

Research Article

Date Palm Production Practices and Constraints in the Value Chain in Afar Regional State, Ethiopia

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The study was conducted during 2015/2016 in two districts of Afar Regional State which were purposively selected based on their experiences on date palm production and locations relative to Awash River. Objectives of the study were evaluating the existing production practices and constraints of date palm production to generate baseline information for further researches and extension. A total of 117 household heads were interviewed using structured and semistructured questionnaires. Key informant interviews, focus group discussions, and direct observations of date palm plantations have been also conducted. The study was designed to address date palm production along the value chain. The majority of household heads were male, married, and illiterate. About 94.19% of household heads allocated less than one hectare of land for date palm production and had 21–40 years (77.8%) of experience. Seeds (90.6%) were dominantly used for propagation, which are not appropriate for date palm production. Local varieties with low yielding potential were cultivated using flooding irrigation (76.9%). Date palm production was practiced traditionally and constrained with high incidence of insect pests. Capacity building training sessions and researches on proper agronomic, management, and postharvest handling practices are recommended to improve the production of date palm in the region.

1. Introduction

The date palm (*Phoenix dactylifera* L.) tree belongs to the family *Arecaceae* and is considered as a symbol of life in the desert, as it tolerates high temperatures, water stress, and salinity more than many other fruit crops [1, 2]. It is one of the most valuable domesticated fruit trees because of its significance in human societies, health benefits, productive capacity in harsh semiarid and arid environments, and the range of subsistence products from its fruits and other parts of the large palm [3]. The crop has been cultivated since ancient times. The earliest record from Mesopotamia showed that date palm cultivation has been started probably as early as 3000 BC. More proof of the great antiquity of the date palm has been found in Egypt's Nile Valley where its frond has been used as the symbol for years in Egyptian hieroglyphics [4]. Date palm also has religious importance. In Christianity, the

palm leaves are used for celebration of Easter Sunday [5]. In Islam, dates are mentioned several times in the Quran. They are used usually to break the long fasting days in the month of Ramadan [6].

The world date palm production is in increasing trend. For instance, its production increased from 1.8 million metric ton in 1961 to 2.8 million metric tons in 1985 which further increased to 5.04 million metric tons in 2001. The world date palm production reached about 8.06 million metric tons produced on about 1.149 million hectare of land [7]. Date palm production is the most important agricultural activity for hot arid regions of the world that improves foreign exchange earnings of countries in such harsh environment [8]. According to the report of Pariona [9] Egypt leads the world date palm production with about 1.1 million metric tons annual production and generated about \$41.8 million Dollars from export of fresh date fruits. Similarly, Saudi Arabia and

Iraq have exported fresh date palm to the world market worth about \$94.3 and \$77.5 millions of Dollars, respectively.

Date fruits contain carbohydrates, proteins, fibers, fats, various vitamins, and minerals that make the fruits an important food security crop for agropastoralists in Afar Regional State, which are malnourished and food unsecured. According to Zaid and de Wet [10] the availability of high amount of sugar makes the fruit one of the most nutritious foods available to the people in arid and semiarid areas of the world. Moreover the fruits contain 15–30% water depending on the variety and maturity stage [8]. Date fruit products like date juice, liquid sugar, protein yeast and vinegar, marmalade, chocolate, wine, alcohol, organic acids, and so on [10] made the fruit an important input for food and related industries that create good opportunity for agropastoralists to improve their income and thus their livelihoods. Furthermore, date palm trees have also environmental importance. Date palm trees planted in towns, esplanades, avenues, and squares can provide shade from strong sunlight for the people in arid climates [11].

According to Demeli [12] date palm has been introduced to Ethiopia from Middle East countries about 200 years ago by traders from Yemen and Sudan. Since then, it is cultivated mainly by agropastoralists in Afar, Somali, Gambella, Dira Dawa, and Benishangul-Gumuz Regions. The production of date palm especially in Afar Region has a long tradition where it is established as wild crop in Afambo, Aysaita, Gewane, and Amibara districts along the Awash River [11] within the Danakil Depression which are especially suitable for date palm production [13]. Furthermore the presence of Awash River in the region is an excellent opportunity for establishment and expansion of small-scale and large plantation of date palm in the region [11].

However, due to less attention of the government of Ethiopia in general and that of Afar Region in particular, the development of date palm production in the country is extremely low where the exact annual production is registered in any statistical database. No researches and extension activities have been conducted by governmental as well as nongovernmental organizations. Date palms in the region are produced by agropastoralists using traditional farming practices which are acquired from their parents and grandparents through time. No training sessions or extension services by respective stakeholders are given to agropastoralists on cultivation, management, and postharvest handling practices of date palm which are important for successful production of date palm as indicated by Zaid and de Wet [14] and Glasner et al. [15]. Generally, improper cultural and poor postharvest handling practices and use of inferior quality varieties and thus low yields characterize date palm production in the region [11].

Based on the suitability of environmental conditions, long experience of agropastoralists, and high nutritive values of date fruits, date palm production in the region contributes to improvement of the incomes as well as to reduction of malnutrition and thus improvement of food security for poor agropastoralists. As palm tree is the most versatile plant, and virtually every part of the tree is utilized to make functional items ranging from rope and baskets to beehives,

fishing boats, and traditional dwellings, date palm production can be an additional income source for agropastoralists that helps in reducing poverty in arid and semiarid areas [16]. Furthermore date palm plays a significant role in the control of desertification and as means of land reclamation in the country at large and in Afar Region in particular. The aim of this study was therefore to evaluate the practices of date palm production and identify its constraints so as to generate baseline information for improvement of date palm production and thus to contribute to improvement of the livelihoods of agropastoralists in the region.

2. Materials and Methods

2.1. Description of the Study Area. The study was conducted in Afambo and Asaiyta districts of Afar Region. The agropastoralists in these districts have long experience in the production of date palm. The districts are categorized as Awsa Kee Gewane livelihood with average altitude ranging from 330 to 350 meters above sea level and an average annual rainfall of 122 mm with bimodal rainy seasons. The first rain is from February to March (*sugum* rains) while the second is from July to September (*karma* rains). The Awash River is the main source of water for irrigated crop production where Tendaho and Middle Awash Agriculture Development farms owned by the government of Ethiopia are the biggest once in the area [17]. The total population of Aysaita and Afambo districts is 90,398 with annual growth rate of 2.9%. About 48,747 are male and the remaining 41,651 are female [18].

2.2. Sampling Procedure and Data Collection. From four districts with an experience of date palm production in Afar Regional State, Afambo and Aysaita districts were purposively selected because of their long experience. While *Alasabolo*, *Humadoyta*, and *Berga kebeles* were selected purposively based on the experiences and consumption habits from these districts, the number of household heads (HHs) in each *kebele* was determined according to the formula described by Kothari [19] as indicated below. The individual household heads in each *kebele* were however selected from the lists provided from office of agriculture randomly. Accordingly, a total of 117 household heads were selected with 57, 30, and 30 HHs in *Alasabolo*, *Humadoyta*, and *Berga kebeles*, respectively.

$$n = \frac{(z^2 \times p \times q \times N)}{(e^2 \times (N - 1))} + (z^2 \times p \times q), \quad (F1)$$

where

n is the sample size required, expressed in number of households for key indicators;

N is the total population of the sample *kebeles*;

z = 1.96 to achieve 95% the level of confidence;

p is the proximate proportion of producers and nonproducers of date palm in the study areas. Since all of them are producers, 100% was taken for this study.

TABLE 1: Sex distribution and marital status of the respondents in the study area.

Category	Frequency of HHs (n = 117)	%
Sex distribution		
Male-headed	75	64.1
Female-headed	42	35.9
Marital status		
Single	9	7.7
Married	97	82.9
Divorced	6	5.1
Widowed/widower	5	4.3

Note. n: number of respondent households; HHs: household heads.

e is the tolerant marginal error as defined as in 0.05, that is, 5% maximum discrepancy between the sample and the general population.

Structured and semistructured questionnaires, key informant interviews (KII), and focus group discussions (FGDs) were used to collect primary data; local knowledgeable peoples in the *kebeles* participated during FGD. Moreover direct observations were made to generate primary data on the physical conditions of date palm production in the study area. In addition literatures related to the study area such as published and unpublished documents, governmental and nongovernmental reports, and other similar relevant documents were reviewed.

2.3. Statistical Analysis. Qualitative data were summarized and narrated. Quantitative data collected from the household survey were entered and analyzed using Statistical Package for Social Sciences SPSS version 20 software (SPSS, 2012) computer software program. Descriptive statistics such as frequency distribution, percentages, and chi-square test were applied for analysis. Moreover, the results were summarized in the form of tables and figures.

3. Results and Discussion

3.1. General Demographic Characteristics of Respondents

3.1.1. Sex and Marital Status. The sex and marital distribution of the respondents is presented in Table 1. As the result indicated, sex distribution of household heads influenced the participation of agropastoralists in date palm production in the study area. Accordingly, 64.1% of the households that participated in date palm production were male headed while the remaining 35.9% were female headed. The reason is probably due to the fact that male agropastoralists generally have easy access to land compared to female agropastoralists. Furthermore, female agropastoralists have generally poor control over resources compared to male ones in developing countries as indicated by Salman [20].

The majority of the respondent household heads (82.9%) in the study area were married (Table 1). This is due to the fact that marriage is essential to facilitate the farming

TABLE 2: Educational level of the respondent household heads in the study area.

Educational level	Frequency of HHs (n = 117)	%
Illiterate	83	70.9
Primary school	9	7.7
Middle school	0	0
High school and above	3	2.6
Quran	22	18.8

Note. n: number of respondent household heads; HHs: household heads.

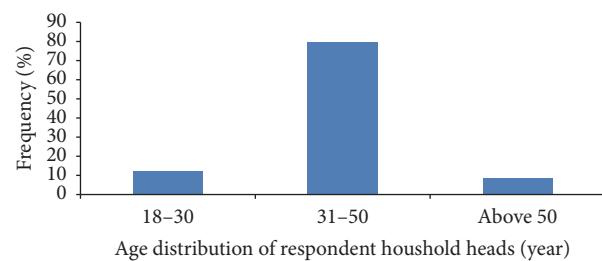


FIGURE 1: Age distribution (%) of the respondent households in the study area.

and household activities under agropastoralists. According to Ekong [21] marriage is traditional which is associated with the culture of agropastoralists. Moreover according to the clan leaders as key informants, divorce in agropastoral society is generally not the norm. In the case of disagreement, mostly the clan leaders and elderly people including the family members of the couples resolve the problems.

3.1.2. Age Distribution and Educational Level. Age distribution and educational level of the respondents are presented in Figure 1 and Table 2, respectively. According to the survey results, the majority of the household heads (91.5%) who participated in date palm production were at working ages. This is probably associated with the fact that crop production and its management including date palm is a hard work that requires physically and mentally matured personnel.

The majority of the respondent household heads (70.9%) were illiterate. While 18.8% of the households were informally educated through Quran, only 9.3% of the respondents visited formal education system. According to Ekwe et al. [22] education is the most important tool to bring changes in human behavior and thus to implement the recommended agronomic practices of crops that are important for the improvement of production and productivity. Moreover, education impacts the ability of farmers to evaluate innovations and technologies being transferred to them [23]. As most of agropastoralists participating in date palm production are illiterate, continuous training sessions and extension services are necessary to improve the production and productivity of the crop in Afar Region.

TABLE 3: Production area allocated and experience of date palm production in the study area.

Area (ha)	<i>Berga kebele</i>		<i>Alassabolo kebele</i>		<i>Humodoyta kebele</i>		Total	
	Frequency (n = 30)	%	Frequency (n = 57)	%	Frequency (n = 30)	%	Frequency (n = 117)	(%)
≤0.59	10	33.3	39	68.4	16	53.3	65	55.6
0.6–0.9	16	53.3	17	29.8	12	40	45	38.5
1.0–1.9	3	10.0	1	1.8	2	6.7	6	5.1
2.0–3.0	1	3.3	0	0.0	0	0.0	1	0.9
Experience (years)								
10–20	8	26.7	4	7.0	2	6.7	14	12.0
21–40	21	70.0	45	78.9	25	83.3	91	77.8
41–60	1	3.3	8	14.0	3	10.0	12	10.2

Note. n: number of respondent household heads.

3.2. Date Palm Production Practices in the Study Area

3.2.1. Area Allocated by Agropastoralists. As indicated in Table 3 the area allocated for date palm production in the sample *kebeles* was relatively different. Most of the sample households in *Alassabolo* (68.4%) and in *Humodoyta* (53.3%) *kebeles* allocated less than 0.59 ha cultivated land for date palm production. However about 53.3% of the agropastoralists in *Berga kebele* allocated about 0.6–0.9 ha of cultivated land for date palm production. Generally however about 94.1% of the sample households in the study area produced date palm on less than one hectare of cultivated land which is low compared to other countries where individual farmer may own more than tens of hectares of land covered by date palm trees [24]. Therefore, date palm production in the country as well as in Afar Region is very low both in quantity and quality which is mostly concentrated around Awash River in Afar Region as indicated in Figure 2.

Afar Regional State has historical experience in irrigated agriculture as rainfall in the region is generally scarce as indicated by Ministry of Federal Affairs [25]. Similarly, the Afambo and Aysaita districts have long experience in date palm production (Table 3 and Figure 2) where most of the respondent agropastoralists (77.8%) had about 21–40 years of experiences. According to Salah [11] and Hussen [13] date palm production in Afar Region along the Awash River is practiced for long periods of time by agropastoralists which is in line with the findings of the present study. According to the key informants the management practices employed by the growers are traditional which have been acquired from their parents through time. No training sessions or extension services about the agronomic, management, and postharvest handling practices of date palm have been given by the responsible stakeholders which are required for the production of quality date palm fruits. Maintaining optimal ratio of leaves to fruits, leaf pruning, bunch management, fruit thinning, dethorning, proper harvesting, and postharvest handling techniques are essential to produce high yield of date fruits with best quality [14, 15].

3.2.2. Propagation and Planting Practices of Agropastoralists. Date palm like other fruit crops can be propagated both by



FIGURE 2: Date palm trees grown at Awash River bank in *Alassabolo kebele* of Afambo District (Photo taken during observation of the production areas, 2016).

vegetative and generative methods. However, seed propagation method is not preferred for date palm as the offspring are not true to type. Moreover seed propagated date palm trees are generally late maturing and produced low fruit yield with inferior quality as described by Zaid and de Wet [26]. According to the authors vegetative propagation like use of offshoots and tissue cultured planting materials as indicated in Figure 3 is the preferred method of propagation for date palm. Nevertheless, the majority of the respondent household heads (90.6%) in this study used seed propagation (Table 4). Only 9.4% of the producers used offshoot propagation technique. The findings of this study indicated that propagation method employed by the agropastoralists in Afar Region is generally not ideal for date palm which is in agreement with the findings of Salah [11] and Hussen [13]. To alleviate this problem and overcome general shortage of quality planting materials, the Afar Bureau of Pastoral Agriculture Development [27] had imported tissue culture technology from England and Israel and introduced it to Afar Region.

Planting season is also an important cultural practice which influences the production and productivity of crops including date palms. According to the survey results, the majority of respondents (88.9%) planted their date palm trees during spring and autumn (Table 4) which are considered as appropriate planting seasons. According to Zaid and de Wet [26], spring reduces the risk of low temperatures which is normally common during winter and helps to use the advantages of warm weather that encourages rapid

TABLE 4: Propagation methods, spacing, and planting season of date palm in the study area.

Category	Frequency of HHs (<i>n</i> = 117)	%
Propagation method		
Seed propagation	106	90.6
Vegetative propagation (offshoot)	11	9.4
Plant spacing		
10 m × 8 m	6	5.1
8 m × 8 m	23	19.7
≤6 m × 4 m	88	75.2
Planting season		
Spring	82	70.1
Autumn	22	18.8
Summer	13	11.1

Note. *n*: number of respondent households; HHs: household heads.



FIGURE 3: Propagation nursery for tissue cultured and improved date palm varieties in Werer Agricultural Research Center (Photos taken during field observation, 2016).

growth, while autumn gives the young shoots longer time for establishment before the arrival of hot summer temperatures.

Production system of fruit crops including date palm generally affects the production and productivity as it influences the number of trees per unit area and intercultural practices. Although spacing differs with variety and climatic conditions, the majority of the respondent households (94.9%) used narrow spacing which is not generally appropriate for date palm production (Table 4). Only 5.1% of the households in the present study used proper spacing of 10 m × 8 m which is suitable for most of the date palm varieties as described by Klein and Date [28].

The use of narrow spacing increases competition for nutrients, moisture, and space among fruit plants. Moreover, it exerts self-shading and reduces light interception which in turn reduces photosynthesis activities of the leaves and thus reduces production and productivity of fruit trees. Moreover, high density planting reduces the opportunities of the farmers to grow other crops as intercrop in the wider spacing especially at early developmental stages of date palms to sustain their livelihoods. According to the results of the key informants, farmers in the study area use closer spacing intentionally to protect themselves from harsh hot and dry climates which are common in the area. The farmers believe

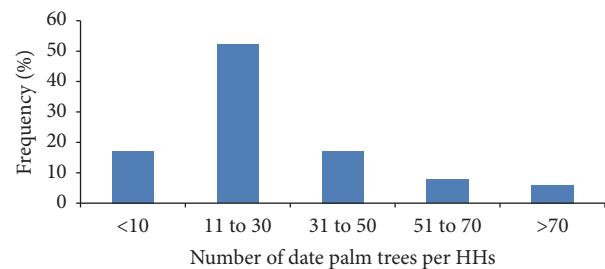


FIGURE 4: Number of date palm trees owned by the respondent households in the study area. HHs: household heads.

that dense planting improves the microclimate under the canopy and helps in tempering the harsh conditions so that life is possible in hot and arid conditions as described by Salah [11] and Hussen [13]. Larger spacing on the other hand reduces the number of fruit trees per unit area which in turn reduces the productivity of the farm land.

About 69.2% of the respondent households in the study area owned about 30 or less date palm trees in their production fields with undefined spacing which may contribute to low yield of date palm fruit in the study area (Figure 4).



FIGURE 5: Basin irrigation technology used to irrigate date palm trees in Aysaita District Community Based Research & Demonstration Site (Photos taken during field observation, 2016).

According to the respondents date palm trees are also intercropped with other crops without defined spacing.

3.2.3. Irrigation Methods Used by Agropastoralists. Irrigation is one of the most important cultural practices in an orchard. It is especially important for date palm production, as date palms are commonly grown in sandy soils with low water holding capacity. Since water is commonly scarce and small date palm trees at their early stage of development have shallow rooting system, the efficiency and frequency of irrigation are of paramount importance in date palm production to sustain production [29].

Based on the survey results, about 76.9% of the households used flooding to supply water to their date palm trees which is in line with the findings of Salah [11] where most growers in Sub-Saharan African countries used flooding technique to supply water for their date trees. Only 23.1% of the households used basin irrigation which is relatively better compared to the flooding technique (Figure 5). According to Liebenberg and Zaid [29] flood irrigation is not a suitable technology for date palm production as it is labor intensive and has difficulty in conserving water. Despite various advantages such as high water use efficiency, low running cost, easy manageability and low labor requirement, no topography limitation, and wind sensitivity [29], drip irrigation technology is not implemented in the study area.

The irrigation frequency depends on soil type, the environmental conditions, and the developmental stages of date palm trees. According to key informants, date palm irrigation is essential especially at early stage of date tree as well as during flowering and fruit set which is in line with the recommendation for date palm production [29]. Agropastoral households in the study area irrigated their palm trees every second or third days during the first six weeks of planting to facilitate their establishment.

3.2.4. Pollination Practices of Agropastoralists. As date palm trees are dioecious species in nature, the practice of pollination is an important cultural activity to produce quality fruits of commercial importance. Although natural pollination by wind, bees, and insects is possible, the fruit set by such method is fairly minimal and thus the expected yield is relatively low. On the other hand parthenocarpic fruits are without any commercial values. Therefore, artificial pollination is important to produce quality date palm fruits [14]. As indicated in Figure 6 about 62.4% of the interviewed household heads practiced artificial pollination of date palm

trees while the remaining 37.6% did not practice any kind of pollination. The agropastoralists used fresh male strand technique to pollinate their date palm trees which is in line with the recommendation for date palm [4]. According to the respondents they cut the strands of male flowers from a freshly opened male spathe and placed 2-3 of these strands lengthwise and in inverted position between the strands of female inflorescence. This is done after some pollen have been shaken over the female inflorescence as recommended by Dowson [4] for proper pollination of date trees.

3.2.5. Diseases and Insect Pests and Their Management by Agropastoralists. The date palm trees and its fruits are attacked by several diseases and insect pests that are in most cases well adapted to the oasis environment [30]. The nature and severity of the problems vary with the cultivar used, weather conditions, and cultural practices employed [31, 32]. Damage caused by insect pests in most cases leads to heavy loss in yield and thus economical losses [30, 32]. Although various diseases occurred in the study area, according to the respondents (57.3%) the most important insect pests that occurred in the study area were weevils followed by stock borer and scales where local date palm varieties were more susceptible to weevils than the improved varieties (Table 5). These findings are in line with the observations of Al-Yahyai and Manickavasagan [30] where Dubas Bug and Red Palm Weevil were the most common insect pests of date palm in the Arabian Peninsula. The agropastoralists are not using any kind of pest management practices in the study area. Therefore, due attention should be paid to the management options of pests during training sessions of agropastoralists and extension services of the developmental partners as recommended by Salah [11].

3.3. Harvesting, Yield, and Postharvest Handling of Date Palm in the Study Area

3.3.1. Harvesting Practices of Agropastoralists and Market Center of Fruits. Although proper stage of maturity at the time of harvesting depends on the distance of the market where the produces are destined and varies with the varieties [14], most agropastoralists in the study area harvested date fruit at Tamar stage (Table 6) which is generally in line with the recommended stage for most date palm varieties [33]. According to the authors date fruit at this stage are dark brown in color and have moisture less than 10% and their structure is firm. Moreover the growth of microorganisms on such fruits is reduced and the shelf life is prolonged which is suitable for long distance transport. The results of the present study are in agreement with this observation where most fruit destined for long distance transport were harvested at Tamar stage as indicated in Table 6.

Marketing is a critical issue in horticultural crops including date palm since they are perishable and cannot be stored for long period of time without quality deterioration. Local and export markets are the two important market centers where horticultural crops can be sold. About 99.1% of the household heads sold their date fruits in local markets like Aysaita town and different towns of Afambo district



FIGURE 6: The process of hand pollination of date palm in the study area (photos taken during field supervision, 2016).

TABLE 5: Common insect pests by date palm type in the study areas.

Types of insect pests	Type of date palm		χ^2	Frequency of HHs ($n = 117$)	(%)
	Local date palm variety	Improved date palm variety			
Aphids	9	1		10	8.5
Stock borer	9	10		19	16.2
Scales	11	1		12	10.3
Red palm mite	4	2	19.628**	6	5.1
Weevils	60	7		67	57.3
Mealy bug	2	1		3	2.6

Note. n: number of respondent household heads; HHs: household heads; ** statistically significant at a significant level of $p \leq 0.01$.

TABLE 6: Harvesting stages of date palm fruits and their marketing center in the study areas.

Harvesting stages of date	Marketing center			χ^2	Frequency of HHs	%
	Aysaita town	Afambo	Djibouti			
Khalal stage	8	0	0		8	6.8
Rutab stage	20	0	1	11.313*	21	17.9
Tamar stage	70	18	0		88	75.2

Note. n: number of respondent households; HHs: household heads; * statistically significant at a significant level $p \leq 0.05$.

(Table 6). Only 0.9% of the households have the capacity to sell their fruits in regional market like Djibouti. The results are generally in line with the observations of Shilpi and Umali-Deininger [34] who indicated that pastoralists generally prefer to sell their products in easy accessible markets. Moreover, local markets contribute to the economic relationships among agropastoralists which are mostly associated with pastoral livelihoods [13, 35, 36].

According to the key informants, harvesting is generally labor intensive as date fruits are mostly handpicked. It is carried out by climbing up on the date trees using local as well as modern three leg ladders made up of aluminum to reach and collect fruits easily. On the other hand maturity stages of fruits and environmental conditions during harvesting are very important considerations to reduce postharvest losses. Date fruits should be harvested at proper maturity stages and protected from direct rainfall, as rainfall increases damage on fruits through the development of spoilage microorganisms and thus reduces their shelf life [14].

3.3.2. Varieties Used by Agropastoralists and Fruit Yield. The yield of crops including date palm depends on the variety used, the prevailing environmental conditions, and the management practices employed. The introduction and adoption of productive and pest resistant/tolerant varieties are among others the key factors that influence production and productivity of date palm [23].

According to the survey results, both local and improved varieties of date palm were produced in the study areas (Table 7). The majority of the agropastoralists (81.2%) produced local varieties where the local variety *Bollo* is dominantly (91.6%) preferred by the growers. Only 18.8% of the respondent households used improved date palm varieties. About 75.8% of local variety users obtained yield ranging from 26 to 45 kg fruit per tree per year. On the other hand, about 81.8% of the agropastoralists who planted improved date palm variety recorded yields ranging from 71 to 80 kg fruit per tree per year. The yields obtained from improved varieties were statistically higher than the

TABLE 7

(a) Yield of date by palm type in the study area

Yield of date palm (kg/tree/year)	Date palm type		Total	χ^2
	Local variety (n = 95)	Improved variety (n = 22)		
20–25	8	0	8	
25–30	61	0	61	
40–45	11	0	11	116.00**
45–50	15	0	15	
61–70	0	4	4	
71–80	0	18	18	

** Statistically significant at a significance level of $p \leq 0.01$.

(b) Local varieties grown in the study area

Name	Frequency of HHs	%
<i>Harissa</i>	4	4.2
<i>Bollo</i>	87	91.6
<i>Awssa</i>	4	4.2

Note. n: number of respondent households; HHs: household heads.

TABLE 8: Major constraints of date palm production in the study area.

Category	Frequency of HHs (n = 117)	%
Inappropriate agronomic & management practices	71	60.7
Shortage of quality planting materials	13	11.1
Diseases & insect pests problems	14	12.0
Poor postharvest handling practices	11	9.4
Lack of market	8	6.8

Note. n: number of respondent household heads; HHs: household heads.

yields of local varieties in the study area ($p \leq 0.01$) as indicated in Table 7. According to the information of the key informants the local varieties currently cultivated by most of the agropastoralists were grown earlier as wild in Afar Region which is in agreement with the review made by Ashraf and Hamidi-Esfahani [37]. Therefore, introduction and adoption of improved date palm varieties in the region is of paramount importance to improve production and productivity of the crop in the study area. To this end the Ethiopian Ministry of Agriculture in cooperation with FAO has imported about 14 improved varieties of date palm from England and Israel in 2008 and introduced them to Afar Region as indicated by key informants. The planting materials of such varieties are currently produced in Melkasa Agricultural Research Center using tissue culture technology (Biotechnology) to produce disease and insect pest-free female planting materials within very short period of time [38].

3.3.3. Postharvest Handling Practices of Agropastoralists. Transportation and storage conditions are very important to reduce postharvest losses in perishable horticultural crops including date palm fruits. Storage conditions employed in the study area are however inappropriate for date palm fruits as almost all of the respondents stored and transported their date fruits in sack. Moreover, postharvest handling practices

such as washing, hydration, curing and dehydration, sorting, grading, and packaging were not practiced by the respondents. Thus the shelf life and quality of fresh date palm fruits produced by the respondents are very low and experienced very high postharvest losses. According to Glasner et al. [15] and Ashraf and Hamidi-Esfahani [37] date palm fruits should be stored in clean, cool, and dry condition to prolong their shelf life and thus to reduce postharvest losses. Moreover, drying of date palm fruits improves the shelf life.

3.4. Constraints of Date Palm Production in Afar Region. Date palm production in Afar Region has a long history and is mostly concentrated at banks of rivers and seasonal streams. The crop is neglected and grown for long period of time as wild plant without any agronomic and management practices. Currently, however, it is produced by agropastoralists in relatively organized small farms with inappropriate cultural and management practices. Constraints of date palm production in the study area are generally summarized and presented in Table 8.

According to the survey results, the majority of the respondents (60.7%) perceived that the major constraint of date palm production in the study area is poor agronomic and management practices coupled with poor postharvest handling practices. The agropastoralists lack appropriate

knowledge and skills necessary for the improvement of production and productivity. According to the key informants, high incidence of diseases and insect pests is the bottleneck for the development of date palm production in the area which is in agreement with the observations of Al-Yahyai and Manickavasagan [30] where they found Dubas Bug and Red Palm Weevil as most common insect pests of date palm in the Arabian Peninsula. According to the authors diseases caused mainly by *Phytoplasma* and fungi, such as lethal yellowing and *Fusarium* wilt, remain threats to the date palm-producing regions of the world. The knowledge and skills of agropastoralists about insect pest management options are extremely low. Moreover pesticides that can be used for the management of pests are not available in the study area.

Furthermore, lack of improved date palm varieties and their planting materials as well as use of inappropriate propagation methods were the other constraints of date palm production in the study area. Propagation of date palm is carried out exclusively through use of seed which results in low quantity and quality of date palm fruits. In addition poor postharvest handling practices such as poor storage, absence of curing, sorting, grading, and packaging, and lack of market linkage between producers and customers were also considered as problems of the sector in the study area. Date palm fruits are collected from the ground after cutting the fruit bunches which incurs damage and thus decreases the shelf life and increases the postharvest loss of date fruits.

The major constraints of date palm production observed in this study are generally in line with the observations made by Hussen [13] and Salah [11] who observed that absence of high-performing cultivars, lack of technological know-how about date palm cultivation, and inadequate and inappropriate irrigation systems are the major agricultural constraints for commercial cultivation of date palm in Sub-Saharan African countries including Ethiopia. Furthermore, socioeconomic constraints like lack of credit facilities and training sessions are the other problems for the development of commercial date palm production in the area.

4. Conclusions and Recommendation

Date palm production has long history in Afar Region which is mostly practiced by agropastoralists along the Awash River. The agronomic practices of date palm production such as propagation and irrigation methods and plant spacing employed by agropastoralists are traditional and inappropriate for the production of date palm which is inherited from generation. The agropastoralists used local varieties that are low yielders as well as low in quality. Moreover, they are using postharvest handling practices that are not suitable for the production of high quality date fruits. Furthermore, date palm production in Afar Region is constrained with lack of improved varieties, high incidence of diseases, and insect pests. Continuous training, and extension services, research, and developmental interventions in the cultivation and management of date palm trees as well as handling of date fruits by the responsible stakeholders are recommended to improve the incomes and livelihoods of the agropastoralists in the study area.

Conflicts of Interest

The authors declare no conflicts of interest.

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