

Traditional use and classification systems of cactus pear (*Opuntia ficus indica*) in Gantafeshum woreda Eastern Tigray Northern Ethiopia

Misgna Mulu

Department of Biology

College of Natural and Computational Science, Adigrat University P.O.Box 50 Adigrat Ethiopia

Abstract

Cactus pear (*Opuntia ficus-indica*), is the most popular fresh fruit used by the local people during the rainy season in Ganta Afeshum woreda, Eastern Tigray Northern Ethiopia. The present study was designed to investigate and document the Traditional use and classification system of *Opuntia ficus indica* in the woreda. The study was conducted from January 2013 to December 2014 using both primary and secondary data. Data was collected from 60 sample respondent farmers of three purposively selected Kebeles by field observation, structured and semi structured interviews and questionnaires. Descriptive type of research was applied to analyze the attained data. The result of this study revealed that 14 categories of cactus pear are available based on the traditional classification system of the local people in the study area. Five traditional devices are commonly used by the local users to manage cactus pear. The main hazards to *Opuntia ficus indica* in the woreda are herbivores, termites, and snowfall. The possible side effects while using *Opuntia ficus indica* are constipation in children, spines and glochids in all users. The local people use cactus pear for food, forage, fuel wood, income source, fence, and erosion protection. Even if the local people are using their own traditional use and classification system, modern and study based improvements are required for better usage and sustainable productivity. Therefore, this paper suggests that researchers should give more attention to improve the varieties, the use and also the equipments used for this socially friendly plant.

Keywords: Cactus pear, traditional classification, Traditional use

1. Introduction

Traditional people around the world depend on plants for food, medicine and general utility including tremendous botanical expertise, for they have unique knowledge of such resources [18]. Cactus pear is a crop species prominently in the modern folklore of ethno botany and it is recognized as ideal crop for arid regimes [11]. Why it is ideal for such regimes is due to its extreme efficiency at converting water into biomass [17]. From the different species of cactus, *Opuntia ficus indica* is one of the several long domesticated once [8] and [7]. This species is the most wide spread and economically important of these cactus crops as important as corn and Tequila agave in the agricultural economy of modern Mexico [3]. The usage of cactus pear as human food was started at least 9000 years ago [16] and [21].

Now days, *Opuntia ficus indica* is used in numerous ways. First and for most it is grown for the large, sweet fruits (often called "Tunas") which are available in local and commercial markets worldwide [4]. Mexico, Algeria, Chile, Brazil and northern Africa are among the important tuna growing regions of the world [2]. In addition, the young cladodes (stem segment of *Opuntia ficus indica*) are harvested as a vegetable crops. Although, this crop is less valuable world wide than the fruit crop, vegetable products of cactus pear are available in many local and commercial markets [22]. Various other uses have been reported; including as binding and water proofing agent in adobe [6]. Medicinal properties of *Opuntia ficus indica* especially in digestive, neurological, skin etc have been documented as early as 1552 G.C. [10]. It has been grown from pre- Columbian times as a host plant for cochineal insects for the production of voluble, vivid red and purple dyes and 150,000 hectare of land was planted with cactus pear by ranchers and small producers with government support [9].

Somewhat as was the case in south Africa until recent years, but depending also on area and circumstances, the cactus pear in Ethiopia, is vivid as both how a blessing and a curse but more so than in south Africa in Tigray it plays a crucial role in sustaining humans and live stock during drought and famine . As it is reported by Abay [1] the cactus pear also known as 'beles' in this region of Tigray, plays an important economic and cultural role, which is reflected in traditional songs and sayings also. According to Hagos, [13], more than 85% of the population of Tigray derives their livelihood directly from agriculture. Because of ever increasing human and live stock pressures on the Land, a decline in soil productivity and recurrent drought and famine, there is increasing reliance on cactus pear to minimize risk and ensure crop and food security. "Cactus pear is playing a crucial economic role as a source of food, animal feed (forage) fuel wood, and in some case as a means of additional income. There by, increasing the efficiency and economic viability of small and low income farmers". As came to the case of Ganta Afeshum woreda, irrespective of its potential of cultivation of variety and abundance of *Opuntia ficus indica* and other resources, this sector of development is not as it is expected and still

now, the agriculture sector, which is highly dependent in nature, is not giving much reward to the economy. Producing surplus food and sufficient product to the market is hindered by many factors [14]. Then the study was conducted, with the aim to assess and document the traditional use and classification mechanisms of *Opuntia ficus indica* in Ganta Afeshum woreda.

2. Objectives of the study

2.1.1. General objective

The general objective of the study is to assess the traditional use and classification systems of *Opuntia ficus indica* in Ganta Afeshum woreda.

2.1.2. Specific objectives

The specific objectives of the study are:-

- To document the varieties of *Opuntia ficus indica* based on the traditional classification system of the woreda.
- To determine the traditional devices used for harvesting *Opuntia ficus indica* in the woreda.
- To identify the awareness of the local society on the benefits, side effects and possible hazards of *Opuntia ficus indica* in the woreda.
- To check the limitations of the local people and recommend possible solutions that can help the society.

3. Materials and methods

3.1. Description of the study area

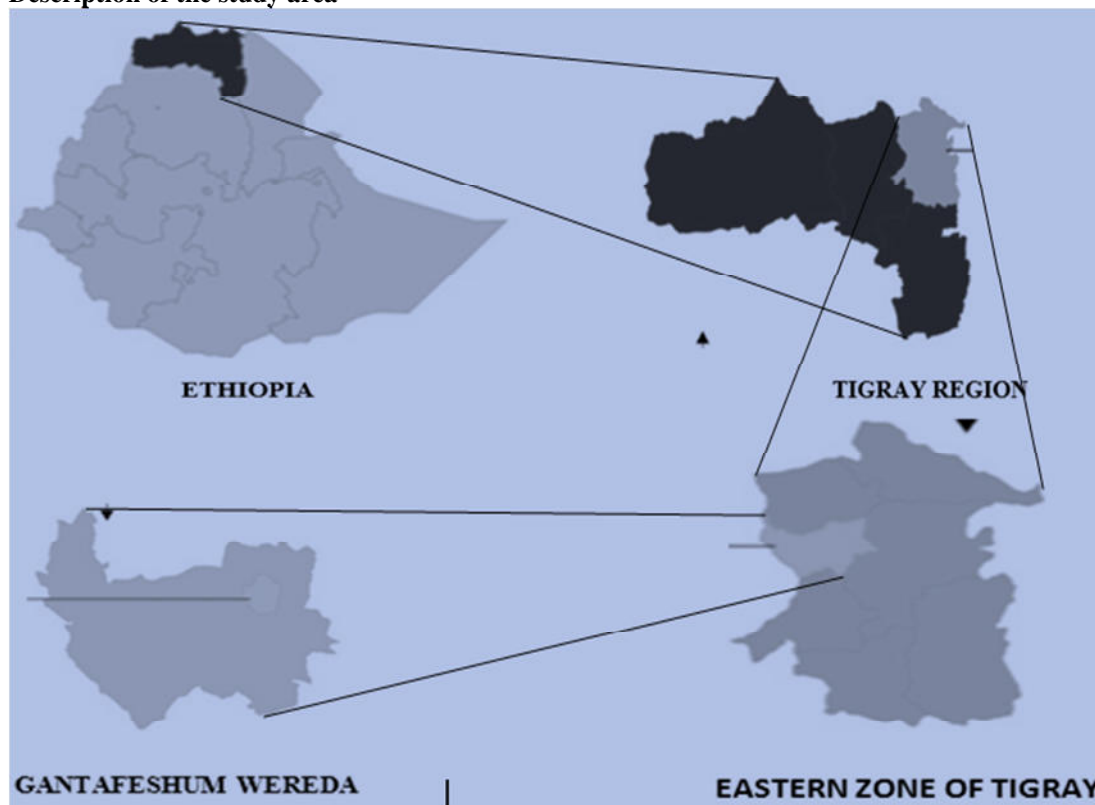


Figure 8 Location of Ganta Afeshum Woreda

The study was conducted in northern part of Ethiopia, eastern zone of Tigray, at Ganta Afeshum woreda. Ganta Afeshum woreda is located in Tigray regional state of Ethiopia which is bordered on the south by Hawzen woreda, on the west by Ahferom woreda, on the north by Gulomahda woreda, on the east by Saesi Tsaedaemba woreda and surrounding the separate woreda of Adigrat town [23]. Adigrat town is the administrative center of Ganta Afeshum woreda. The total population of this woreda is 88,644 of whom 42,096 are men and 46,548 are women [24]. Ganta Afeshum woreda is about 921 km far from Addis Ababa and 115 km from Mekele town, the capital city of Tigray regional state. It is located at an altitudinal range from 1900 to 3000 meters above sea level. It has different agro-ecological areas namely Dega, Weina dega, and Kola. Its annual rainfall ranges from 450 mm to 650 mm. Its maximum rainfall occurs from June up to September. Agriculture is the main occupation

of the woreda. The agricultural activities are mainly mixed type with cattle rearing and crop production under taken side by side.

3.2. Study design

Both structured and semi structured questionnaires were prepared focusing on the traditional management of opuntia ficus indica in the woreda. For this purpose 60 purposively selected farmer respondents were interviewed. Field observation and focus group discussions were also made.

2. Sample size and sampling procedure

In the present study, 3 kebeles of Ganta Afeshum woreda, namely Sasun Bethaweriat, Buket may aba and Gola genahti were purposively selected based on the degree of cactus pear availability, transport accessibility, and history of cactus pear distribution. 20 households were purposively selected from each kebele for the interview and hence a total of 60 respondents were included in the study. All the cactus pear owned and used by the sample respondents was considered as study plant, to assess and document the traditional use and classification systems of opuntia ficus indica in the study area.

3.3. Data collection

A detailed and organized structured and semi structured questionnaires were designed in an attempt to generate basic information related to the traditional management of cactus pear with particular emphasis on traditional use and classification system of opuntia ficus indica. The questionnaires were prepared in such a way that farmers could give information that are recent and easy to recall and it was filled directly by interviewing the purposively selected respondent farmers from villages of the 3 kebeles. Field observation and focused group discussions were also made to generate relevant information about opuntia ficus indica in the study area.

3.4. Data Analysis

The data, obtained in this study were analyzed using descriptive statistics.

4. Result and discussion

4.1. Age-sex composition of respondents

The age and sex composition of the respondents is clearly tabulated (Table 1). Out of 60 respondents, 40% and 23.4 % of them were found between the age group of 20-30 and 41-50 year respectively. The respondents age group of >50 years males and females account a very small proportion of which six male respondents or 10% and five female respondents which are 8.3%. However with the age from 31-40 years are about 11 respondents or 18.3% or 4 female respondents 6.7% and seven male respondents 11.7% were found in the level.

Table1. Age-sex composition of the respondents

Age	Male N (%)	Female N (%)	Total N (%)
20-30	11 (18.3)	13 (21.7)	24 (40)
31-40	7 (11.7)	4 (6.7)	11 (18.3)
41-50	7 (11.7)	7 (11.7)	14 (23.4)
>50	6 (10)	5 (8.3)	11 (18.3)
Total	31 (51.7)	29 (48.3)	60 (100)

4.2. Introducing opuntia ficus indica to Ganta Afeshum Woreda

As it is shown in (table2), Opuntia ficus indica is invasive to Ganta Afeshum woreda. From the total of 60 respondents, 60% of them suggested that opuntia ficus indica was introduced from Italy with Italian soldiers in the periods when Italy invade Ethiopia on October, 1935 to May, 1935. During this time, opuntia ficus indica was introduced with faces of Benito Mussolini soldiers to northern part of Ethiopia border of Eretria and distributed by birds. About 36.7% of the respondents stated that opuntia ficus indica was introduced from Rome in around 1845 by missionaries or believers of Catholic Church when they migrate to south east part of Adigrat town namely Golaa. This agrees with [15] and [20] who reported that missionaries were the ones that introduced cactus to Northern Ethiopia around 1847/8.

Table2. Introducing of cactus pear to Ganta Afeshum Woreda

Number of respondents	Item								
	Where			When			How		
	Italy	Rome	Eretria	1904	1935	1845	Bird	soldiers	Imigration
10	√					√		√	
2			√	√			√		
18	√				√			√	
22		√		√					√
8	√				√			√	
Total	36	22	2	24	26	10	2	36	22
Percent	60	36.7	3.3	40	43.3	16.7	3.3	60	36.7

4.3. Farmers interest to cultivate Cactus pear

The interest of the farmers to cultivate *opuntia ficus indica* is different due to different reasons (Fig 2). From the total of 60 respondents, 80% of them have a good interest to cultivate *opuntia ficus indica*. Their reason is due to its multipurpose nature. They stated that it can grow in severely degraded soil which is inadequate for other crops; it is the best alternative plant to protect soil erosion within a short period of time. 1.7% of the total respondents have no interest to cultivate *opuntia ficus indica* due to the following reasons. The presence of spines and glocheds, its seasonal nature, the enability to store the fruits for long period of time and its availability in mountains as a wild plant are their main ones. The other about 18.3% of the respondents are in a border line due to the mismatching ideas listed above.

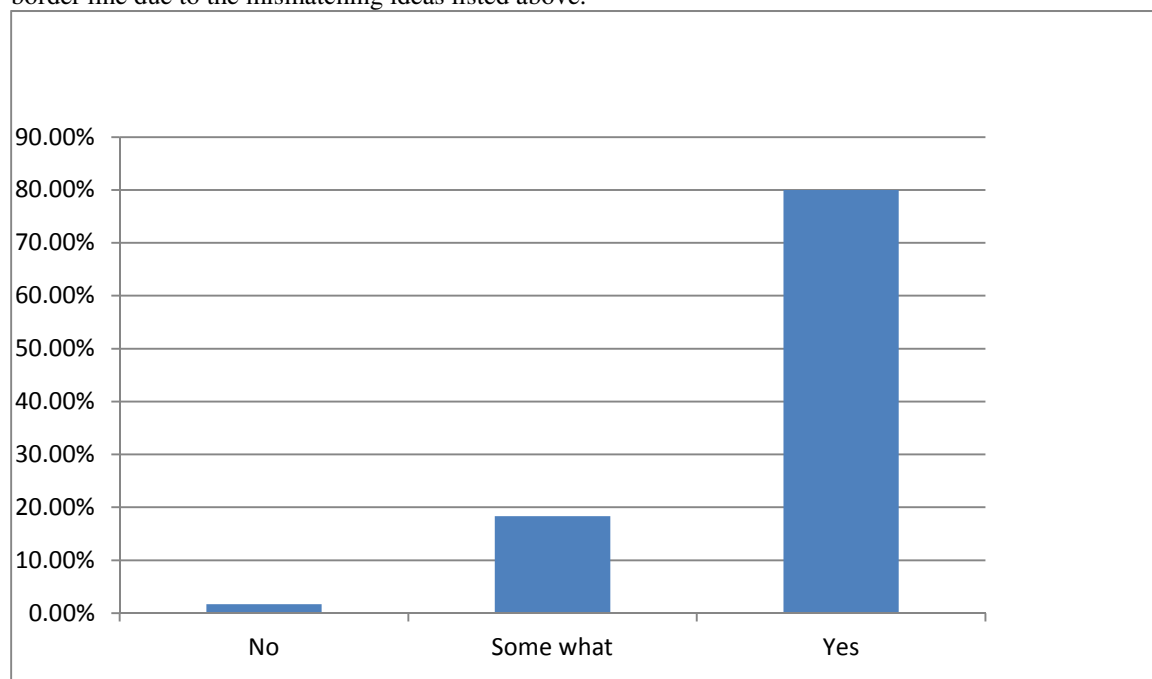


Fig.2 Interest of respondents to cultivate *opuntia ficus indica*

4.4. The use of Cactus pear to the farmers

All the respondents (Figure 3) stated that *opuntia ficus indica* is used as a source of food and forage including the time of draught and shortage of food availability. Majority of the respondents discussed that this plant is the guarantee of poor, given from the lord God. Accordingly, it can be suggested that *opuntia ficus indica* can play a great roll in the improvement of food security of the society. It is not only that but 25% of the respondents have stated that *opuntia ficus indica* is used as medicinal plant and for alcoholic beverage preparation. This agrees with [5] and [19] who reported that cactus pear in Tigray used as a source of food, forage, fuel wood, cash income, raw material for various industrial products, as live fences and soil conservation purposes. Even if this also agrees with the idea of [12], the use of cactus pear for cochineal production is not known in this woreda. As the explanation of these respondents, even though they have the awareness, they are not practicing the beverage preparation due to lack of experience. The people are using only the fruit as a fresh food for themselves and the cladodes and the peel of the fruit for their cattle but not in the forms of juice and beverage.

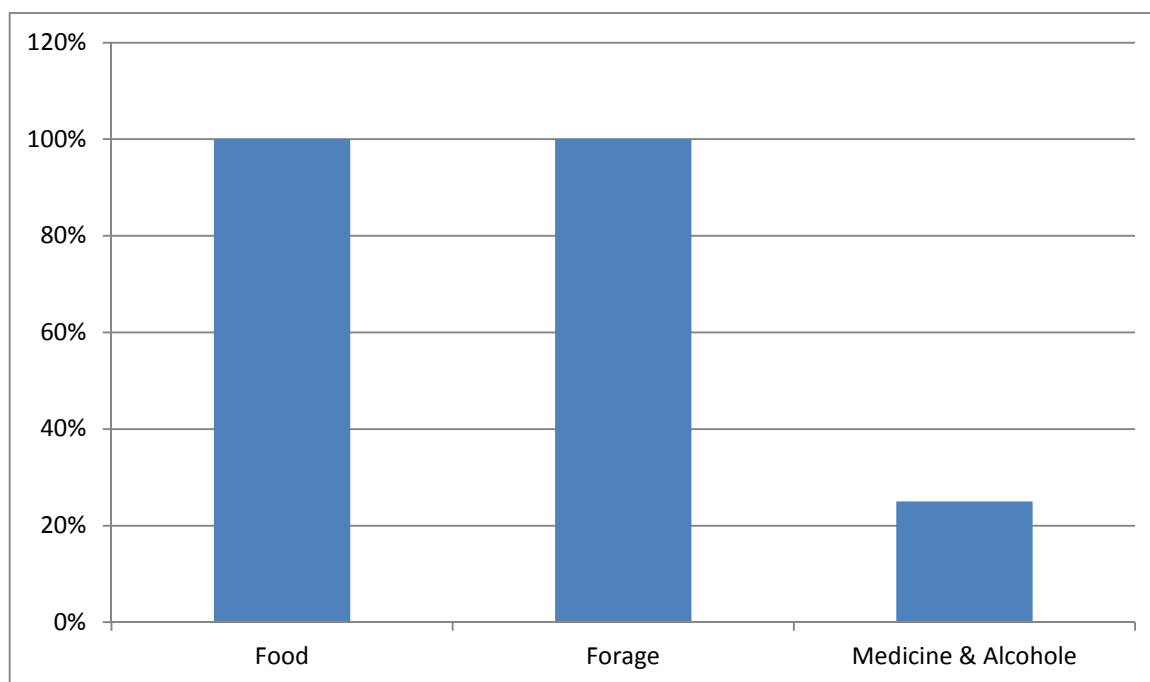


Fig. 3 The use of Cactus pear for the respondents

4.5. Procedures in using the fresh fruit for human food

Everybody in GAW knows how to use the fresh fruit for eating. It has its own procedures to use that fruit.

1. Choose the ripen one and pick it down with tools like wire or beaker.
2. Avoid all the glochedes gently with tree leaves especially conifer plant is used to avoid the glochedes. Try to make sure that the fruit is free of glochedes.
3. Peel the skin part gently by using a small knife and enjoy the delicious test of this sweet fresh fruit. The youths are experienced enough to peel the fruits with their fingers even rarely without avoiding the glochedes also.

4.6. Procedures in using the cladodes for cattle feed (forage)

1. Select the mature cladodes and cut them by using cutting tools like sickle, machete or knife.
2. Burn the spines by using flames only if you use spiny cladodes. If it is spine less, no need to use fire.
3. Cut the spine free cladodes in to pieces small enough for consumption by the cattle.
4. Serve the cattle.

4.7. Traditional Classification of Cactus pear

As it is shown in (table 3), the local people of Ganta Afeshum woreda classifies *opuntia ficus indica* using their own criteria. Based on these traditional classification systems of the local people, there are different types of Cactus pear. 100% of the respondents suggested that their main criteria to classify *opuntia ficus indica* is color of the edible fruit. Based on this criteria, it is classified as qeyh(red), tsaeda(white) and qetelia (bright red). On the other hand all the respondents stated that they also use thorn of the stem as criteria to classify Cactus pear. Based on this criteria, it is classified as ashaque (spiny) (Fig 3A) and lemats (spine less) (Fig 3. 25 % of them also classify it based on the habitat as beles chincha (if it grows in stony areas) and beles dikui(if it grows in organically fertile area). The other criteria stated by 13.4% of the respondents is the internal composition of the edible fruit. Based on this criteria, Cactus pear is classified as hamblo (thick skinned), beso(seed less), atsam(if thin bone like structures are available in the fruit), carrot(hard flesh and chunky seeds), firuy(normal) and manta (twin).

Table 3 Traditional classification of opuntia ficus indica

No.	Criteria	Category	Characteristics	Number of respondents	Percentage (%)
1	Color	qeyh	Red	60	100
		Tsaeda	White		
		Qetelia	Bright red		
2	Spine of the cladodes	Ashaque	Spiny	60	100
		Lemats	Spine less		
3	Habitat	Beles Chinchu	From stony area	15	25
		Beles Dikui	From organically fertile area		
4	Physical composition of the edible fruit	Hambilo	Thick peel	8	13.4
		Beso	Seed less		
		Atsam	Contai thine bone like structures inside		
		Carrot	Hard flesh and chunky seeds		
		Firuy	Normal		
		Manta	Twins		



Fig.4. Two varieties of cactus pear. A) spine less variety. B) Spiny variety

4.8. Signs of ripening of cactus pear

The local people have their own mechanism to detect the ripening of the fruit (table 4). All the respondents stated that the main indication of a ripened cactus pear fruit is its change in color. The unripe one is green in color in all the categories of the cactus pear fruit. When it becomes matured, it changes from green to red, white or bright red. Even children and birds can detect its ripening depending on the color change. It is not only this but there are also other techniques used by the local people. 80% of the respondents stated that when the fruit starts ripening, it becomes softer. Then softening of the fruit is one sign to decide it as ripe. The unripe fruit is hard in texture. On the other hand, 55% and 35% of the respondents state falling flowers and glochids and flattening in the interior and peripheral part together with change in size respectively. These respondents explain that when cactus pear fruit is ripened, its dry flower falls down. The glochides starts falling and the ripened one has less glochides than the unripe one. The size of ripened cactus pear fruit is also bigger than the immature one.

Table 4 Determination of ripening of opuntia ficus indica fruit

Sign	No. of respondents	Percentage (%)
Color change	60	100
Change in texture	48	80
Falling its glochedes and flowers	33	55
Change in size	21	35



Fig. 5 Color change during ripening of cactus pear fruit

4.9. Traditional devices used for Cactus pear

Majority of the respondents (65%) respond that they use wire to harvest the cactus pear fruit. 25% of the respondent use both wire and beaker but the 10% uses only beaker for harvesting the fruit. The fruit harvested with wire is highly susceptible to spoilage due to the physical piercing by the wire. It has also less demand in the market especially for transportation to long distance markets. The respondents who use this device stated that they are using it due to lack of awareness and experience about the other devices. Their idea is that this device is easy to make and fast to harvest the fruit. The respondents who use both wire and beaker are transforming themselves to adapt the beaker. They use wire to harvest fruit for their consumption and beaker to harvest the fruit for sell. The respondents who use only beaker to harvest the fruit stated that they completely transformed themselves from using wire to beaker due to the following reasons. The main reason is that the fruit harvested by beaker has safety for use and storage. It has more demand in market by customers. It can be transported to fare places. It is safer to eat than the one harvested by wire. The fruit harvested by wire is not safe for self consumption also. Glochedes that penetrate through the pierced part can injure the tongue and other fleshy mouth parts. The other reason is that it is easier to make beaker than wire. It can be made from left over beakers and wood from the surrounding. The wire one needs to buy from market. While using wire you can lose the fruit or you can also tear it which is wasting time, energy, and the fruit at the same time. When using beaker, you will not have such wastages.



Fig. 6. Traditional devices used for cactus pear. A) Traditionally prepared scalpels ('Mekref') to peel tunas. B) Traditional basket ('Kefer') container for tunas. C) Traditional wire ('Dekle') to pick up tunas

Table 5 Different traditional devices used to harvest opuntia fruit.

No.	Harvestng device	No. of respondents	Percentage (%)
1	Wire	39	65
2	Beaker	6	10
3	Both (beaker and wire)	15	25

Planting procedures

According to the respondents, the local people plants cactus pear in areas which are not comfortable for other crops. Stony, rocky and hilly places are more preferred sites for cactus pear. Bordering of farm lands and natural drainage areas are also preferable sites of cactus pear by the local farmers. The local farmers have their own procedures to plant cactus pear.

Procedures used by the local people to plant cactus pear

1. First select an appropriate site and prepare it.
2. Select good varieties to take cladodes from.
3. Take cladodes cutting appropriately.
4. Place it in upright position if it is rainy season and in flat position if it is dray season.
5. Support it with soil and stones from the bottom and keep it from herbivores.

Opuntia ficus indica can also reproduce from seeds (Fig 7 B). As it was understood from the long term observation, seeds can be dispersed by predators like human, birds, and herbivores(Fig.7 A). Once a seed falls on soil, it can grow in to new plant. Cactus pears grown on top of houses are best evidences for this type of reproduction. The farmers in Ganta Afeshum woreda do not use this type of reproducing technique for it is easier to use the cut and throw method.

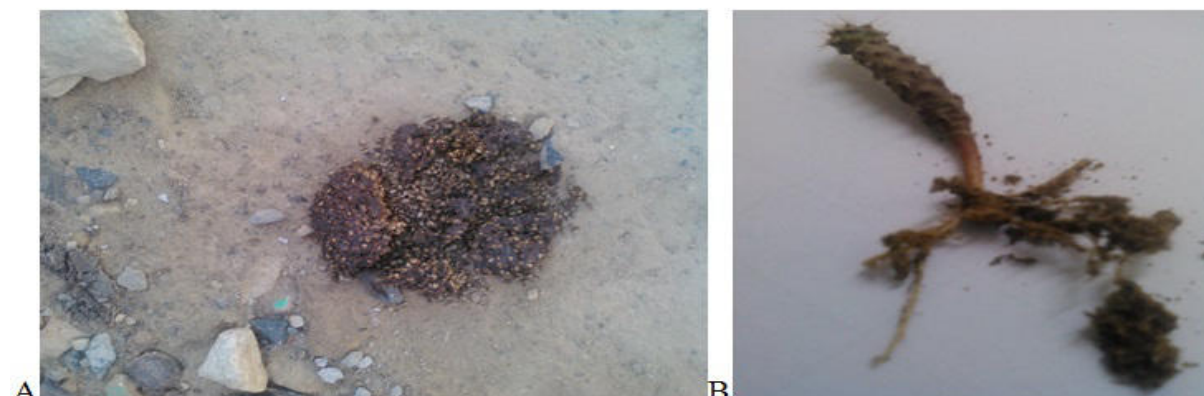


Fig. 7 A) Cactus pear seeds dispersed in faces. **B)** Cactus pear germinated from seed

5. Recommendations

- Using the traditional knowledge of the society as a base line, more researches should be done to develop the capacity of the users in using cactus pear.
- Attention should be given by government to transform the traditional equipments in to modern and safe devices. This includes training of farmers on how to manage cactus pear, Prizing and encouraging new discoveries and good modifications.
- Factory related market should be available to encourage the farmer's productivity. If more demand is created, the farmer will give more attention to the plant and get profit from their cultivation.

6. Acknowledgment

The author is great full to the contributions of the respondent farmers for their time and unlimited help during the study period. This study was done with the willingness of the author but there was no institution or organization contributing any financial fund.

7. References

- [1]. Abay, F. 1997. Tapping farmer's knowledge; cactus (*Opuntia ficus-indica*) diversity for future improvement in Tigray, Ethiopia. Paper presented at the International Workshop on 'Opuntia in Ethiopia: state of knowledge in Opuntia research'. Mekelle University College, Tigray, Ethiopia, 22 to 27 February, 1997.
- [2]. Barbera G. F. Carimi P. Inglese 1992. Past and present role of the Indian-fig prickly-pear (*Opuntia ficus-indica* (L.) Miller, Cactaceae) in the agriculture of Sicily. *Economic Botany* 46: 10-20. Web of Science
- [3]. Barrientos P. F. 1966. El nopal y su utilización en Mexico. La Sociedad Mexicana de Historia Natural, Mexico City, Mexico.
- [4]. Basile F. 2001. Economic aspects of cactus pear production and market. *Journal of the Professional Association for Cactus Development* 5: 31-46.
- [5]. Brutsch, M.O., 1997. The Beles or Cactus Pear (*Opuntia ficus-indica*) in Tigray, Ethiopia. *J. PACD* 2:130-141 Department of Agronomy, Faculty of Agriculture University of Fort Hare
- [6]. Cárdenas A. W. M. Arguelles F. M. Goycoolea 1998. On the possible role of *Opuntia ficus-indica* mucilage in lime mortar performance in the protection of historical buildings. *Journal of the Professional Association for Cactus Development* 3. Online at [http:// www.jpacd.org/contents1998.htm](http://www.jpacd.org/contents1998.htm).
- [7]. Casas A. G. Barbera 2002. Mesoamerican domestication and diffusion. In P. S. Nobel [ed.], *Cacti: biology and uses*, 143-162. University of California, Berkeley, California, USA.
- [8]. Casas A. J. Caballero C. Mapes S. Zárate 1997. Manejo de la vegetación, domesticación de plantas y origen de la agricultura en Mesoamérica. *Boletín de la Sociedad Botánica de México* 61: 31-47.
- [9]. Donkin, R. (1977). Spanish Red: anethongeographical study of cocchineal and the opuntia cactus "transaction of the american philosophical society 67: 1-77.
- [10]. Emmart E. W. 1940. *The Badianus manuscript*. The John Hopkins Press, Baltimore, Maryland, USA.
- [11]. Felger R. S. 1979. Ancient crops for the twenty-first century. In G. A. Ritchie [ed.], *New agricultural crops*. American Association for the Advancement of Science Symposium, vol. 38, 5-20. Westview Press, Boulder, Colorado, USA.
- [12]. Gebremeskel, G., Getachew A. and Firew T., 2013. Assessment of the potential of cactus pear (*Opuntia ficus indica*) as livestock feed in Northern Ethiopia, *livestock research for rural development* 25(2).
- [13]. Hagos, F. 1997. The role of 'beles' in household food security under different farming systems of Tigray. Paper presented at the International Workshop on 'Opuntia in Ethiopia: state of knowledge in Opuntia research'. Mekelle University College, Tigray, Ethiopia, 22 to 27 February, 1997.

- [14]. HaiIeselassie Tsegay. (2009). Differential uses of cactus pear and income of house hold in estern Tigray, Ethiopia. Mekele University, Ethiopia.
- [15]. Kibra, K., 1992. Agro-ecological constraints and the role of cactus pear on household food availability. M.Sc.Thesis, Agricultural University of Norway.
- [16]. Kiesling R. 1998. Origen, domesticación y distribución de *Opuntia ficus-indica*. Journal of the Professional Association for Cactus Development 3. Online at <http://www.jpacd.org/contents1998.htm>.
- [17]. Kluge M. I. P. Ting 1978. Crassulacean acid metabolism: an ecological analysis. Ecological studies series, vol. 30. Springer-Verlag, Berlin, Germany.
- [18]. Martin, G.J. (1995). Ethnobotany: A method Manual. Chapman and Hall, London. Pp. 265-270
- [19]. Mitku, H. Tesfay B. and Zimmerman, H.G., 2002. Current and potential use of cactus pear in Tigray, Northern Ethiopia. In: Proceeding of IVth International Congress on Cactus Pear and Cochineal. pp. 75-86. (Nefzaoui, A. and Inglese, P. eds.). Acta Hort. 581, ISHS, Hammamet, Tunisia.
- [20]. Neumann, L., 1997 Opening speech. In: Proceedings of the International Workshop on “Opuntia in Ethiopia: State of Knowledge in Opuntia Research” February 23-27, 1997, Mekelle University, Ethiopia and Wiesbaden Polytechnic, Germany, pp 5-9
- [21]. Ostolaza C. 1994. Cactus y etnobotánica. Quepo 8: 79-86.
- [22]. Sáenz-Hernandez C. J. Corrales-Garcia G. Aquino-Pérez 2002. Nopalitos, mucilage, fiber, and cochineal. In P. S. Nobel [ed.], *Cacti: biology and uses*, 211–234. University of California, Berkeley, California, USA.
- [23]. http://en.wikipedia.org/wiki/Ganta_Afeshum retrieved on: 29-5-15
- [24]. Census 2007 Tables: Tigray Region, Tables 2.1, 2.4, 2.5 and 3.4.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:

<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

Academic conference: <http://www.iiste.org/conference/upcoming-conferences-call-for-paper/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

