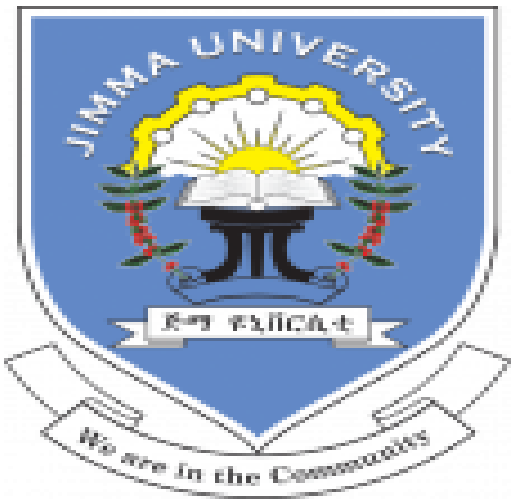

College of Natural Sciences

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Feeding Ecology and Pest Status of Common Mole Rat (*Tachyoryctes splenden*) in Selected Agricultural Fields, Dewachefa District, Oromia Special Zone, North East, Ethiopia

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List of abbreviations and acronyms

ANOVA	Analysis of variance
CSA	Central Statistical Agency
GPS	Geographical Position System
HB	Head - Body length
HF	Hind foot length
SPSS	Statistical Package for Social Sciences
TL	Tail length

Appendix

Acknowledgements

I would like to express my deepest gratitude to my Advisor, Dr. Tadese Habtamu Jimma University for his valuable encouragements suggesting the topic of study and for his consistency and patience in correcting the manuscript. I am also thankful to my Co Advisor ,Gadisa Natea(Msc) the one who encourages me in my research work.I would also like to extend my deepest gratitude to my internal examiner Dr. Tsegaye Gadisa from Jimmaa University for his fruitful advice and instruction methods of the study in the field. My sincere thanks also go to my friends Mohammed Aragaw,and my brother Kider Asefa and Awol Asefa for their unforgettable support during my study period. I would like to thank wollo university National harbarium Centere for help in stomach content analysis. I would like to thank my parents Rahmet Yasin and Asefa Muhe,My sister Shebere Asefa, Zeyineb Asefa for all unfailing love, support and encouragement during the study period. I acknowledge jimma university, for providing financial support.

Abstruct

This study was conducted to assess the abundance, distribution, feeding habite, population structure and impact of common mole rat on agricultural products in three selected kebeles on Dewachefa District,Oromia special zone, North East, Ethiopia.The study was conducted for two seasons (August and September) and (November and December, 2019) wet and dry season respectively. The abundance and distribution of common mole rat in the three selected study sites were estimated from fresh mound count. Localy made snap conical traps were used to capture common mole rats. To identify the food sample and quantity of food fragments,stomach content analysis was conducted. Semi-structure interview with open and closed-ended questions were used to gather relevant information about traditional control mechanisms. T-test was used to compare two related means (external body measurement and burrow system between seasons and sex ratio). A total of 45 common mole rats (30 males and 15 females) were trapped from the three study sites in both seasons. The abundance of common mole rats in selected three study sites (Siter (34), Bedeno (30)and Tuche (23)), was not statistically significant (t = 3.464, p = 0.074). The total damages of Sugarcane and Banana in both seasons in three selected kebeles were 11.56 % and 3.2% respectively. From a total of 661 isolated food fragments of stomach sampel,Grass with 225 (34 %) contributed the largest proportion, followed by Sugarcane (31.2%), Banana (24.5 %) and Papaya (10.3 %) as food items. From the response of 52 respondents, the techniques such as trapping (32.7 %) and rodenticide (23.1 %) were majorly used to reduce the impacts of common mole rats.The result of this research indicated that the abundance and distribution of common mole rats were high in grassland and Sugarcane habitats.Therfore, the researcher strongly belives that further investigation should be conducted to reduce the damage by common mole rats on the agricultural crops.

key word : Agricultural fields, crops , Dewachefa , Pest status, *Tachyoryctes splendens*

1.Introduction

1.1 Backeground

The root-rats, genus Tachyoryctes Rüppell, 1835 endemic to African are solitary subterranean rodents. They live in underground,in semi-permanent burrow-systems,and are exclusively herbivores (Jarvis, 2013). According to Jarvis and Sale (1971) the adult males weigh an average of 250 g with an average head and body length of 202 mm. *Tachyoryctes splendens*, one of the species in the genus has a thick soft fur that ranges in color from a shining black to brown, reddish brown, pale gray and cinnamon buff (Happold and Happold, 1991). The short and powerful legs are suited for digging (Ziyine, 2005).

Tachyoryctes splendens are the least modified for fossorial life of the East African common mole rats. It can construct a burrow system consisting of a nest chamber, a bolthole, and a number of foraging tunnels. The nest chamber is used for sleeping, storing food and sanitation (Munir, 2006). Burrows of all the common moles have a similar architecture. They consists of numerous long superficial foraging galleries (15 - 35 cm deep) and usually a deeper area, more protected from predators and from temperature extremes (Davies and Jarvis 1986; Lovegrove & Painting 1987).The total length of a burrow system may reach up to 52 meters (Kingdon, 1974). Jarvis and Sale (1971) reported that all burrow digging was done with the incisors unless the soil is very soft.

In Ethiopia, the *T.splendens* is mostly found between 1300 and 3900 meters above see level (Yalden *et al*., 1976 cited in Mengistu and Bekele, 2003). It can also live at elevation of upto 4150 meters above sea level (Kingdon, 1974).

It prefer open habitats like grasslands, wooded savannah with scattered trees and cultivated areas with loose soil in different regions in Ethiopia (Yalden, *et al.*, 1976; Bekele and Leirs, 2003). *Tachyoryctes splendens* is a solitary fossorial rodent that occurs in central Africa in a wide variety of habitat types including agricultural areas where it is regarded as a pest (Bennett and Jarvis, 1995; Kingdon, 1997).

Tachyoryctes splendens feeds mainly on the underground parts of plants. Such as roots, rhizomes, tubers, bulbs, corms and also it sometimes comes to the surface to forage for nesting materials and food for instance grasses and cultivated legumes (Jarvis and Sale, 1971; Kingdon, 1974; Nowak, 1999). A feeding behavior of *T.splendens* makes it an

agricultural pest. It causes agreat damage to crops like Enset (*Ensete ventricosum*), Potato (*Solanum tuberosum*) and Maize (*Zea mays*) in southern,western and central regions of Ethiopia (Mengistu and Bekele, 2003).The common mole rats are the major pest which attach the Banana rhizomes in Debub Ari District, South Omo Zone, Southern Ethiopia (Gezahegn *et al* ., 2018 and Loth , 2017). The common mole rat is a known pest on Enset, grass, Potatoes, Sugarcane and other crop plants and cause significant reduction of yield in Angecha, centeral Ethiopia (Kokiso, 2006). This reduction of yield could be a serious problem in areas where the major crop plants like Sugarcane, Banana and Papaya and as well as grazing grassland.To reduce this crop loss, proper control and sustainable management of pests should be given priority (Greaves, 1982 ; Singleton, *et al.,* 2003).
The ecology of common mole rats are still poorly known in different parts of Ethiopia (Wube, 1999).

Based on information from rural and agricultural development office and by observing the amount of crop loss caused by common mole rat (*Tachyoryctes splendens*) in the District three kebeles (Siter, Bedeno and Tuche) were selected. The cultural practices of the people live in this district remained primitive and at subsistence level where crop yield is low to feed such a high population .In addition to these rodent pests reduce crop yield. Among the rodent pests, the East African common mole rat (*T. Splendens)* is the most economically prominent important rodent pest of the district when i observed during preliminary servey. However, no study has been conducted on common mole rat to assess its distribution, abundance, diet composition, pest status and control measures in these district. Therefore, this study tried to investigate distribution, abundance and feeding habit of common mole rat. The findings of this study will be used as a sources of information for interested persons who wanted to conduct further researches in the future.

1.2 Statement of the problem

In Ethiopia, many studies have been carried out about rodents (Bekele,1996 ; Gebresilassie *et al*., 2004 ; Gadisa and Bekele , 2006; Mengistu, 2011). However, sufficient information about the feeding ecology and pest status in different localities of the country, particularly for common mole rat is too rare (Wube, 1999). The common mole rats are the major pest which is attack differenet kinde of crops like Enset , Sugarcane , potato and other crops in agricultur field (Mulatu , 2015).

Dewachefa is one of the districts in Oromia special zone where different crop plants and friuts are grown.Common mole rats destroy different types of plants including Sugarcane, Banana, vegetable, cereal and grazing grassland due to their ubiquitous feeding habit. According to information from farmers due to unproper control of common mole rats, farmers are suffering by the impacts of this species. Thus, proper control and sustainable management of common mole rat is prerequist to keep food security in the discrit specially for farmer who depend on monocultural system .

Hence, this study was undertaken to gather information about abundance, distribution , feeding habit and economic impacts of common mole rats on agricultural crops in selected farms in the district which is essential for future control and managment activity.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study was to assess the distribution, abundance, feeding habit and economical impact of common mole rats on agricultural products in selected area of Dewachefa district Oromia special zone, Northeast, Ethiopia.

1.3.2 Specific objectives

- ✓ Determine the population structure of common mole rat
- ✓ Determine the abundance and distribution of common mole rat
- ✓ Determine the feeding habit of common mole rat
- ✓ Identify the type of crops most affected by the common mole rat
- ✓ Estimate economic loss in agricultural fields and grazing grasslands due to common mole rats
- ✓ Asses traditional control strategies used by the local people to minimise the impacts

1.3.3 Significance of the study

The finding of this study had a significant value to provide information on distribution, abundance, feeding habit and economic impact of the species on agricultural product. Hence the result gives good information regarding the types of crops which are mostly affected and the amount of lost.In addition it could be a source of important information for the society to introduce different integrated pest management techniques to control common mole rat attack and ensure agricultural productivity in the farmland. Further more, it express the season

associated with sever crops damage and the farmers whose crops are exposed to such damage. It has also significant contribution for affected farmers inorder to screen out their problem to concerned stake holders.This study will instigate other researchers to conduct related studies which has not been investigated.

2. Litrature review

2.1 Taxonomy

The root-rats of the African endemic genus Tachyoryctes Rüppell, 1835 are solitary subterranean rodents, living underground in semi-permanent burrow-systems it belongs to the one of the mammalian Order Rodentia (Leonid *et al*., 2014).

According to Nowak (1999), the total number of species in the genus Tachyoryctes is not clearly known. Baskevich *et al*.(1993) considered *Tachyoryctes splendens* as one of the 14 species of the genus Tachyoryctes. Ellerman (1941) placed it to the family Muridae while Baskevich *et al.*, (1993) and Kingdon, (1974) grouped it the family Rhizomyidae. Formerly, naming of the species was based upon colour and geographical variations (Yalden *et al*., 1996; Greaves, 1989). In the family of Rhizomyidae 11 species of the genus Tachyoryctes were recognized (Kingdon, 1997). Recently many taxonomists agree to include two species in the genus Tachyoryctes: the wide spread, *T. splendens* and the larger, *T. macrocephalus* which is confined only to the Bale Mountains of Ethiopia (Yalden *et al*., 1976).

2.2 Physical description of *Tachyoryctes splendens*

The external morphology of East African species (*Tachyoryctes splendens*) is basically rat like can be black, brownish, reddish brown, pale gray cylindrical with small eyes and ear pinnae, short limbs and tail, broad feet and large prominent incisors are modifications for underground life. In south Ethiopia, Kokiso (2006) in Angacha district from 14 specimens recorded, head and body length of 222 to 268 mm, tail length 54 to 80 mm, hind foot length 29 to 33 mm and skull length of 47 to 57 mm.

2.3 Distribution of common mole rats

The distribution pattern of the East African common mole rat (*Tachyoryctes splendens*) is discontinuous ranging from Ethiopia and parts of Somalia as far as Eastern Zaire, Burundi and Northern Tanzania (Nowak, 1999). It is native to East Africa and the eastern parts of Central Africa. It is found at elevations of up to 3,300 metres in Ethiopia and up to 3,000 meteres in other parts of its range (Musser *et al*., 2005). It is an adaptable species and able to live in a range of habitats including savannah, moist tropical forest, agricultural land, pasture, coffee plantations and gardens. They seldom occur in areas with less than 500 mm rainfall

per annum, but they are best established in wet uplands (Kingdon, 1997; Nowak, 1999).The distribution pattern of common mole rat varies and fluctuates seasonally based upon altitude and vegetation cover as well as climatic factors like precipitation (Bekele and Mengistu, 2003). Tachyoryctes favours deep, well-drained, often-volcanic soils, rainfall over 510 mm a year and vegetation cover of grass to open forests (Jarvis and Sale, 1971).Thus, local distribution of common mole rat is influenced by topography, soil and vegetation characteristics of the habitat. Since areas of suitable soil and vegetation are patchily distributed, individuals also tend to be spatially clumped (Bennett and Faulkes, 2000).

2.4 Burrowing system

All subterranean rodents including *T.splendens* excavate burrows by shearing soil from the wall of tunnels, pushing the loose soil behind them and then moving the soil through a lateral tunnel to the surface (Jarvis and Sale,1971).The East African common mole rats, *T. splendens* construct large, single, multipurpose nest for food storage, sleeping, sanitation as well as for breeding (Jarvis, 1973; Jarvis and Sale, 1971). Common mole rats,*T. splendens* have a blind-ended tunnel, the bolthole at the deepest part of the burrow system it serves as escaping tunnel from the danger (Jarvis and Sale, 1971). However, Hickman (1977) argued that the deep tunnel bolthole primarily functions to keep humidity high in the burrow system.

The burrows of all common moles rats have a similar architecture, they consist of numerous long superficial foraging galleries (15-35 cm deep) and usually a deeper area were more protected from predators and from temperature extremes, containing a nest and a bolt-hole (Jarvis & Sale, 1971; Davies and Jarvis, 1986 ; Lovegrove and Painting, 1987). Burrows offer effective protection against climatic conditions and at a depth of approximately 30 cm a significant amount of the daily temperature fluctuations disappear (Reichman & Smith, 1990). Although burrows do have one main disadvantage this being it is energetically more expensive to create an underground burrow system (Thomas *et al*., 2013).

Mound production in fossorial animals is directly related with soil moisture because when the soil has a good moisture,the ability of common mole rats to forage becomes effective(Miller, 1964). The common mole rats from arid areas produce more foraging runs when the soil is softened by moisture. On the other hand, males appeared to produce longer burrows than females as well as more fresh mounds, suggesting increased habitat exploration (Bennett & Faulkes, 2000).

2.5 Reporoduction

Though the breeding activity of *T.splendens* is highest during the rains and lowest in the dry season, it continues throughout the year (Katandukila *et al.,* 2013). Females may deliver up to four young per litter but usually only one or two and also young are weaned at 4-6 weeks, leave the mother about one month later, reach sexual maturity at 6 months of age. The average life expectancy is about one year (Nowak, 1999).

Three age classes are distinguished according to body weight: juvenile (< 50 g), sub adult (50–200 g in females, 50–250 g in males) and adult (> 200 g in females > 250 g in males) (Scharff *et al*., 1999). Size and position of testes for males, and vaginal conditions (closed or perforated) for females, are observed to determine the reproductive conditions of the captured animals.

Reproduction in subterranean mammals is constrained by both the prevailing ecological conditions and the burrow environment (Bennett and Faulkes, 2000). The subterranean niche precludes the use of many common cues that are normally used to maximize reproductive success for example, photoperiod is unlikely to be an important proximate cue whereas rainfall in the form of changing soil moisture content is used to trigger breeding (Bennett & Faulkes, 2000; Herbst *et al*., 2004; Hart *et al*., 2006).

Temperature is a potentially important environmental cue that common mole rats may utilize for their daily and seasonal activity patterns. The temperatures within common mole rat burrow systems are much less variable than those above ground (Bennett and Jarvis,1995). Rainfall is an important variable that can be detected underground because it softens the soil (if it reaches sufficient depths) and brings about subsequent plant growth and flushes of vegetation (Dennis and Marsh, 1997). These occur in winter rainfall regions and as a consequence, mating occurs in the winter months, with the young being born in the spring when food is abundant and the soil easily workable. This also facilitates dispersal and construction of independent burrow systems (Bennett & Jarvis, 1995 ; Herbst *et al*., 2004; Hart *et al*., 2006).

2.6 Feeding habite of common mole rats

Tachyoryctes splendens feeds mainly on the underground parts of plants: roots, rhizomes, tubers, bulbs, and corms and also it sometimes comes to the surface to forage for nesting materials and food, such as grasses and cultivated legumes (Leonid *et al*., 2014). A feeding behavior of *T.splendens* makes it an agricultural pest,it causes agreat damage to crops like enset (*Ensete ventricosum*), potato *(Solanum tuberosum*) and maize (*Zea mays*) in southern,western and central regions of Ethiopia (Mengistu and Bekele , 2003). Common mole rat impact on agricultural fields especially on Enset and potato crops are high during the wet season and also the major pest on farmland and cause redaction of yield and income loss (Arega, 2017).

2.1. Ecological importance of common mole rats

Rodents are known to have economical, ecological, social and cultural values and also benefit the environment. But, their conservation status is at risk (Singleton *et al*., 2003). Subterranean rodents, despite their relatively small size are important in controlling the ecosystem structure and development. Common mole rats can excavate vast burrow systems and deposit soil in abandoned tunnels and on the ground surface altering strongly the soil characteristic in texture and water holding capacity (Spinke *et al.*,1998). Their burrowing activity below ground, foraging and excrements all have direct and indirect effects on other ecosystem components. They formed large distinct area within the grassland matrix by burrowing and mound building. The soil is constantly turned over and the plants cropped by the activities of these animals resulting in land resembling a ploughed area (Weinest and Mazurek, 1984).

3. Materials and methods

3.1 Description of study area

The present study was carried out in Dawachefa Districts in the Amhara Region in Oromia special Zone, North East Ethiopia. The area is located between 10° 46′ 0"–10° 54′ 0" N latitude and 39° 41′ 0"–39° 53′ 30" E longitude (Figure 1). It is found at a distance of 339 km northwest from Addis Ababa, the capital city of Ethiopia . The altitudes of the area ranges between 400 -2500 m a.s.l. The traditional agro ecologies are Dega, woina-dega and kola that covers 5 , 15, 80 percent respectively. There are 26 kebeles in the district and the total area of its covers about 62400 hectar (Dewachefa Distric finance and economy office, 2016 un pub.)

Based on the 2007 national census conducted by the Central Statistics Agency of Ethiopia (C S A) this woreda has a total population of 133 388, of whom 66746 are male and 66642 female. From the total population about 2876 or 2.16 % are urban inhabitants. According to the report of CSA the majority of the inhabitants (98.73 %) are Muslims while 1.1 % of the population are followers Ethiopian Orthodox Christianity.

The soil is sandy, sandy clay and sandy loam with moderate fertility. The main crops grown in this District are Sugarcane Banana, Papaya, Sorghum, Teff and Maize, Onion and Potato. Cattle, goats and sheep are the major livestock in order of importance, but there are also a few camels kept by wealthier people for burden. Sorghum, Sugarcane and Teff are the major crops traded out of the zone, moving from local markets into Afar, and to the markets of Dessie, Kombolcha. Cattle and goats mainly go via main-road collection markets to be finally sold Addis Ababa, while sheep from Bati and Kemissie markets are traded to Dessie and Kombolcha.

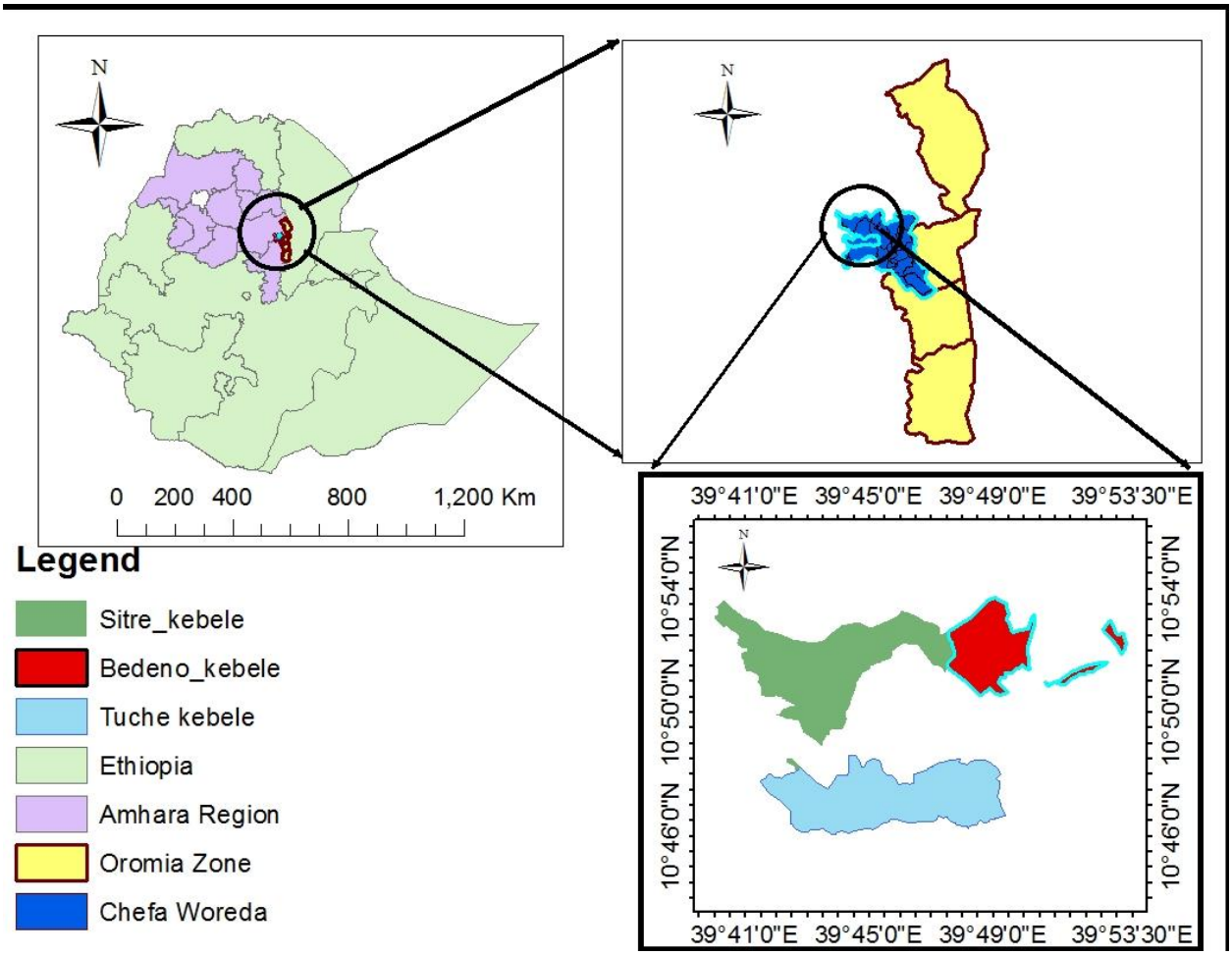

Figure 1.Map of Dewachefa Woreda and the study sites

A 10 years climate data between(2009 and 2018) of this district was analayzed (ENMA , 2019).

The mean monthly minimum temperature of the area ranges from 9.4 ^{0}C to 16.69 ^{0}C, mean monthly maximum temperature ranges 28.1 ^{0}C to 35.12^0 C .The warmest months are December,November and January while temperature drops during the peak rainy months July, August and September (Figure 3). According to the data this study sites are semi dessert because of 80 % area of the district are kola.

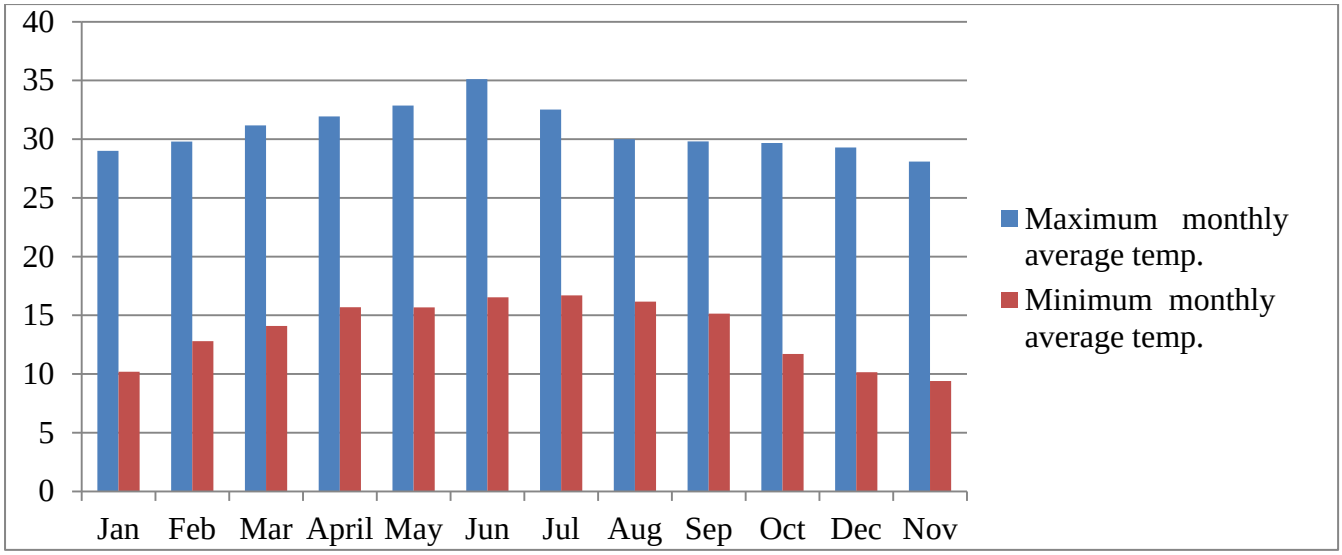

Figure 2. Monthly average temprature of Dewachefa District (2009 to 2018)

The monthly rainfall of the district is between 5.09- 351.1 mm.The average annual rainfall is 1042.33 mm. The largest amount of rain occurs between July and Augest.The peak rainy months are September , March, April and May while October, December, November, January and February are the drier months. (E.M.A., 2019).

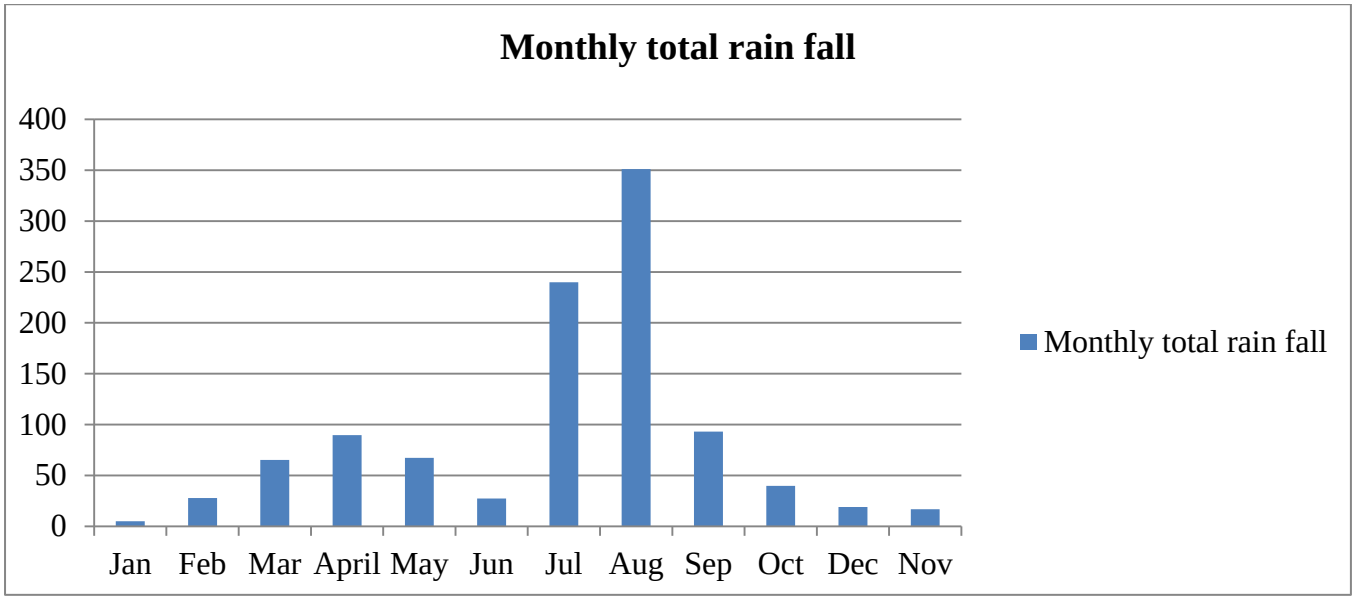

Figure 3. Mean monthly distribution of rain fall in dewachefa (2009 to 2018)

3.2 Material

To collect data material was used were :- Camera, dissecting kits, Meter tape, Digital balance, Spade, Axe, Conical local trap made of Iron wire, microscope, 75% Ethyl alcohol , data sheets and Gloves.

3.3 Methods

3.3.1 preliminary survey

A preliminary survey was conducted for ten days in each months (January and February) in the year 2018 before the actual data collection to determine specific study sites. Based on stratified sampling technique, three sites (Siter, Bedeno and Tuche) were selected from Dewachefa District using information from rural and agricultural development office and by observing the amount of crop loss caused by common mole rat (*Tachyoryctes splendens*) in the habitat of Sugarcane , Banana , Papaya and grazing grassland.

3.3.2 Study design

To gather the relevant data to attain the objective both qualitative (interview and quastioner) and quntitative (laboratory work and field) were conducted. As the distribution of common mole rats is discontinuous, grids and transect lines were not employed. However, direct soil mound counts were carried out to investigate abundance and distribution of common mole rat (Kokiso, 2006). The procedure followed by Jarvis and Sale (1971) was burrow system excavated by using Spade and Axe. Snap traps were set in selected study plots. Morphometric measurements were recorded from the trapped and freshly killed common mole rats. The trapped animals were sexed and the age was structured in the field by close observation following (Scharff *et al*., 1999). From traped common mole rat stomach content analysis was performed following the method used by (Yaba, 2007). Counted the damaged crops in agricultural fields during wet and dry season for the estimation of yield loss. Gathered information about traditional control stratagies through closed and semistructured interview.

3.3.3 population structure of common mole rat

Trapping was conducted twice during the wet season (August and September) and the dry season (November and December, 2019). Four plots (each 25 m x 100 m, i.e.10000 m^2) were selected purposively in three selected kebeles. Among these,the first two plots were set in Sugarcane plantation and Banana in Siter kebele, the third plot in Papaya in Bedeno kebele

and the fourth in grassland area in Tuche kebele. In each plot five snap traps were set in a 8x5 m^2,with a distance of 10 m between them. In the grassland areas, the traps were in a 10 x 5 m^2, with traps spaced at 10 m apart. The traps were baited with peanut butter rolled with barley flour (Habtamu , 2005). During each trapping session,the traps were set between 17:30 and 18:30 pm for nocturnal catches and cheked between 6:00 and 7:30 am in the morning for five consecutive days per seasons. The trapped animals were then weighed by electronics beam balance and sexual conditions were recorded. Sexual conditions of trapped animals were identifyed based on Size and position of testes for males, and vaginal conditions (closed or perforated) for females. Pregnant females were identified from their enlarged nipples, large swollen abdomen and body weight. Three age classes were distinguished according to body weight: juvenile (< 50 g), sub adult (50–200 g in females, 50 – 250 g in males) and adult (> 200 g in females > 250 g in males) ,that division was based on reproductive and growth data of captive animals (Scharff *et al*., 1999).

For captured animals standard body measurements were taken; weight (W) in gram, head - body length (HB), tail length (T) and hind foot length (HF) were measured in (mm) by using ruler and putting the capture common mole rat on flat surface dorsoventrally.

3.3.4 Assessment on abundance and distribution of common mole rats

Data to assess the abundance and distribution of common mole rats in selected study sites were collected in two season (August and September, 2019 for wet) and (November and December, 2019 for the dry). The abundance and distribution of common mole rat in each of selected study site were estimated from fresh common mole rat mound count (Kokiso, 2006).Tewolve (each of them were 25 x 100 m) plots were selected purposevly in three selected kebeles as showed below (Table 1).Then the count of surface sign mound of common mole rat in each plot in both seasons were used to estimate the abundance of common mole rat per hactar by using the following formula.

$N = (A/a) * n$ where N = the estimated total population size

A = the total study area

a = the area of one plot

n= the mean number of organism per plot

(https : // www. deanza . edu > 3c_ Estimation population size Dispersion)

Table 1. Number of plots for abundance analysis of common mole rat

Habitat types	Number of plots		
	Siter	Bedeno	Tuche
Sugarcane	1	1	1
Banana	1	1	1
Papaya	1	1	1
Grassland area	1	1	1

To determine the distribution of common mole rats based on the surface sign of mound , Sixteen (16) extra plots were needed , (each of them with 25 x 100 m) were selected purposively in three selected kebeles as showed below (Table 2). Then the count of surface sign mound of common mole rats in each plot per habitat (crop type) during wet and dry season were used to estimate number of population per hectar by using the above formula.

Table 2. Number of plots for distribution common mole rats

Types of habitat	Number of plots			Total plots per habitat
	Siter	Bedeno	Tuche	
Sugarcane	2	1	1	4
Banana	1	2	1	4
Papaya	2	1	1	4
Grassland area	1	2	1	4

3.3.5 Stomach content analysis

Stomach content analysis was performed following the method used by (Yaba, 2007). The common mole rats were trapped from all sites, dissected and stomach contents were sampled and stored in 75 % alcohol and later used for analysis in the laboratory .The stomach contents were spread onto a Petridish and mix thoroughly. Then, the contents were washed on sieve with 1.5 mm to remove carfully chews or digested food and undigested food fragment for proper identification. Stomach contents were dried in open air for a day and count each food sample fragment to record the proportion of food consumed and variation in the food sample fragment eaten by common mole rat in each seasons.

3.3.6 Burrow system of common mole rat

The procedure followed by Jarvis and Sale (1971) burrow system of the common mole rats in different crop field were excavated (Banana, Papaya and grazing grassland) and measured the length and depth of nesting, foraging tunnel and bolthole. When I get the common mole rat in the burrow system captured its by hand for the purpose of stomach content analysis and external body measurment. A total of 12 excavations were made six during wet season and six during dry season. Three elemnts of burrow system were destingushed based on its function and structure that means, Foraging tunnels originated from the main tunnel branched into several peripheral tunnels and terminated at common mole mounds.The common mole mounds were characterized by both old and freshly excavated piles of soil. Nest chambers were excavated within individual burrow systems of *T. splendens* but only one was active at any particular time, with other nest chambers back-filled with soil and no longer in use. An active nest was connected to the main tunnel by a single entry / exit point. Bolt hole which was located at the end of the main tunnel, and at a greater depth than the nest chamber.

3.3.7 Estimation of yield loss in agricultural fields and grazing grasslands.

The total count of damaged Banana , Sugarcane and other crop plants were recorded from the plotted farmland to investigate the impact of common mole rats during wet and dry seasons. To know the damaged crops in agricultural field , the crops were failed , wilt or dried when the common mole rats feed the root of crops. The damage of Sugarcane and Banana were counted for 12 consecutive days per month in wet and dry seasons in the selected kebeles to calculate the percentage of damage and income loss (Kokiso, 2006). Totaly thirty six (36) (each of them were 25 x 100 m) plots were selected purposively in three selected kebeles as shown below (Table 3).

Table 3. Number of plots to count damaged crop plant.

Types of habitat	Number of plots		
	Siter	Bedeno	Tuche
Sugarcane	4	4	4
Banana	4	4	4
Grassland area	4	4	4

To calculate % of damage crop plants per hectar= $\frac{total\ count\ of\ damaged\ crop\ plant}{total\ count\ of\ normal\ and\ damage\ crops} \times 100$

The income loss on Banana and Sugar cane were calculated on the basis of local market price. As local market of the study area, a matured Sugar cane and Banana fruit on average costs birr 7 and 25 per kg respectively during the data gathering time .One single Banana plant yields , 22 kilogram per a year based on the information gathered from farmers. The researcher counted all normal and damaged Sugarcane and Banana plants in the agricultural farms in each study sites during wet and dry seasons and calculated the percentage of damage and income loss per hectar. The area covered by common mole rat mounds were measured by measuring the diameter of mounds using meter to estimate grass yield loss (Kokiso, 2006). Out of 57 farmers inhabited around study sites using sample size determining formula (Yamane, 1967) 52 (19 from Bedeno and 23 from Siter and 10 individual from Tuche study sites) respondents were selected purposively. To determine the level of damaged crop plants (low < 25 %, medium 25 % - 50 % and high >50 %) and control mechanism of common mole rats were collected with semi-structured interview with open and closed-ended questions (Arega , 2017).

3.4 Data analysis

Data was analyzed using SPSS software of version 20. T-test was used to compare two related means (external body measurement and burrow system between season) .it also used to compute significance levels between seasons for the abundance, distribution and sex ratio of common mole rats in the three selected sites.

4. Results

A total of 45 individual common mole rats were trapped using both live and snap-trapping techniques in this particular study. Out of the total captured common mole rats, 30 (24 male and 6 female) of them were trapped by localy made conical snap traps while the rest 15 (6 male and 9 female) were trapped during excavated burrow system in both wet and dry seasons as shown (Table 4).

Table 4. Numbers of traped common mole rats

Season	Sex	Types of traps	
		Live trap	Snap trap
Wet	M	4	19
	F	5	4
Dry	M	2	5
	F	4	2
Total		15	30

4.1 Population structure of common mole rat

In this study 30 male and 15 female common mole rats were trapped in the study sites. The ratio of male to female common mole rats was 2:1. And the proportion of male and female common mole rats has significance difference (t= 7.746, p=0.001)

Figure 4.Snap trap set on trapping the common mole rat

The composition of different age groups and sex of common mole rats between seasons are given in (Table 5). Out of the 45 common mole rats, adults comprised 28 (62.2 %), sub-adults 11 (24.44 %) and juveniles 6 (13.33 %). From the total 45 common mole rats , 28 (62.22 %) and 17 (37.77 %). of them were captured during wet and dry season respectively. The number of captured common mole rats were statistically significant (t = 6.708 , d.f. = 5 , P = 0.001) between seasons.

Table 5. population structure of common mole rats

Study site	Season	Sex		Age							
		M	F	Total	Adult	%	Sub adult	%	Juvenile	%	Total
Siter	Wet	7	3	10	6	60	3	30	1	10	10
	Dry	5	3	8	5	62.5	2	25	1	12.5	8
Bedeno	Wet	6	3	9	5	55.6	2	22.22	2	22.22	9
	Dry	3	2	5	3	60	1	20	1	20	5
Tuche	Wet	6	2	8	6	75	2	25	-	-	8
	Dry	3	2	5	3	60	1	20	1	20	5
Total		30	15	45	28	62.3	11	24.4	6	13.3	45

4.2 Abundance and distribution of common mole rats

In this study the abundance and distribution of newly dug soil mound varied in different habitats (Banana , open grassland , Papaya and Sugar cane) and seasons. Based on fresh soil mounds, the distribution of common mole rat was discontinuous (fig. 3).

A

B

C

D

Figure 5. Representative figures of fresh soil mound in selected farm

The total count of surface sign (mounds) in each crop fields in different seasons varied from site to site (Table 5). The highest number of of surface sign (mounds) counted in grassland was (59) while from, Sugarcane and Banana 45 and 37, respectively . However, the least number of surface sign (mounds) was counted in papaya habitats, 32 both in wet and dry seasons.

Table 6. Sample of fresh mounds of common mole rats in different habitats of each study sites.

Season	¤ Farm type	Site			Total
		Siter	Bedeno	Tuche	
Wet	Sugar cane	11	8	7	26
	Papaya	9	6	5	20
	Banana	10	7	5	22
	Grass	11	14	12	37
Dry	Sugar cane	8	7	4	19
	Papaya	5	4	3	12
	Banana	6	5	4	15
	Grass	7	9	6	22
Total		67	59	46	172

The abundance of common mole rats from surface sign showed that common mole rats were more abundant in Siter and Bedeno sites with 34 and 30 common mole rats per hectare followed by Tuche site with 23 in both wet and dry seasons (Table 7). The difference in abundance of common mole rats among study sites (Siter , Bedeno and Tuche) was not statistically significant ($t = 3.46$, $p = 0.074$). However, surface sign count showed that there was significant variation between wet and dry season ($t = 6.708$, $df = 5$ and $p = 0.001$).

Table 7. Abundance of common mole rats in the habitats among the different site.

Study site	Number of plots	Estimated population size	
		Mean ± SD /plot	Individual per hectare
Siter	4	8.4 ± 2.6	34
Bedeno	4	7.5 ± 1.7	30
Tuche	4	5.7 ± 2.1	23

The distribution of common mole rats was high in grazing grassland (78) during both seasons. Banana , Sugarcane and Papaya farm fields have 49 , 67 and 42 common mole rats per hectare respectively in both season. Maximum numbers were recorded during wet season which was 49 in grazing grassland area and the least number was 26 on Papaya field. On the

other hand, during the dry season, the highest was 29 and the lowest was 16 individual of common mole rat in grazing grassland area and Papaya field respectively (Table 8).

Table 8. Density of common mole rats in the crop field

Crop type	Season	No of plot	Population estimation	
			Mean ± SD/plot	Density /ha
Sugar cane	Wet	4	8.6 ± 2.08	43
	Dry	4	6.3 ± 2.08	25
Papaya	Wet	4	6.6±2.08	26
	Dry	4	4 ± 1	16
Banana	Wet	4	7.3 ± 2.5	29
	Dry	4	5.0 ± 1	20
	Wet	4	12.33 ± 1.5	49
Grass	Dry	4	7.3 ± 1.5	29

4.3 Stomach content analysis

Diet components of the common mole rats were investigated from the stomach content of trapped individual common mole rats (Table 4)**.** Stomach samples of common mole rats were analyzed thought-out the study period. Some variations were observed in the proportion of food items consumed by common mole rats during wet (August to September) and dry (December and November) seasons .The food items were grouped into plant root (Sugarcane , Banana , Papaya , grasses and unidentified food item). The roots of Sugarcane and grass consumption by common mole rats was high in the wet season than the consumption of Papaya and Banana.The root of Sugarcane and grass contained the largest portion in the diet of common mole rats (Table 9).

Out of the total 661 food fragments , 206 (31.2 %) comprised Sugarcane,162 (24.5 %) Banana, 68 (10.3 %) Papaya and grass 225 (34 %) in both seasons (Table 8).

Table 9. Percentage of the food fragment from stomach of trapped common mole rats .

Identified food item	Number of fragment in				Total (%)
	Wet	%	Dry	%	
Sugar cane	110	28.9	96	34.2	31.2
Banana	95	25	67	23.8	24.5
Grass	135	35.5	90	26.5	34
Papaya	40	10.5	28	32	10.3

Figure 6. Disecting for stomach content sampling from common mole rat

4.4 Burrow system

Different length of burrows and length and depth of nest and foraging tunnel were recorded in all study sites. The highest burrow length was 17 m which was dug during wet season by male and least burrow length observed during the dry season which is 8 m dug by male. The t-test for burrow system between seasons have significant difference (p = 0.000) . And also the t-test for burrow system between male and female common mole rats have significante difference (p = 0.000).

Table 10. Mean and SD of adult common mole rat burrow system measurement

Site	Season	No. of burrow excuvated	Burrow	Foraging tunnel		Nest	Bolthole	
			Length (m)	Depth (cm)	Length (m)	Depth (cm)	Length (m)	Depth (cm)
Siter	Wet	2	16±1.4	16±1.4	12±2.8	57.5±3.5	4±0.7	57±4.2
	Dry	2	13.5±.7	16±0.00	11±1.4	48±11.3	2.5±0.7	41.5±9.1
Bedeno	Wet	2	11.5±3.5	17.5 ± 0.7	9±2.8	55.5±2.12	2.5±0.7	55±1.4
	Dry	2	9±1.4	16.5 ± 0.7	7±0.7	55±2.8	2±00	55±14.1
Tuche	Wet	2	13.5±3.5	16.5±2.12	9± 2.12	50.5±7.7	4.5±0.7	52.5±3.5
	Dry	2	11.5±.7	19.5±2.12	8.5±0.7	55±2.82	3±00	44±5.6

The nesting chamber consisted of sleeping area with the nesting materials, and sanitary area (Fig.7). The nest materials observed at study sites were dry grass, (*cyperus spp.*)and dry leaves of Banana.

Figure 7. Nest of common mole rats

Common mole rats excavate soil using well developed incisors and forelimbs. This was clearly observed during this study on live trapped common mole rats from excavated boltholes after they were released (Figure 8).

Figure 8. Common mole rat excavating soil

4.5 External body measurements of common mole rat

Body measurements (mm) and weight (g) of common mole rats trapped. (W=Weight, HB=Head body length, T = Tail length, HF = Hind foot Length).

Table 11. Body weight in gram and other external body measurements in mm of the common mole rats

Site	Sex	No. of common mole rats	Body measurement			
			W	T	HB	HF
Siter	M	6	260.6 ± 5.5	52 ± 6.1	196.5 ± 17.5	37.3 ± 7.1
	F	5	241.6 ± 1.33	51.4 ± 5	196.2 ± 19.1	35 ± 6.1
Bedeno	M	5	260 ± 4.5	49.8 ± 5.7	196 ± 19.8	38.4 ± 7.8
	F	2	248.5 ± 0.7	51 ± 7	209.5 ± 30.4	35 ± 8.4
Tuche	M	7	254.4 ± 3.2	52.8 ± 4.9	194.8 ± 16	36.7 ± 7.8
	F	3	248.6 ± 0.5	50 ± 5.5	216.6 ± 23	37.6 ± 5.8

From the total 45 captured common mole rats, 28 (male, 18 and female , 10) adult common mole rats were used for taking external body measurement. Out of 28 common mole rats, 11, 9 and 8 common mole rats were taken from Siter, Bedeno and Tuche sites respectivrly. The

head-body length ranged from 232 to 183 to 232 mm, tail length was from 44 to 59 mm, hind foot length ranged from 29 to 46 mm and the body weight ranged from 219 to 268g in both seasons and in all study sites. The body measurments of common mole rats during wet and dry season have variation but not significance difference (T; t = 0.461 , p = 0.649, HB ; t = 1.17, p = 0.252, HF, t = 0.75, p = 0.46). However the t – test for body measurements showed significant differences for body weight (w ; t = 2.21 , P = 0.03). The body weight measurement of males ranged from 251 g to 268 g and females ranged from 219 g to 250 g.The tail length of males ranged from 45 mm to 59 mm and females ranged 44 mm to 46 mm. The head body length of males ranged from 186 mm to 231 mm and females ranged 183 mm to 231 mm. The hind foot length of males ranged from 29 mm to 46 mm males and females ranged 29 mm to 43 mm .Variation of body measurements were observed between males and females but not significant differences (Hf ; t = 0.597, p = 0.556, Hb ; t = -1.24, p = 0.225 , T ; t = 0.398 , p = 0.694) . However the difference in body weight measurement between males and females was statistically significant (t = 4.67 , p = 0.00).

4.6 Yield loss in agricultural fields and grazing grass due to common mole rats

The total number of damaged Sugarcane and Banana in all study sites were138 and 35 during wet and 92 and 23 during dry seasons respectively.The percentage of damaged plants and income reduction are indicated in (Table 12)**.**

Each Sugarcane costs from 5 to 8 birr in average 7 birr per each sugare cane plants. The Banana costs 25 birr per kilogram. However, one Banana plant yeilds 22 kg per a year in average.The researcher had seen mounds that covered grasslands areas which reduced grass yield that left for cattle's to feed it. When measure the diameter of a single mound which covers about 40 cm to 60 cm and the average is 55 cm. The total count of mound on the surface of grassland area in all sites were 59 (Figure 5 D) . So the reduction of grass is 14 m^2.This area of grassland support at least three cattle to feed per aday. Due to this, the farmers lost thier grass which feed their cattle.Therefore, common mole rats have major economic impact due to loss of grass for their cattle in the study area.

Table 12. The percentage of damaged crop and incom loss

Study site	Crop type	Average No. of individual /ha	Season					
			Wet				Dry	
			Number of damage in all plots	Loss in birr	% of damage /ha	Number of damage in all plots	Loss in birr	% of Damage /ha
Siter	Sugarcane	2500	70	490	2.8	60	420	2.4
	Banana	714	15	8250	2.1	10	5500	1.4
Tuche	Sugarcane	2200	50	350	2.3	41	287	1.8
	Banana	680	9	4950	1.3	6	3300	0.8
Bedeno	Sugarcane	1900	37	259	1.9	26	182	0.36
	Banana	665	11	6050	1.65	7	3850	1

Figure 9. Damaged sugar cane and banana

4.7 Farmers response about pest status, crop damage and method of control

FIn all sites respondents were interviewed about the behavior of the animals,their impact on agriculturally important crop plants and controlling mechanisms. Based on the respondents response on sugarcane (59.6 %), Banana (28.8 %) and cereal (11.5 %) are common mole rat the pests. However,the status of common mole rats were high on sugarcane agricultural farm. About 82.7 % of the respondents responded that the highest common mole rat attack occured during the wet season than dry season (7.7%) (Table 13).

Table13. Pest status and control mechanism of common mole rats

Interview Questions	Variables	Study site			Total	
		Siter Number of respondents	Bedeno Number of respondent	Tuche Number of respondent	number of respondent	Percent age (%)
Crop value most	Sugarcane	15	9	5	29	55.7
	Banana	6	6	3	15	28.8
	Papaya	2	3	1	6	11.5
	Cereal crops	-	-	1	2	3.8
Crops mostly damaged by common mole rats	Sugarcane	13	12	6	31	59.6
	Banana	6	6	3	15	28.8
	Papaya	-	-	-	-	-
	Cereal crops	3	2	1	6	11.5
	Vegetation	-	-	-	-	-
Season of the highest common mole rat attacks	Wet	19	17	7	43	82.7
	Dry	3	1	1	4	7.7
	Both wet &dry	1	1	2	4	7.7
Damage of crops by common mole rat attack	Low (<25%)	2	3	1	6	11.56
	Medium (25-50 %)	13	11	7	31	59.6
	High (> 50 %)	8	5	2	15	28.85
Controlling mechanism	Trapping	8	6	3	17	32.7
	Rodenticide	6	4	2	12	23.1
	Flooding	4	5	2	11	21.2
	Burrowing	2	2	1	5	9.62
	Other	3	2	2	7	13.5

5. Discussion

5.1 Population structure

From the 45 common mole rats captured 66 .6 % were males while the rest 33.33 % were females the reason might be male common mole rats are wider field excursion than females. On the other hand, the responsibility of females in nursing their litters might have hindered their movement from one area to the other. As a result, they have limited chance of entering the traps. The finding of the this study was similar with a research conducted in Masha by Arega in 2017. Most of the individuals trapped were adults. This could be due to the presence of large home ranges for adults than sub-adults.This is supported by Gebresilassie *et al.*,(2004) in that adult individuals have wider home range than sub adult rodents in Maynugus irrigation field, Northern Ethiopia. In addition, the numbers of male and female common mole rats were captured in wet season was more than those captured than dry season. The reason behind this may be, wet season is very favourable for most common mole rates and have the availability of variety food. In addition, there were large number of captured common mole rats in Siter and the least numbers were in Bedeno and Tuche site. According to information from rurarl and agricultural office it might be the availability of food variety, suitable and the land is not regularly cultivated in Siter site than Bedeno and Tuche.

5.2. Abundance and distribution

During the time of this study habitat complexity in related to food availability is a key factor to influence the overall abundance and distribution of common mole rats in the study area. This asumption has related with the previous studies in Masha, Southwest, Ethiopia about the association of common mole rats with the resources found in an enviroment (Arega , 2017).

As observed in this survey,among the three study sites,the highest abundance of common mole rats were recorded in Siter and Bedeno sites in both seasons. This might be due to the presence of sufficient food resource in these sites when compared with Tuche site. The density of common mole rats is high in grazing grassland habitat when compared with the habitats of Banana, Papaya and Sugarecane during wet season. This is because of the habitats become stable, the land is not regularly cultivated and have sufficient amount of food resources which has great similarity with the findings of (Spinks *et al.,* 2000); Faulkes and Bennett , 2007). The highest density of common mole rats in this study was recorded in areas of grazing grassland and Sugarcane farm during the wet season but their number slightly

decreases in dry seasons.This is Similar to the finding of Kokiso , 2006 in Angecha, centeral Ethiopia.

Generally the result of this study showed that the common mole rats are widely distributed and abundant in wet season than dry season. This variation among seasons has a greate similarity with the study finding in Gimbo Woreda Kaffa Zone Southwest Ethiopia by Mulatu (2015) who reported that seasonal cultivation affects the distribution of the common mole rat population.

5.3 Stomach contents

During investigation process different kinds of crops were observed. Based on the result from stomach content analysis, the type of plants found in the sites were similar with that of the food content found in the stomach of common mole rats. In addition to the response of farmers clearly indicated that common mole rats were assumed to be generalist feeder because it feeds any kind of plant roots where available. Diet analysis from the stomach content showed that common mole rats feed on a variety of food item like Sugarcane, Banana, Papaya and grass root. The finding of Arega, 2017 in Masha, South west, Ethiopia, the feeding habite of common mole rats were mainly feed underground part of plants, is related with this idea . Even if, Sugarcane, Banana and grasses were identified from stomachs of common mole rats, grass and Sugarcane contained a high proportion where indicates that common mole rats are considered pests to damage the agricultural products in the study area.

5.4 Burrow system

This study indicated that the burrow system measurment of commone mole rats have significant difference between seasons.The reason behind this can be hardness of soil that limit excavation. This idea is explained in the study of (Spinks *et al.,* 2000).The finding of this study showed that burrow system *of T. splendens* consisted of three elements. The nest which is used for sleeping, storage and sanitation (Figure7). The nest contains grasses, Banana and Sugarcane leaves (Figure 7). The other element is the foraging tunnels which are used for foraging. On the other hand according to the study by Hickman (1977) foraging in some cases used to air tightly plug in order to maintain humidity and temperature as observed by and to protect themselves against predators.

The third elements is bolthole that serves as escaping tunnel whenever common mole rats save them seleves from external attack. In this study, some common mole rats were caught

within the bolthole.This indicates that bolthole serves as an escaping passage as studied by Jarvis and Sale (1971).

The burrow system measurement of common mole rats varied from site to site. The reason behind this is the availability of food resources in agricultural fields. The short length burrow system is because of the availability of food resources. The stability of habitats, availability of food resources and disturbance due to the nature of crop field management are important factors to determine burrow locations ,burrow system size, and density of *T. splendens*.

The burrow system (foraging tunnel, nesting and bolthole) of male and female common mole rats were also have significante difference ($p = 0.000$).This may be due to the digging and food searching ability of male and female common mole rats.

5.5 External Body measurements

In this study the slight differences in HB,T,and HF were obeserved but there was significance diffrence in weight of common mole rats in all study sites. The difference might be limited availability of food sources during the dry season than the wet season.Similar result was reported by the study of (Mulatu, 2015) in Gimbo Woreda Kaffa Zone Southwest, Ethiopia. Variation of body measurement was observed between males and females but not significant difference.However, the difference in body weight measurement between males and females was statistically significant ($t = 4.67$, $p = 0.00$) .The finding of this study was similar with the research conducted in London by Jarvis and Sale (1971) which showed that there is differnce in weight and morphometric variations among sex.

5.6 Impact of common mole rats on agriculturally crops and grazing grass

In this study the number of damaged Sugar cane and Banana were analyzed in three study sites during wet and dry seasons. The results showed that highest damage was observed in Siter and Bedeno sites followed by Tuche site (Table 13). The common mole rats severly attacked Sugar cane than Banan during the wet season .As mentioned by Kokiso (2006) in Angecha, centeral Ethiopia, common mole rats are very active and high ability to find their foods in wet season. The reason behind is,in wet season the lands have very loose soil and easy for excavation and searching food. Common mole rats were common in open grasslands specially near Banana and Sugar cane plantations, because of this,the land near these plantation were not cultivated . Farmers keep grasslands as a food source for their cattle, sheep and other animals although this grassland is served as foraging site for common mole

rats.So the reduction of grass will result in loss food for cattle.This finding is similar with the study by Mulatu , (2015) in Gimbo Woreda, Kaffa Zone , Southwest , Ethiopia. The major crop plant susceptible by common mole rats in the study sites were Sugarcane, Banana and grass root which are the main sources of income for the people of the area. The overall damage and the percentage of the damaged Sugarcane and Banana common mole rat as a pest. As shown in (Table 12) majority of of the respondents estimated loss of their crops by common mole rat attack was high . Regarding controlling mechanism of common mole rats majority number of the respondents used trapping followed by rodenticide and flooding . This finding is similar with Kokiso, (2006) in Angecha, centeral Ethiopia. Common mole rats consume small proportion of the Banana and they expose the plant to bacterial, nematodes and other vertebrate pests to wilt for more damage (Figure 9).

6. Conclusion and recommendations

6.1. Conclusion

The population stracture of common mole rats in all habitats and seasons were varies due to the absence or presence of resource availability and mortality during dispersal.

Abundance and distribution of common mole rats were high in Siter and Bedeno than Tuche study sites. In this study the number of common mole rats were high in the habitat of grazing grassland and sugarcane plantaion during wet than dry season due to availability of food resources and regular agricultural field cultivation. Grass, Banana,Sugarcane and Papaya roots were obtained during stomach content analysis in both seasons. Analysis of stomach content indicated that root of sugar cane and grass were the frequent food items of the common mole rats

The burrow system (nest, bolthole and foraging tunnel) measurment of common mole rats varied among season due to the nature of land and resource availability. The current local society control mechanism of common mole rats to reduce the economic impact majorly used trapping followed by rodenticide.

The common mole rats are major pests of sugarcane and grazing grassland and have a big economic impact. Therefore, priority should be given by the concerned stake holder to minimize the problem.

6.2. Recommendations

Based upon the findings of this study, the following recommendations are made to control the common mole rats which damages Sugar cane, Banana, grazing grassland and other plants in the study area.

- In all study areas there is high number of damage on agricultural crops. So carrying out different mechanisms such as proper periodical cultivation as well as introduction of indigenous predators (owls, cat and eagles) helps to reduce and regulate common mole rat population.

- This study focused on abundance, distribution, feeding habite and economic impact of common mole rats although, further studies about breeding activity of common mole rats should be conducted to taken precontrol measurment.
- Common mole rats hide themselves on the border where the land was cultivated, so periodic cultivation is probably the greatest value to reduce its foraging site.

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Appendix

Appendix I

Data collection sheet for population of Common mole rat, *Tachyoryctes splendens*

Name of data collector_____

Species_____

Site	Altitude	Season	Sex			Age		
			M	F	Total	adult	Sub adult	Juvenile

Format used to collect damaged crops

Season	Month	Number of damaged crops			
Wet		sugar cane	papaya	banana	
	August				
	September				
Dry	Desember				
	November				

Appendix II.

Questionnaires for respondents

Dear respondents! This questionnaire is prepared as part of the data for my master`s study titled "Feeding ecology and pest status of mole rat (*Tachyorycte Splenden*) in Farmland, Dewachefa district , Oromia special zon ,Ethiopia.The information you provide will only be used for the purpose of this research and will be kept confidential you are not required to write your name. The result and success of the study depends on the quality of your responses you are thus kindly requested to complete the questionnaire by reading the instructions in each item carefully before you give your responses.

I. Background and farming activity

1. Sex A. Male B.Female

2. Age of respondent. ☐

3. Residence A. District ---------- B. Kebele---------- C. Village----------

4. Educational status of respondents

A. Illiterate B. Primary C. Secondary D. College/University

5. Family size Male_____ Female. _____Total_____

6. How long (in years) you have been living in this village?

A. < 10 B. 10– 30 bC. >30

7. How many hectares of land do you own?

A. <0.5 ha B . 1 ha C. 1.5 ha D. 2.0 ha E. >2.0 ha

8. Cultivated farmland size by crop in hectares

Sugarcane _____banana _____ vegetables. _____ papaya _____Cereals _____ Other_____

9. Crop types valued most

A. sugarcane B. Banana C. Papaya D. Cereal crops

II. Crop pests

1. Which part of the crop specially attacked by the mole rats?

A. stem B. root C. leaf D. seed

2. Types of crop mostly damaged by mole rat?

A. sugar cane B .papaya C. banana D. vegetation E. others

3. In which season do the occurrence of the mole rat population is high and damages more?.

A. Dry B. Wet C. Both dry and wet

4. What percentage of crop types are damaged by mole rats? Use traditional methods such as count, arm, feet, etc.

A. Low (<25%) B. Medium (25-50%) C. High (>50%)

5.What kind of controlling method do you apply?

A. Trapping B. Rodenticides C. Flooding D. Burrowing E. Mention if there is other

6. Dose the controlling method effective...

A. yes B . no

7. if the above answer is yes why this method is more effective?