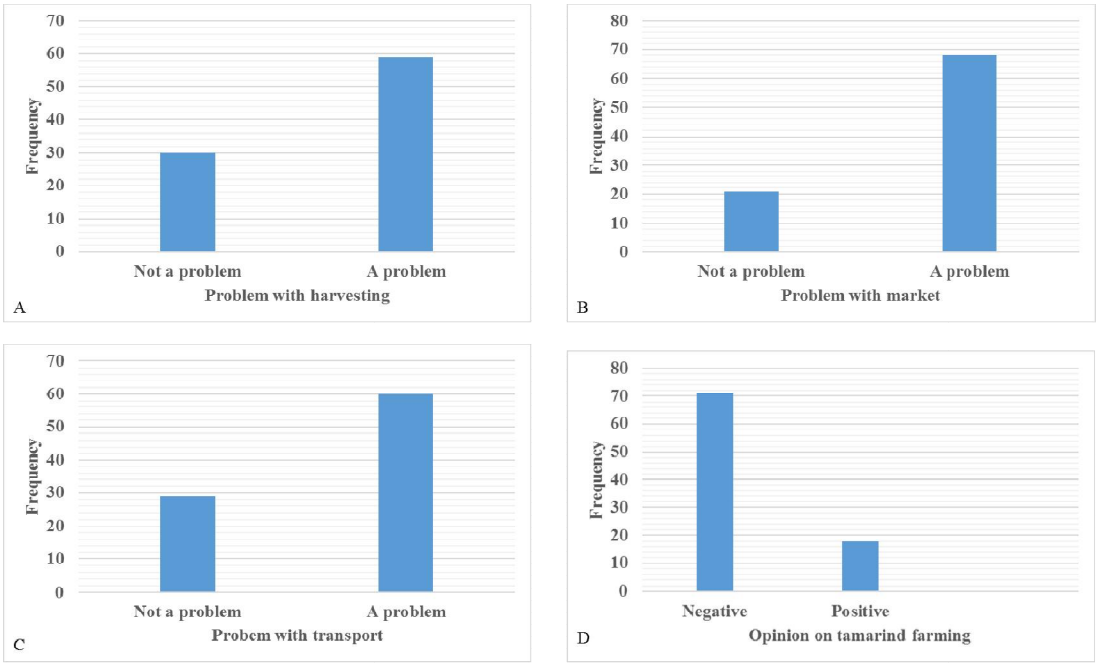

Fig. 5. Challenges in tamarind production; harvesting problem (A), problem with marketing (B), problem with transport (C) and opinion on tamarind farming (D)

4. DISCUSSION

In Eastern parts of Kenya land was prepared manually using simple implements like hoes and machetes which are readily available and cheap. Some farmers used animal - draw ploughs on donkeys that are readily available. The animals are also used for transportation in search of water, firewood and food and this is in agreement with reports by [10]. Farmers reported they are

not able to afford and maintain farm machinery in the production.

Due to less farming land acreage, farmers are forced to intercrop tamarind with other crops. The short seasoned intercrops (pigeon pea and maize) provide source of food and income to the farmers unlike tamarind that is perennial. The pigeon peas and other intercrops benefit as they do not get direct scorching from the sun. Weeding was mainly practiced due to the presence of intercrops.

High population of tamarind in this region is associated with other ecosystem services that tamarind offers. These benefits include, control of soil erosion as the area is prone to mud slides, source of firewood, use as shelter and shade. This is in agreement with the reports by [11] who reported that Tamarind in West Africa provided ecosystem services. In this region the fruit was either eaten as a solid fruit or used as an ingredient in porridge preparation which is supported by [12] who reported that in India the fruit pulp can be eaten raw when dipped in a sweetener or salt as a snack while in Bahamas it was dipped in wood ash. [13] also confirmed that in Africa tamarind was a useful source of food during lean periods. He stated that the tamarind was also used in cultural activities such as worship which was not evident in the Eastern parts of Kenya. Medicinal use available in the area as a cure to mouth rash is supported by [14] who reported that the fruit is effective against fungal pathogens.

Farmers reported that they do not have a particular season when they plant the crop as it grew own its own upon seeds falling on the ground and having obtained favorable germination conditions. This is supported by [12] who reported commercial use of Tamarind in Africa is still under developed.

Farmers were not sure of the period taken by tamarind to maturity but most of them reported 5-8 years which is in line with report by [15]. In this blog it was reported that tamarind takes 6-7 years to maturity. The fruit is harvested for marketing and home use and this is in agreement with reports by [16] who reported that tamarind produced in Africa was mainly for domestic consumption. Fruits from Kitui and Mwingi were sold to traders from the Coast who used the fruits for making jams and sauces for Coastal dishes. This is in agreement with reports by [11] who reported that the fruit can be used to make sauces and juice. High yields and positive opinion in tamarind production in Mwingi and Kitui is associated with ready market to the Coastal traders. Ready market in the Coast is in agreement with reports by [17] where she reported that tamarind could be collected around Eastern parts of Kenya and sold to the Coast). The yields reported in this region are slightly lower than yields reported [16], who reported that each tamarind tree per season yields 150-500 kg.

Challenge in transport experienced was associated with poor infrastructure of the region. Most dominant transport mode is human and animal transport. There were no available mechanical means of transporting the produce to the market which was also associated with long distances to the market. Marketing tamarind fruits was a challenge and this is similar to reports by [17] who reported that ready market available in Coast and traders could travel all the way then come back for the next batch which took a long time.

Harvesting tamarind fruits was a challenge mainly in Kitui and Mwingi as this region has extremely tall trees whereby climbing was difficult. In Embu tamarind population was in abundance due to favorable climate. The fruit trees were abandoned as the farmers had a negative opinion on tamarind production. Negative opinion was associated with the presents of other cash crops that have ready market such as mangoes, tea, avocado and pawpaw. In Embu the trees were used as source of firewood. This is supported by reports by [11] who reported that that tamarind trees in West Africa were heavily used as source of fuel.

Diseases were not reported and this is supported by [12] who reported that the tree was free from serious disease. A serious pest in tamarind production was reported to be the weevil which attacked the fruits when mature on the trees and after harvesting. This contrary to reports by [18] who reported major pests that attacked tamarind were borers and beetles.

5. CONCLUSION

This study reveals that tamarind trees are of great importance in the Eastern parts of Kenya as they offer food security and ecosystem services. More research should be done to improve the crop and determine cultivars present in the region to unlock tamarinds potential. Morphological characterization of the available tamarind germplasm is also necessary.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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