Indigenous Knowledge of Enset (Ensete ventricosum (Welw.) Cheesman) Disease Protection by Gurage People, Southern Ethiopia

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Research Article

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Abstract

In Ethiopia, the Enset -based farming system is a major agricultural system that serves at least one-fifth of the country's population. Farmers locally have received knowledge from generations of experience and experimentation that match neighborhood conditions. Yet, the scientific strategies were less used farmers' Enset (Ensete ventricosum (Welw.) production and protection. This study aimed at assessing farmer's indigenous knowledge of protecting their Enset crops form disease. The study adopted multistage sampling methods and a total of 135 respondents were selected. The study identifies, "chegino", "Janfa", and "quaqusa" as the major and the most important diseases that counteract the Enset production in the study area. Furthermore, the study indicates the traditional disease prevention methods of the community to control the habitually acknowledged Enset disease. Most farmers in the surveyed area use sanitation (37.8 %) or uprooting of infected Enset plants and Dis-budding (31 %) then burn or bury the residue for reducing the spread of the disease. However, crop rotation and rotation of planting holes were applied by few farmers. Besides, this study shows that the death of experienced older folks, climate variability, farmers moving to other crop production, and lack of help to apply local knowledge is the primary imperatives of the farmers to apply native knowledge on the ranchers in the study area. Thus, farmers' indigenous knowledge can be combined with scientific knowledge to improve livelihood of the farmer.

Introduction

Enset is commonly known perennial crop, indigenous of Ethiopia mainly produced and maintained by generation transferred local/indigenous knowledge in the southern part (Brandt et al., 1997). It is grown and distributed at altitudes between 1600 and 3000 meter above sea level with an average annual rainfall of 1100 to 1500 mm and it is chiefly propagated vegetative (Tsehaye and Kebebew 2006). Enset based farming system is an indigenous and sustainable agricultural system that covers large hectares of land and serves at least

one-fifth (20%) of the country's population in Ethiopia (Garedew 2017 and Borrell, et al. 2019). Moreover, due to its contribution to soil fertility, long storability, its multiple uses, accessibility at any time, and relatively high productivity depending on edaphic factors, altitude, cultural practices and varietal differences, Enset cultivation is suitable for sustainable agricultural systems (Mulualem and Walle 2014 and Garedew 2017)

Enset has been known to play a role as a barrier of food deficit for human and feed for animals during the dry time and recurrent drought due to its resistance to fluctuating rainfall patterns after establishment (Garedew 2017). Kocho and Bulla are the major foods obtained from Enset, which are obtained from pseudo stem and leaf petioles and the other type is *amicho* obtained from the underground corm that is eaten boiled (Hunduma 2015; Melaku 2021).

Despite its suitability and potentials, area allocated to Enset production is declining from time to time due to bacterial wilt attack and many farmers started replacing Enset fields with other crops (Yemataw et al., 2016 and Zerfu et al., 2018). Moreover, there is no modern scientific management method; therefore the disease management is based on cultural controlling methods (Melese *et al*., 2014; Yemataw, Z et al., 2016).

In the traditional agriculture, farmers have a wealth of knowledge on weather forecasting varieties selection and cultivations, pest and diseases management; which are generally well adapted to their socioeconomic and environmental conditions (Garedew, 2017). Moreover, Enset is an indigenous crop production and processing activities are based on farmer's experiences and indigenous knowledge. However, there is lost and aging of experienced people, who have indigenous knowledge on Enset production and bacterial disease control practice and climate variability (Mohamed and Tariku, 2012). Therefore, Effort and national commitment and multi-dimensional support is very critical for recording, valuing, extending and exchanging this rich source and also preparing mechanism and practical strategy for synthesizing this knowledge with new knowledge and agricultural development programs (Sultana & Muhammad, 2018).

Even though Enset remained a staple crop of Gurage people for decades, little research and development attention was given. Moreover, the lessening of experienced elders who had indigenous knowledge link with their center of Enset crop origin has good sense to find out the indigenous knowledge of Enset disease management. Beside, no investigation has done on producer Indigenous knowledge in the Enset disease prevention and management in the Zone. Therefore, this study is conducted to identify major traditional methods of the community to decide on Enset planting time, to identify habitually acknowledged Enset disease and treatment and to Identify Constraints of applying indigenous knowledge on Enset disease prevention.

Research Methodology

Description of the study area

Gurage Zone is one of the Zones in South Nations, Nationalities and people regional state, which is located 158 kilometers southwest of Addis Ababa. It is bordered on the southeast by Hadiya and Yem special Woreda, on the west, north and east by the Oromia Region, and on the southeast by Siltie. Total population of this Zone is 1,791,034, of whom 868,626 are men and 922,408 women (CSA, 2021).

Topographically, the zone lies within an elevation ranging from 1000 to 3600 m above sea level with annual average temperature ranging from 13 °C to 30 °C and mean annual rainfall ranging from 600 to 1600 mm. The main food crops are Enset (*Enset ventricosum*) followed by barley, pulses, wheat and potatoes. The zone has three agro-ecologic namely, low land, mid land and high land. The main sources of income for households in the zone are the sale of crops, remittance, local employment, and the sale of

livestock (Dendir and Simane, 2019). The assessment was conducted in in major Enset growing Woreds namely Cheha, Sodo and Egha of Gurage zone from June to September 2021.

Sampling, data collection and analysis

The assessment was conducted on both western and eastern part of Gurage zone. The assessment site was selected purposely on Enset production, constrains and management methods. The study follows a cross-sectional research approach to triangulate the data. The study adopted multistage sampling methods. First, three districts; namely, Cheha, Ezga and Sodo district, were selected purposively based on their Enset production potential, secondly three Kebeles were selected randomly from each districts. Finally, 15 household heads from each rural Kebeles, a total of 135 respondents were selected randomly. In each Kebele, elder family members were purposively selected and participated in focus group discussion. The study was composed of both quantitative and qualitative data found from both primary and secondary sources.

Household data were collected through a structured Questioner. Additionally, Case studies, key Informants, Direct observation and Focus Group discussions were applied. Descriptive statistics such as frequency and percentage were used to analyze the data. The results of the analysis data were categorized, summarized, discussed, and presented in tables and graphs.

Result And Discussion

Traditional way of rainfall forecasting

Approximately, 80 percent of Ethiopia's population lives in rural areas that are completely dependent on rain-fed agriculture for their livelihood, for their growing crops, raising livestock, selling seeds and tools, or other related jobs (MC, 2019). Climate forecasting is essential for deciding time of planting and other farming household decisions. Ethiopian farmers depend mainly on indigenous weather forecasting to inform their agricultural and pastoral practices and decisions. Farmers and pastoralists use a combination of biological, meteorological and astrological indicators to predict weather and to make agricultural production decisions (Mahoo H, 2015*).*

For instance, study report done by Kagunyu et al. 2016, in northern Kenya revealed that the Borana had many indigenous early warning signs to predict different weather changes. These included the behavior of animals and birds, the presence of insects, clouds, color of slaughtered domestic animals intestine, dream interpretation and patterns of stars. The afar pastoralists also traditionally predict weather and climate variation through the observation of divers' bio-physical entities including livestock, insects, birds, wild life and trees (Balehegn, M 2019).

To predict the onset of rain the Gurage community also uses numerous signs (figure 1). Consequently, this study indicated that "YeGaganno demts", "yeahya joro", and "Muket" are major traditional methods of the community to forecasting rainfall to decide to plant Enset crop. About 85% of the community believed

“Gagano demts” (shriek of duck birds) as a best way of forecasting rainfall. According to them, the pattern and the strength of the bird called Gagano shouting sound was indicator of the amount of rain and how soon it would rain. This was also supported by focus group discussion. Conversely, 70 % of the respondent said that when the donkey uproar, his ear will stand (“yeahya joro”) as an indicator of the rain. Another sign indicated by 76.6 % of the respondent was the increasing temperature (muket).

This indicated that still most of the community uses at least one of the previously mentioned forecasting methods; this implies that the community has trust on traditional rain fall forecasting. The result supported by Ayele (2017), who found, farmers and pastoralists had trust and are responsive to indigenous weather forecasting.

Case study

Mr. Birhane Sherka Sula lives in Tachegnaw Geraba Rural Kebeles. He is 81 years old and has more than 50 years of experience in Enset production. As he said “from my experience I used ‘Gagano demts’, ‘yeahya joro’, and ‘Mukit’ to forecasting rainfall for the required amount of water to produce Enset crop. Of course, water is not required at the time of planting. But, the rain should be fall in required amount or should not fall totally”.

We triangulated the case through a focus group discussion that all participants were in the position of Mr. Birhane Sherka Sula in the study area. Besides, it was supported by Jafari and Kideghesho's study in 2008 who find out that Indigenous Peoples were adapted and attached to contextual activities.

Constraints of Enset production

According to the respondents and field observation data, Enset bacterial wilt (*Xanthomonas campestris PV. Musacearum)* which damage mostly bud and leaves of the plant followed by wild animal (like porcupine and pigs) are the most important constraints of Enset production. The prevalence of bacterial wilt in the assessing area is 78% while wild animal 56%. Both disease and wild animal account 67% (Figure 2). Wild animal pests such as porcupine and pigs that eat the root, pseudo stem specially porcupine is eating the root of the crop after testing the quality of each Enset crops and eating the most testy Enset crops this testy Enset land race is required by the farmer as a food and a medicinal value especially for bone maintenance.

Moreover, Enset farmers in the study area identify, predict and protect Enset disease by using indigenous knowledge. Traditionally, experienced people identify major and the most devastating disease of Enset production in the study area as “chegino”,“Janfa” and “quaqusa”. Moreover, focus group discussion approved that, there is at least one of the aforementioned disease in every farm found in the area. Planting materials such as Knife, Environmental change most of the time in summer, animal, human

being, hens are identified as a transplanting the disease. All farmers are confirmed that they applied the same and known remedy methods to treat and protect the disease.

Farmer practice of Enset disease prevention

The community had traditional disease prevention methods to control the habitually acknowledged Enset diseases. In the assessing area the farmers are planting the crop before 5 days of moon-rise and after 5 days of moon-set for bacterial wilt management. In Addition to this farmers are identified tolerant Enset crops in their fields such as Badedet, Ashikit and Fereze Enset land race is identified as tolerant to bacterial wilt. While, for “Janfa” they used two options to decide to plant the Enset crop. First, check the availability of the required amount of moisture/rainfall. On the other hand, checking the rain does not fall totally. Whereas, for the “quaqusa” problem, before planting the farmers clear the site from any residual of Enset leaves.” (Case study)

Case study

Mr. Yabonih Tebeka lives in Laygnaw Geraba rural Kebeles. He aged 51 years old and has more than 30 years of Enset production experience. He said, “I applied the following protection/remedy to cope up and protect the disease. For “chegino” I only plant Enset crops before 5 days of moon-rise and after 5 days of moon-set. This is because if I planted at the aforementioned date, the Enset crop wills susceptible to bacterial disease. For “Janfa” there are two options to decide to plant the Enset crop. First, check the availability of the required amount of moisture/rainfall. On the other hand, I checked the rain does not fall totally. For the “quaqusa” problem, before planting the site was clear from any residual of Enset leave.” This is because the photogenes will stay dormant in the leave of Enset and soil. Therefore, I will burn or remove the residual from the planting area.

Farmers locally have received Indigenous knowledge is based on experience and has been often tested over time and made compatible with local culture and environment, and therefore, it has acquired the necessary dynamism and efficiency (IIRR (1996). Accordingly, the focus group discussion also confirmed that all people applied the same traditional disease prevention methods to the problem. However, they are in challenge of identifying the disease type before planting, so most of the time they simply estimate the previously existing disease on their farm. But in some case due to its different way of transmission, the other pathogens might happen on their farm. Though, they try to follow and apply the whole prevention method even it is too difficult.

Management of Enset disease

Enset farmers in Ethiopia try to control the disease by disinfecting farming and processing tools, uprooting and burning infected Enset plants, keeping fields and surrounding areas free of weeds and

volunteer plants (alternative hosts), exposing the soil during dry season prior to planting, proper spacing, avoiding overflow of water from infected to uninfected fields, controlling wild and domestic animals from browsing, use of clean planting materials (suckers or corms), strict control of the movement of planting material from one area to other, rotation of crops, and use of resistant or tolerant landrace (Yemataw, *et al*. 2016; Melese *et al*. 2014).

Managing BWE is difficult and no single action was yet recommended. However, implementing one or more methods could reduce the yield loss due to the disease. Farmers employ different endogenous disease management strategies used in combination or single, which could be effective or non-effective and some are not scientifically justified and may need further investigation. Almost all farmers with no Enset disease on their farms use prevention strategies to prevent the appearance of the disease on their farms. Most farmers in the surveyed area use sanitation (37.8 %) or uprooting of infected Enset plants and Dis-budding (31 %) and some burn the residue or bury it (Table 1). This could be a good method for reducing the spread of the disease. Some farmers also leave the infected plant in the field and are allowed to dry on the farm. This method is risky because the pathogen survives in the soil and residue for long period of time, which could increase the disease severity (Mwebaze *et al*., 2006). The pathogen invades systematically all tissues of the infected plant. We also noticed that they implement other endogenous EBW management and preventive practices like the use of resistant clones (14 %), crop rotation and rotation of planting holes (9.2 %). Crop rotation is practiced if their Enset farm is totally infected with EBW, and avoids all Enset and plant with cereals or vegetables for at least two years until the pathogen is clean from their farm. Crop rotation has proven effective in reducing pathogen populations. The result is in line with Handoro F (2014) reported that bacterial diseases of plants, once established, are difficult to control owing to the lack of effective chemical or other curative treatments. Moreover, cultural practices and sanitation control measures are the most principal control measures for BWE. Karamura *et al.* (2018) reported that good sanitation, curative mechanisms, use of disease-free sucker for planting material, crop rotation, and use of resistant clones can serve as viable management options for bacterial wilt of Enset.

While uprooting/removing infected plants, farmers use diverse strategies to destroy the plant. If the infected plant is nearly maturing and freshly infected, they use for human food consumption. But they complained that the *kocho* and *bulla* quality of the infected plant is very poor and has a bad odor. Others may feed for their animals, and if they feed for animal, the cow dunk is not applied for Enset because they think that the cow dunk obtained after the feeding of the animal with infected Enset may transmit the disease to a healthy plant, hence they apply it to *Chat*, coffee or other crops. However, the potential transmission probability of the pathogen by cow dunk is not investigated yet, but less likely. The result is in line with Kusse, K., et al (2021) control measures to prevent, reduce or eliminate the spread of bacterial wilt in Enset fields including the disinfection/ flaming of Enset cutting tools after use, preventing animals from browsing infected plants, fencing infected sites and the rigorous removal of infected plants including the corms.

Table 1. Enset crop disease management

Number	Management Techniques	Frequency (No)	Percentage (%)
1.	Sanitation (disinfecting tools and use of clean planting material)	51	37.8%
2.	uprooting and dis-budding of infected Enset plants (burring and burning)	42	31 %
3.	Crop rotation and rotation of planting holes	12	9.2 %
4.	Use of resistant clones	19	14%
5.	All other techniques	11	8%

Challenges of Enset producers to apply their indigenous knowledge

Supporting scientific development of Agricultural innovation/technology with indigenous knowledge helps the adoption of intervention by the social system. However, much literature confirmed that farmers' indigenous knowledge was ignored throughout Agricultural innovation/technology development at field and laboratory. As indicated by Mayuri Sengupta, 2015 study the principal constraints to the utilization of native information among the Reang ancestral local area in Tripura (North-East India), and presents two fundamental contentions. In the first place, that there are intrinsic issues and strains inside the idea of native information which isn't equitably shared across the local area. Second, the pith of native information stays pointless in conditions where the Indian state sorts native information and its holders as "in reverse" and "crude". Research also argues that bureaucratic arrangement and structure may also be difficult for local society to negotiate (Ross et al. 2011).

Priories, many challenges of applying indigenous knowledge were raised by farmers. However, during focused group discussion those challenges were sum-up and categorize them as lack of experienced older folks, climate variability, farmers moving to other crop production, and lack of help to apply local knowledge is the primary imperatives of farmers to apply native information on the ranchers in the investigation region. Then the farmer gives a wait for those challenges as very high, high, moderate, simple and very simple (Figure 3).

Almost half of the respondent indicates shift to other crop highly affect the application of indigenous knowledge, followed by climate variability and lack of support. While, only 3 % of the farmer indicate shift to other crop has very simple effect on application of indigenous knowledge (Figure 3). This result indicates that farmers are shifting their farming to other crop which may result in omission of farmers' indigenous Enset disease prevention method. This may raise the loss of experienced elders more rapidly, which may also make hide the information from support provider as well as researchers.

Conclusion And Recommendation

The study shows nearly all farmers use their local knowledge to produce Enset crops in the study area. “YeGagano's” voice and using the ears of donkeys are among their climate-friendly forecasts to keep Enset crops influence by the so-called “janfa” and "Chegino" disease. The community has traditional disease prevention methods to control those Enset diseases. Moreover, most farmers in the surveyed area use sanitation or uprooting of infected Enset plants and Dis-budding and some burn the residue or bury. Few farmers use other endogenous enset disease management and preventive practices like the use of resistant clones, crop rotation and rotation of planting holes. Besides, this study shows that the death of experienced older folks, climate variability, farmers moving to other crop production, and lack of help to apply local knowledge is the primary imperatives of the farmers to apply native knowledge on the ranchers in the study area. Thus, this study shows that farmers' indigenous knowledge can be combined with scientific knowledge to improve livelihood of farmers. Therefore, on-farm research needs to be coordinated to improve contributions of farmers and scientists in the development, adaptation and dissemination of appropriate innovations. Moreover, authority officials need to be aware of the importance of local knowledge to community.

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Appendices

Operational definition

- **“Chegino”**: it is a word named by Guragegna language to moonrise and moonset date and time calculation.
- **Enset:** Enset (Enset e ventricosum, Musaceae) is an African crop that currently provides the staple food for approx. 20 million Ethiopians.

- **“Gagano demts”**: it is a word named by Guragegna language to “sound of duck birds”
- **“Janfa”**: it is a word named by Guragegna language refers to a low amount of rainfall which results from inadequate moisture to Enset production at summer season (December, January, and February).
- **“Muket”**: it is a word called by Guragegna language refer to “unexpected increment of temperature”
- **“Quaqusa”:** it is a word named by Guragegna language to the dry part of Enset leaf
- **“yeahya joro”**: it is a word called by Guragegna language to “erect of donkey ear while it shouting”.

Figures

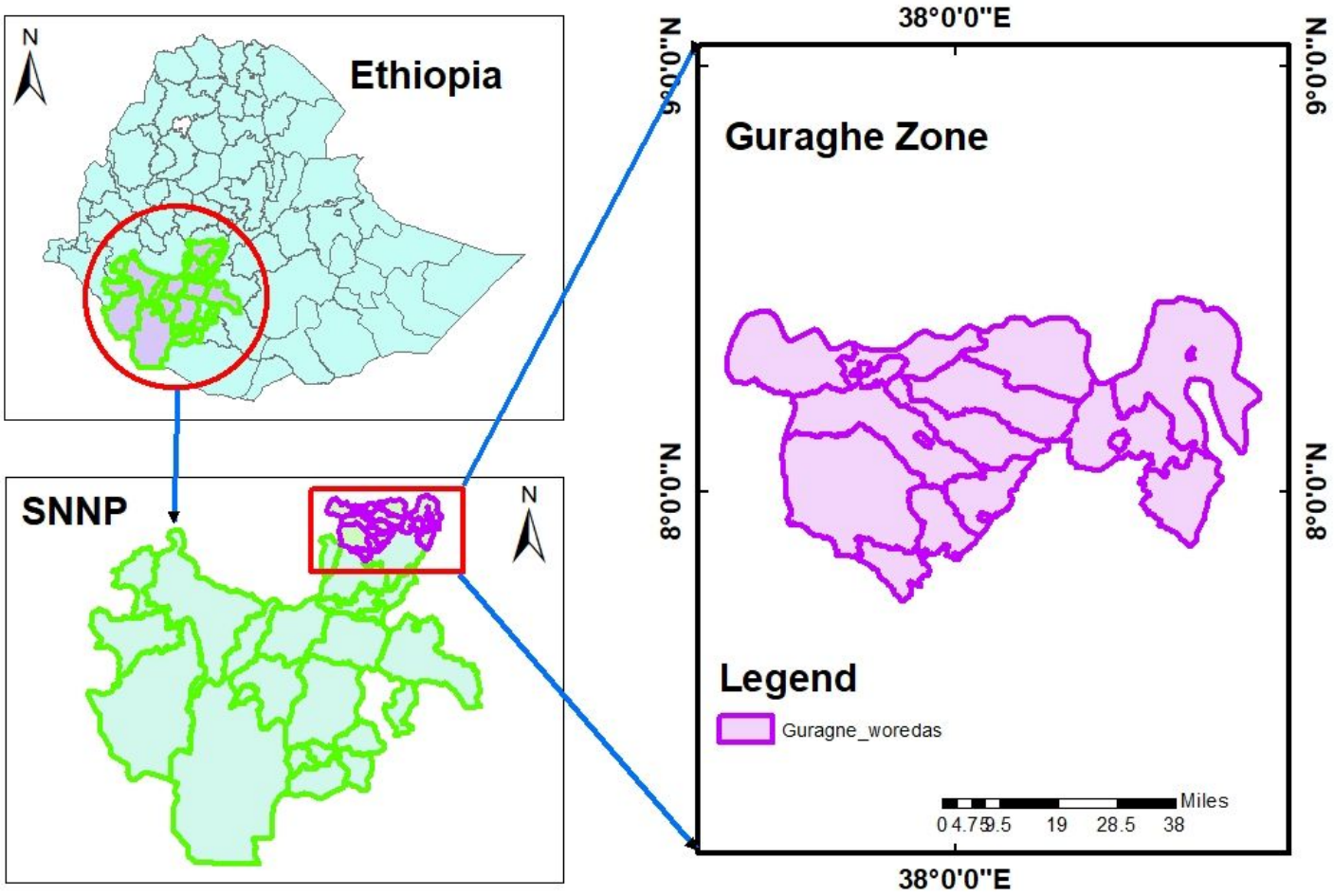

Figure 1

Study area map (Ethio GIS)

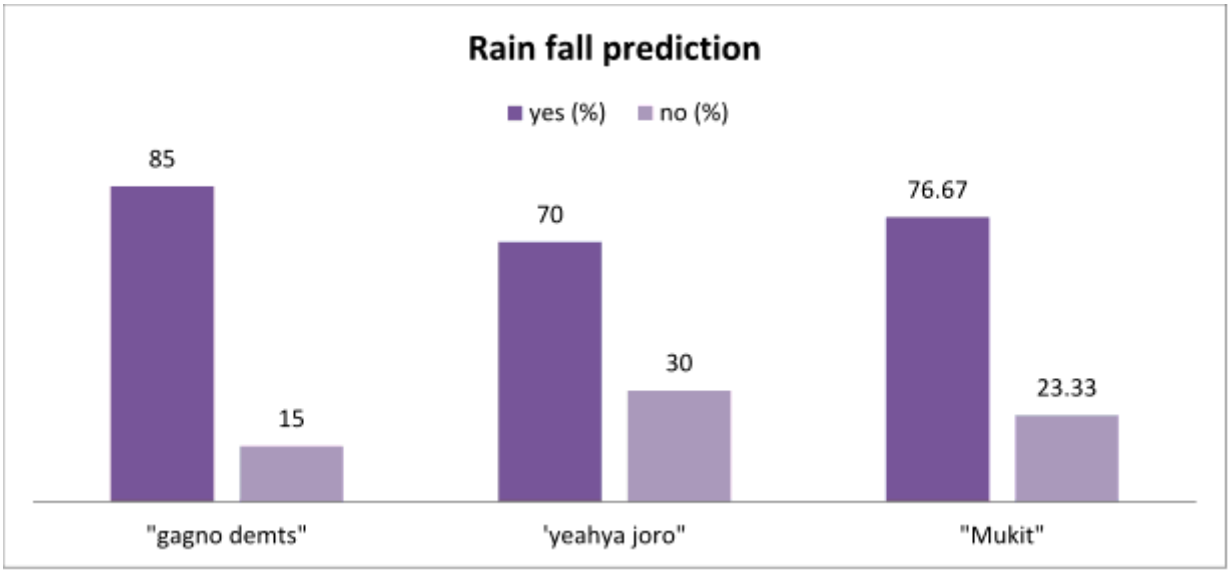

Figure 2

Rainfall prediction by indigenous knowledge

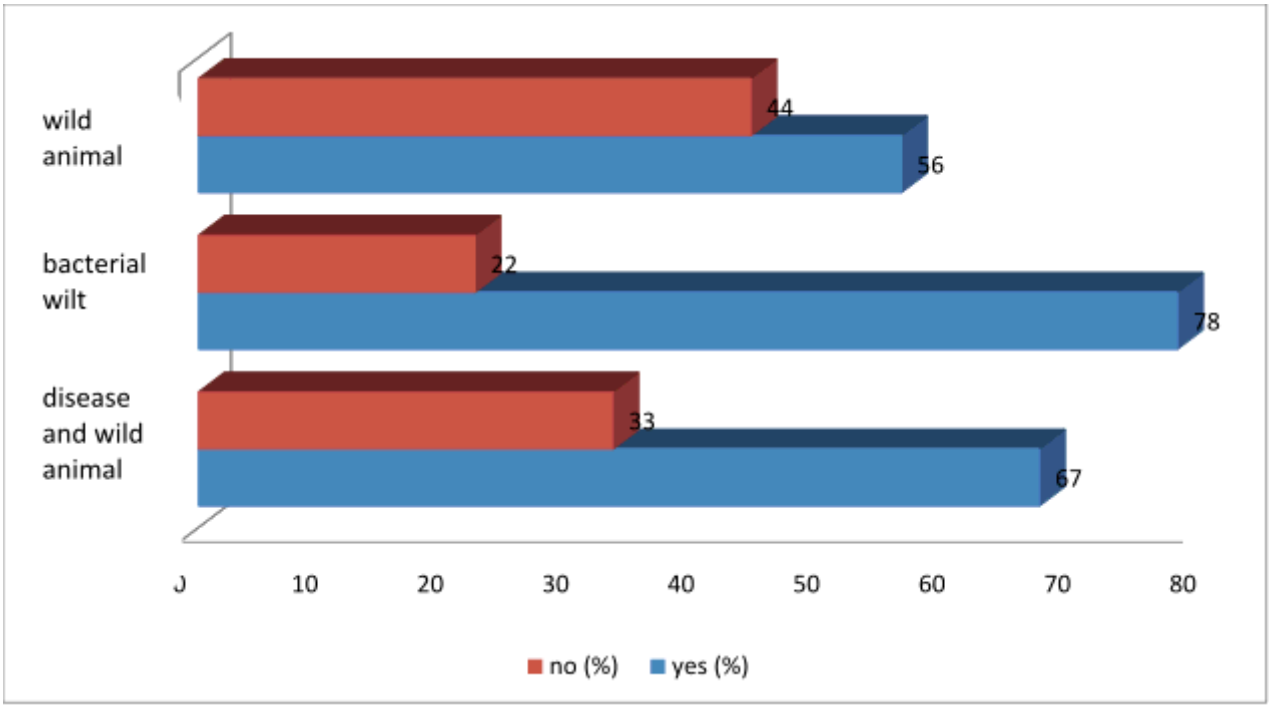

Figure 3

Major constraints of Enset crops production

Figure 4

Enset picture affected by: A) “quaqusa”; B) “chegino” and “Janfa”

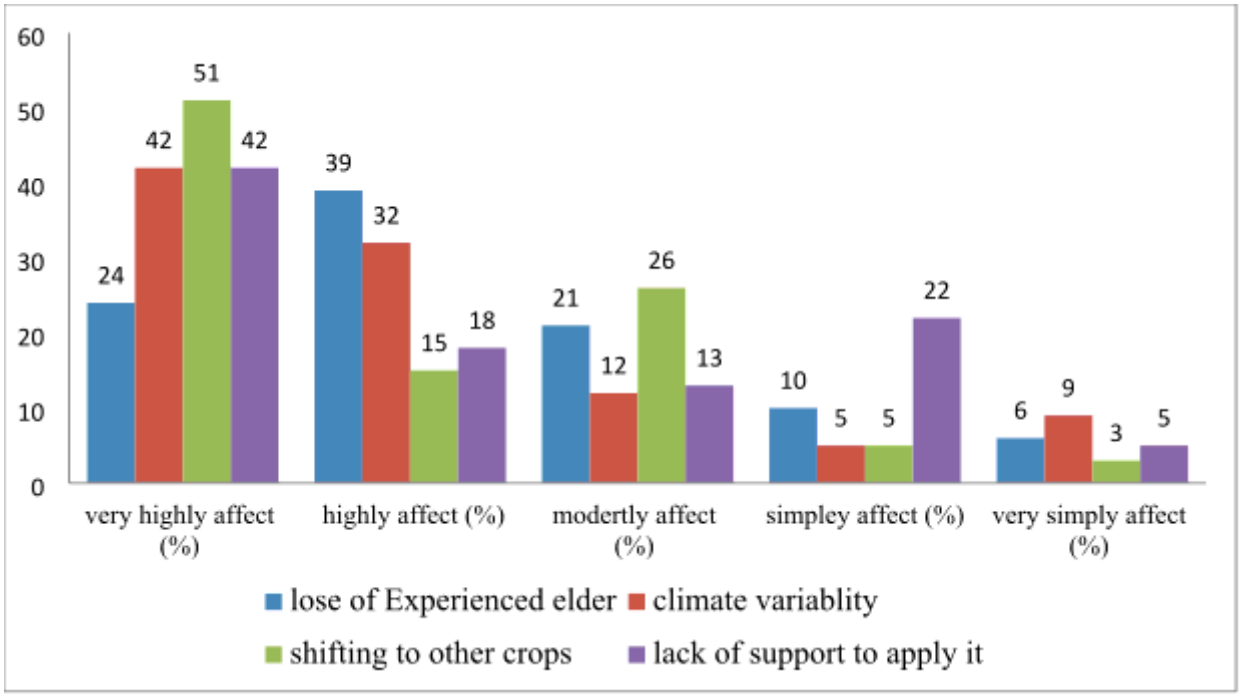

Figure 5

Farmers Constraints to apply indigenous knowledge