

# Ethno-production and Utilization Practices of Foxtail Millet (*Setaria italica* (L.) P. Beauv) in Northern Mindanao, Philippines

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**Abstract:** Mainstream agriculture focused on major staples compromising genetic diversity, local knowledge, and food and nutrition security. Foxtail Millet, a minor cereal, is climate resilient yet an uncirculated traditional food crop. Its grits is nutrient-rich which could be an alternative human food and feeds. This study was conducted to evaluate the ethno-production and utilization practices of the crop in Northern Mindanao, Philippines. Data were obtained from 30 key informants through a semi-structured questionnaire and data were statistically analyzed using the MaxQDA software. Farmer-respondents identified five planting methods (broadcast, drill, hill, dibble, transplanting) and four fertilization practices (goat manure plus foliar fertilizer, synthetic fertilizers, fermented “tubog” with “kuhol” juice, and fermented “tubog” with sunflower leaves) employed in raising the crop although some of them did not apply fertilizers. Foxtail Millet has varied folkloric uses, as human food, animal feed, and as medicine. Its grains are utilized as feeds of newly hatched chicks while milled grits and flour are processed into “biko”, “suman”, “puto”, “binignit”, “dawacaldo”, hotcake and wine. Grains are also utilized as fever anti-suppressant, and for viral infection and measles. It is said to cure indigestion, boost the immune system of teething infants and for aroma therapy to prevent the spread of air-borne diseases. Foxtail Millet has been under-cultivated and underutilized in the Philippines. Research undertakings may be geared at re-introduction, collection, identification and multiplication of the remaining cultivars. The development of processing equipment such as thresher and milling machine should also be taken into consideration.

**Keywords:** foxtail millet, ethno-production practices, utilization practices

## 1. INTRODUCTION

Cultivating different crops and different crop varieties has historically served as an insurance policy for farmers to protect their livelihoods, particularly in facing climate variations, pathogenic infestations, price fluctuations, and socio-political disruptions. However, agro-bio-diversification and the use of local knowledge requires skills to raise these crops. According to Warren [22], local knowledge or indigenous knowledge (IK) reflects the experiences based on traditions and includes recent experiences along with modern technologies. It is a non-conventional body of knowledge that deals with some aspects of the theory, but more of the beliefs, practices and technologies developed without using synthetic inputs nor utilization of modern and scientific management of farms [4]; [6]. Local knowledge is a collection of facts which relates to the entire system of concepts, beliefs and perceptions of people throughout the world [1]. Indigenous knowledge system (IKS) is said to be highly dependent on local than on external resources by which people generally use a diversity of adaptive strategies to be able to survive [5]. IKS is regarded as an ethno-science, folk knowledge, traditional knowledge, local knowledge, people’s knowledge, among others. These knowledge forms are known by other names, and among them are indigenous ways of knowing [2]. Indigenous knowledge (IK) is a local knowledge that is unique to a given culture or society and the systematic body of knowledge are acquired by local people through experiences, informal conduct of experiments as well as understanding the nature of the environment for a particular culture [22];[14]. IK reflects the experiences of a group of population based on their traditions [7]. However, included in that body of knowledge are the experiences gained that include, among others, the adoption of modern technologies. IK is also as a non-conventional body of knowledge which uses theories, but mostly grounded on beliefs, practices and technologies developed without direct inputs from the conventional and scientific inquiries relative to farm management [4], [7]. Indigenous Knowledge may mean “native peoples’ ideas belief and or traditional knowledge” [5]. Hence, it is also preferred to use the term local knowledge system, since indigenous people are no longer free from outside influence and their knowledge systems are constantly reshaped by their contact with the change agents of the outside world [5]; [19].

It is a common knowledge that the shift of vast diversity in crops has narrowed the genetic base. With modern technology, there is loss of genetic resources as well as local knowledge about traditional agricultural practices. One of the most important crops in the history of civilization is Foxtail millet (*Setaria italica* (L.) P. Beauv.). It is an important cereal since ancient times in China and became a main crop 4100 years ago [10]. Since then, the growing area of foxtail millet continued to increase until the 1980s. Foxtail millet is one of the oldest domesticated C<sub>4</sub> Panicoid crops having a comparatively small genome, short life cycle and inbreeding nature [9]. It has two species, the *Setaria italica* and *Setaria viridis* which is the wild progenitor. Foxtail Millet has diverse origins in East and Southeast Asia and Africa [17]. It has vast number of both wild and cultivated species and has been in cultivation in East Asia in the late 7,000 years ago [8]. Early readings suggest that Foxtail Millet has significant benefits to humankind. However, this crop remains underutilized and neglected [16]. The problems leading to extinction of this crop such as poor marketing facility,

tedious post-harvest processing, changing food trends, unacceptable to the new generation, government fair price only focus on distribution of rice and not millets, migration from rural areas; and availability of cheap rice through public distribution system [15]. Further, there is less attention towards research and development and lack of promotional policies for Foxtail Millet [12]; [20] and grain yield is low compared to other cereals [20].

In the northern Philippines, it is one of the cereal crops but eventually lost its dominance due to pond-field cultivation of rice and increased production of Sweden culture of sweet potato [17]. The significance of the crop cannot be under estimated. Foxtail millet could be grown for its grain, as human food and animal feed and fodder. It has high nutrient content richer than rice and corn. It can be grown in marginal areas with less water requirement. Moreover, it is climate resilient, drought-tolerant and can be grown in water scarce environments. With the acute problem on food and nutrition security, Foxtail Millet could be an alternative cereal crop. It was claimed that Foxtail Millet is nutritionally superior to rice and corn but despite its many benefits and uses, the crop was left uncirculated and underutilized.

The study sought to determine the ethno-production and utilization practices of Foxtail millet in Northern Mindanao, Philippines. The results of the study would somehow help revived Foxtail Millet production and utilization as additional staple food options for the Filipinos. Once re-accepted and utilized, it may address food and nutrition security and zero hunger among Mindanaoans.

## **2. MATERIALS AND METHODS**

### **2.1. Locale of the Study and Site Identification**

Qualitative and quantitative investigations on the ethno-production and utilization practices of Foxtail Millet were conducted in selected areas of Northern Mindanao and nearby provinces. Actual visits in the regional and provincial agriculture offices in Region 10 and Agro-Eco Philippines, Inc. were done to obtain the data on the presence of Foxtail Millet in their respective areas. Various municipalities were also visited as per recommendation of the informants from both levels.

### **2.1 Selection of Informants and Data Gathering**

Purposive sampling was used in the identification of the key informants. The informants for the identification of site planted with Foxtail Millet were the key personnel from the regional and provincial offices of the Department of Agriculture. On the other hand, the respondents of the survey on production and utilization practices of Foxtail Millet were farmers and staff of Agro-eco Philippines, Inc. who had prior knowledge and experiences in the production and utilization of the said crop. Data were gathered through semi-structured key informant interview to obtain the necessary information. Series of interviews were conducted to a total of 30 key informants. Data gathered were carefully tallied, recorded, collated and were statistically analysed using the MaxQDA software.

## **3. RESULTS AND DISCUSSION**

### **3.1. Identification of Site Planted with Foxtail Millet**

The information on the presence of Foxtail Millet was gathered from the Agro-Eco Philippines, Inc. and the Department of Agriculture Regional Field Office-X. The Provincial Agriculture Offices in the region were also visited and key informants were interviewed. Municipalities that grow Foxtail Millet as identified by the key informants at the regional and provincial levels were also visited and key personnel were interviewed.

Results show that Foxtail Millet is existing in the municipalities indicated in the map (Figure 1). However, no standing crops were observed during the survey period since it is usually planted during the months of March to June.

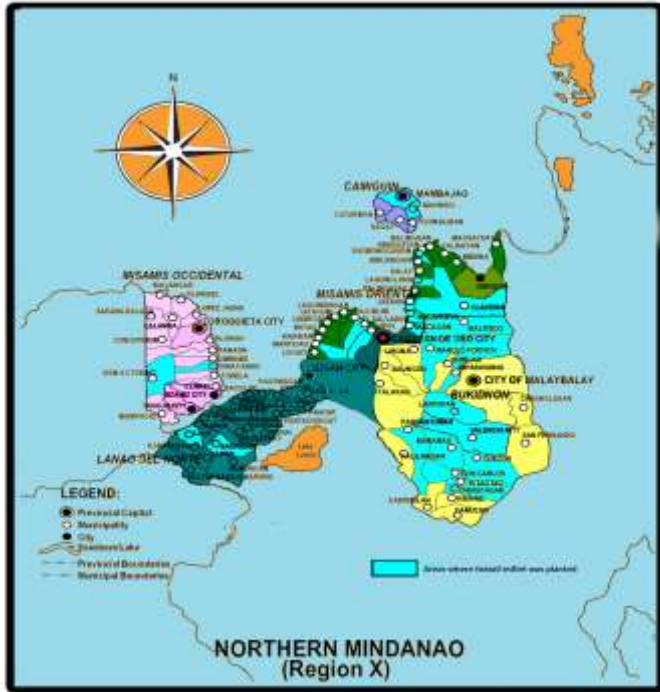


Figure 1. Map of Northern Mindanao showing the areas where Foxtail millet was planted (*Modified from <https://www.gingoo.gov.ph/about-gingoo/maps/regional-map>*)

**Province of Bukidnon.** The crop was grown in Mindagat and San Luis, Malitbog Bukidnon from September 2017 to January 2018 under the network of Agro-eco Philippines, Inc. It was also planted in Pangantucan by the Bagobo tribe [3]. The crop was also planted in other areas of Bukidnon like Banlag in Valencia City, Dangcagan, Impasug-og, Quezon and Lantapan. However, the crop was last observed in late 1980s and early 1990s since farmers in these areas shifted their crop of interest to rice, corn and other cash crops.

**Province of Misamis Oriental.** The crop was observed to be grown in patches in different municipalities. According to the informant, this crop had been growing in Sitio Dal-as, Sta. Ana, Tagoloan, Misamis Oriental until early 2000s because farmers stopped planting due to marketing problems. In Villanueva, this crop was last observed in sitio Calingagan, Imelda in the late 1970s. According to the key informant whose grandparents were planters of foxtail millet, they stopped cultivating the crop because of the tedious processing practices and the lack of processing equipment. Five years ago, this crop was planted by Mr. Boy Faciol of Awang, Opol, Misamis Oriental and Ms. Felecisma Catiil of Bolisong, El Salvador, Misamis Oriental as part of the program on the collection and retrieval of traditional crop species of Agro-Eco Philippines, Inc. In Lagonglong, Misamis Oriental, Foxtail millet was planted in Cabagtukan in the 1970s to early 1980s but farmers stopped planting due to lack of processing equipment. This crop was also observed in wild cultivation in Kaulayan, Sugbongcogon, Misamis Oriental in 1980s-1990s but due to the peace and order situation, this was left uncultivated and uncirculated.

**Province of Misamis Occidental.** The informer from the Provincial Agriculture Office of Misamis Occidental, said that this crop is widely cultivated in Don Victoriano. This information was confirmed by the personnel of the Department of Agriculture of the said Municipality. Accordingly, this crop was largely grown in the area by the Subanen tribe until 1980's as their source of food and medicine. Currently, only few individuals are growing this crop in their backyards for medicinal purposes. According to the informant from Don Victoriano, this was lost in circulation because market outlets. The informant from the Provincial Agriculture Office of Misamis Occidental further said that a certain Barangay in Josefina, Zamboanga del Sur near Don Victoriano was named Dawa (local name of Foxtail Millet). It was believed that in early years Foxtail Millet was widely grown in this area. This information was confirmed by Mr. Gabriel Diaz of Agro-Eco Philippines, Inc., and personnel from the Department of Agriculture Municipal Offices in Josefina, Zamboanga del Sur and Don Victoriano, Misamis Occidental. According to them, the crop was grown in the entire municipality of Josefina until 1990s. It was grown together with the upland rice and some even grow in the wild.

Later, the farmers used Foxtail Millet as buffer crop to upland rice against rice birds. With the introduction of hybrid corn in the area and the shifting of the culture of upland rice to corn, this crop was left uncirculated. To date, few foxtail millet grows in the wild especially in newly opened areas. The informant from the City Agriculture Office of Oroquieta City, Misamis Occidental said that to date, some vendors in the public market of the Municipality of Aurora, Zamboanga del Sur were selling the “budbud cabog”, a traditional food from Foxtail millet and some herbalists were selling the seeds in Cota, Ozamis City. The information was validated by the Municipal Agriculture Officer of Aurora, Zamboanga del Sur. He attested that “budbud cabog” was sold every morning in the public market of Aurora. He added that the vendor was selling this delicacy until the 2<sup>nd</sup> week of December 2017. Through actual site visit in Aurora Public Market, vendors confirmed that they were selling this product consigned to them by a woman who grow this crop in the mountains of Aurora. However, informants during the interview were hesitant to mention the name of that woman. They, in fact cited, that this crop is grown in remote barangays in the Municipalities of San Miguel, Tukuran, Mahayag, Molave and Dumingag, Zamboanga del Sur but data were not validated due to peace and order situation.

Cota, Ozamis City was also visited to confirm the information regarding the selling of foxtail millet seeds by the herbalists. Through actual visit, it was confirmed that approximately 10g of foxtail millet seeds are sold at Php20.00. According to the vendors, they got their supply from the islands of Siquijor and Cebu.

**Province of Camiguin.** A survey visit was also done in the Province of Camiguin and according to the key informant, this crop was grown in Mansua, San Isidro and Takangon, Mahinog in 1970s. In Mambajao, it was observed in Soro-soro, Kiburo, Tupsan, Magting, Pandan as well as in mountains of Itom. But the latest cultivation was observed in 1970s prior to the eruption of Mt. Hibok-hibok.

### 3.2. Ethno -Production and Utilization Practices

**Profile of the Respondents.** A total of 30 key informants were interviewed using a semi-structured questionnaire. Selection was done through purposive sampling based on their experience and knowledge about the production and utilization practices of foxtail millet. Further, prior informed consent through formal letter and verbal communication was sought from the identified key informant before the interview. Out of the 30 key informants, 53% are male and 47% are female. Majority (67%) had actual field experience in cultivating and utilizing foxtail millet and 33% experienced only the utilization of the said crop (Fig 2a). Most of them are Cebuano (43%), 27% are Boholano, 17% are Ilonggo while 13 % are lumads of Mindanao (Fig 2b). The age of the respondents ranged from 27 to 85 years old with mean age of 57 years old. Most of the respondents (37%) were from the age bracket of 50-59 years old, 27% are 60-69 years old while only 3% are from the younger generations ranging 20-29 years old (Fig 3). Among the experienced respondents, only 20% are currently engaged in the growing of the crop in their respective farms.

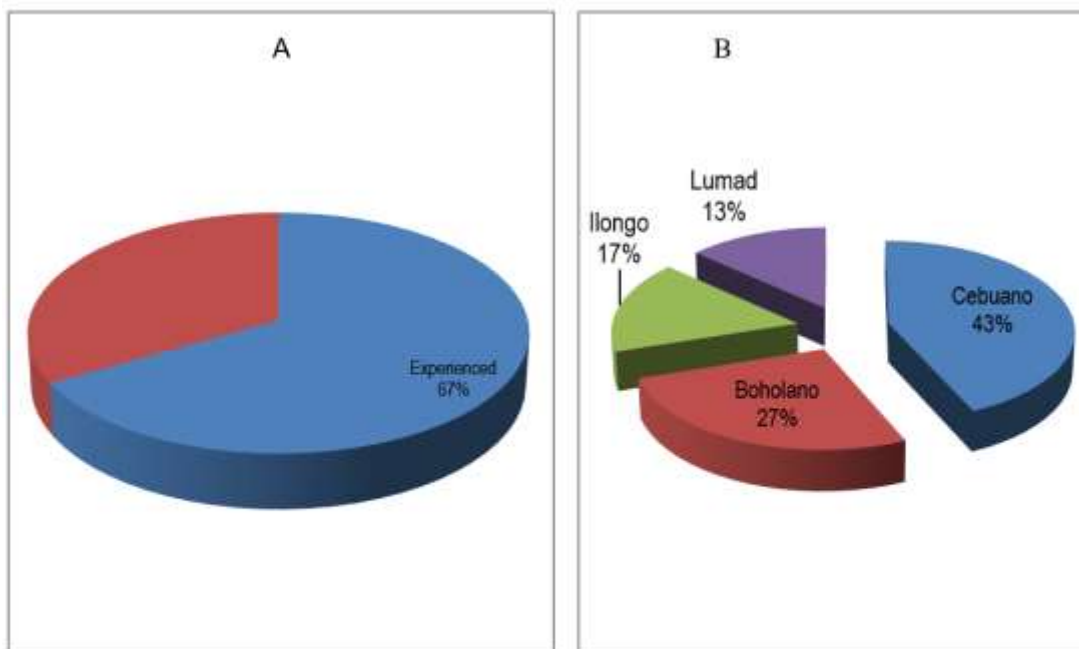


Figure 2. Profile of respondents with (a) experiences in growing foxtail millet, and, (b) ethnic group classification

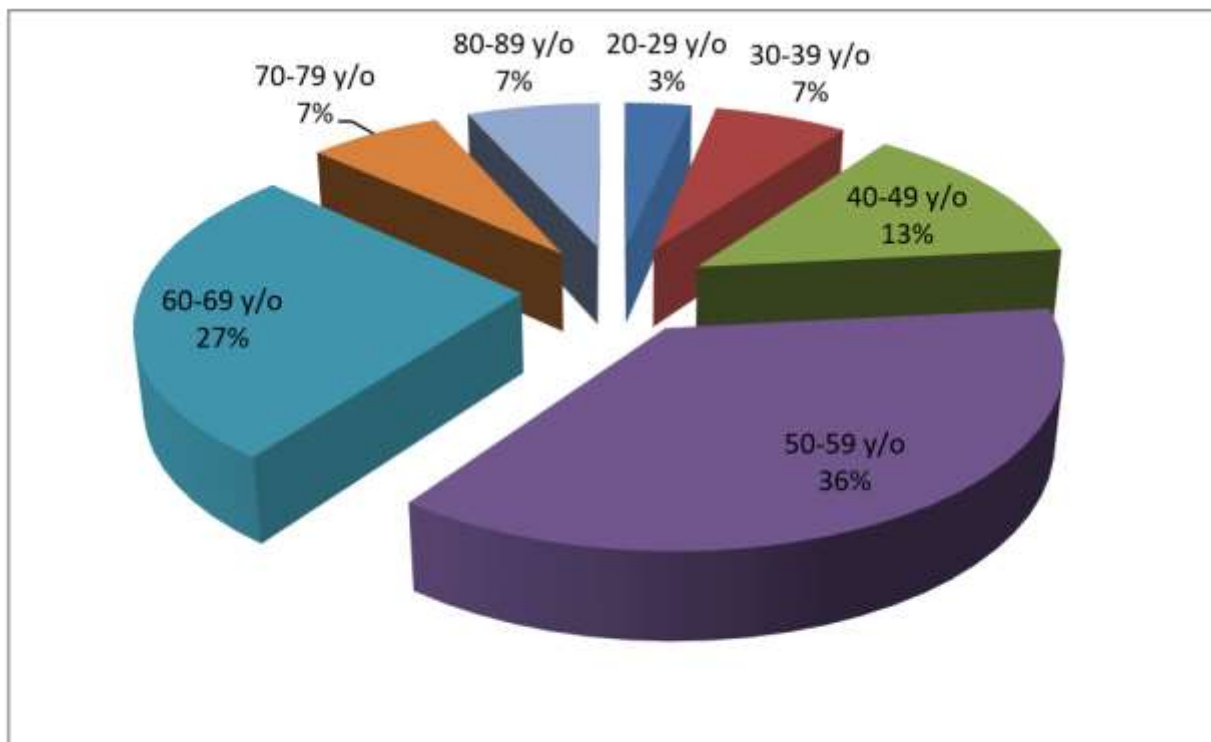


Figure 3. Age bracket of the respondents for ethno-production and utilization practices of Foxtail Millet

**Reasons for Unsustainable Culture of Foxtail Millet.** The result of the survey shows that the cultivation of foxtail millet slowed down starting in the 1980s. Currently, only few farmers are cultivating the crop and mostly are in remote places. As observed, the Regional and Provincial Agriculture Offices in Northern Mindanao do not have data bank on the adoption of this crop since it is not the priority commodity of the government.

During interviews, respondents cited three major reasons why foxtail millet was left uncirculated despite its benefits. These include the following: 1) difficulty in the processing because of no available processing equipment such as thresher and milling machine, 2) unavailability of buyers or market outlets, and, 3) application of synthetic fertilizers.

The harvesting and post-harvest practices of foxtail millet is very tedious and requires a lot of efforts particularly on grits production. Unavailability of buyers made it more difficult, hence farmers were forced to stop the production of foxtail millet for consumption. These findings is parallel to the report of [15] who said that among the problems leading to the extinction of foxtail millet are poor market facility and the crop is unpopular due to tedious processing activities.

In most cases, foxtail millet was planted as an intercrop to upland rice and corn. During the implementation of the green revolution program which includes the utilization of synthetic fertilizers, farmers shifted its cropping system from multiple to monocropping. According to Mr. Maximo Narvasa, the technicians advised them to focus on one crop when using synthetic fertilizers since foxtail millet and other intercrops compete with the main crop for nutrients. Thus, the growing of foxtail millet stopped and farmers focused on raising corn and/or rice (Zozima Abonete, September 24, 2017).

**Salient Characteristics of Foxtail Millet.** Foxtail millet has notable characteristics that *makes* it superior to other crops. According to the informants, this crop can produce tillers even in less fertile soil and low moisture. In the olden times of production, most of the farmers did not use soil ameliorants. This finding conforms to the report [13] that foxtail millet can be planted in less fertile soil with environmental stresses such as intense heat and low rainfall.

According to Mr. Gabriel Diaz, foxtail millet can be sown in the field even without rain and remain viable which they called it “paatang”. In his practice, foxtail millet was planted before the rain comes usually before “Sabado Iglesia” or black Saturday. He said that, usually rain comes on black Saturday and when rain saturated the seeds, it enhances germination. On the other hand, the seeds of foxtail millet can be stored without any treatment under room or ambient condition which remain viable after one year. It grows naturally in areas where it is previously planted and produces panicles like other cultivated crops.

### 3.3. Local Production Practices

**Site Selection.** Farmers used to plant foxtail millet in flat lands, slightly rolling and even in hilly areas. This finding conforms to the report [1] that this crop is adapted to wide range of elevation, soil types and temperature. However, majority of the respondents agreed that this crop would have better yield when planted in newly opened areas (kaingin areas). Similarly, it is grown as first crop on forest clearing in Europe in as early as Bronze Age (<https://www.vurv.cz/altercrop/f-millet.html>). Newly opened areas are usually fertile and rich in organic matter since Foxtail millet belongs to the grass family, it usually needs ample amount of nitrogen and other nutrients. Hence, the experiences of the farmers are scientifically validated.

**Seed Selection.** Most of the respondents utilize the seeds from any healthy panicle characterized by its length and diameter. However, one of them has notable practice in seed selection. According to Ms. Maxima Quieta, they utilized the seeds from the middle part of the panicle. They did not use the seeds from the tip and bottom portion of the panicle. Generally, seeds found in the middle part of the panicle are more vigorous than the seeds from both ends [15].

**Land Preparation Practices.** There were two land preparation practices cited by the key informants during the interview: conservation tillage and conventional tillage using animal drawn plow and harrow. In conservation tillage, farmers clear the area by slashing the weeds. After slashing, they sow the seeds either by dibble method (“poay” or “urok”) or by directly broadcasting the seeds in the soil. This tillage practices were done in hilly and newly opened areas. The conventional tillage practice includes cleaning the area followed by plowing to break the soil surface and harrowing to further pulverize the clods and attain a fine soil tilt. After harrowing, furrowing was done based on the desired row distance.

**Planting Practices.** There was a total of five methods being documented from the survey for this cultural practice. In all cases, foxtail millet is planted as part of crop diversification, as intercrop, as buffer crop and as a mixed crop. Similarly, foxtail millet can be sown as sole crop or intercropped with legumes, cotton and other cereals. The planting methods used by farmers vary according to the land preparation practices and cropping systems employed. In general, foxtail millet is broadcasted, drilled, hill-planted and dibbled in newly opened areas and drilled-planted [17].

*Broadcast Method.* In newly opened areas under crude agriculture system, seeds of foxtail millet are usually broadcasted directly in the field after cleaning. This system does not have any particular seeding rate and the farmers find difficulty in estimating the amount of seeds to be used per unit area. Farmers broadcasted the seeds and waited for germination to occur and subsequent growth.

In recent time as practiced by Mr. Eugenio Geraldo under conventional tillage system, the seeds are broadcasted and covered with thin soil. According to him, this is done by pulling a coconut midrib over the newly broadcasted whereby seeds and the seeds mixed with the soil minimizing losses by ants. As to the experience of Mr. Maximo Narvasa, he broadcasted foxtail millet seeds on 10 days old upland rice as companion crop.

*Drill Method.* In areas prepared through conventional tillage with rows spaced at 30cm apart, farmers drill seeds of foxtail millet in the rows at the rate of 10-20 plants per linear meter. This planting method is similar to the method of planting featured in by <http://www.vurv.cz/altercrop/f-millet.html>. Moreover, it is also planted by drill method with upland rice wherein seeds are mixed with rice before planting at the rate of two “salmon” or approximately 650 g of foxtail millet seeds per can of rice seeds which is approximately 14 kg good for a one-fourth hectare field.

On the other hand, Mr. Maximo Narvasa used to plant foxtail millet by drill method along the furrows where he sow it when rice was ten days old as companion crop. Moreover, farmers are also planting foxtail millet mixed with rice and intercropped with corn in 8:1 ratio wherein in between 8 rows of rice mixed with foxtail millet, there is one row of corn.

*Hill Method.* Another practice in planting foxtail millet is the hill method. It is planted at a distance of 30 cm between rows and 30 cm between hills. The planting distance is also followed in planting as mixed crop with rice. In mix cropping with rice, Mr. Narvasa used two methods. He planted foxtail millet together with rice in the same hill at the same time and/or planted foxtail millet in the same hill but 10 days later than rice. Moreover, foxtail millet is also used as “lapat” or intercrop to rice and corn by hill method with a distance of the 25 cm between rows and 25 cm between hills.

*Dibble Method.* Foxtail millet is also dibbled especially in newly opened areas and in hilly uplands with no specific planting distance which they called it “urok” or “poay”.

*Transplanting.* Ms. Lizel Umbalay mentioned that, to some extent she transplanted foxtail millet especially for medicinal purposes.

**Timing of Planting and Cropping Pattern.** Most farmers implementing the conservation tillage in newly opened areas and planting foxtail millet is planted once a year only March and April. However in flat lands, they are cultivating foxtail millet twice a year wherein first cropping is planted in March to April while the second cropping is from June to August.

**Soil Fertilization Practices.** Most of the interviewed farmers did not apply soil fertilization practices while some has notable practices coming from various sources Goat manure is used as soil ameliorant and applied before planting together with foliar fertilizers. But the farmer-respondent did not state the rate and kind of the fertilizers used. On the other hand, synthetic fertilizer was used by Ms. Julieta Llemit as a soil ameliorant applied at the of rate one “taklob” (approximately 5g) of urea per hill applied as side dressing. Similarly plant based-foliar fertilizer was also used by one farmer such as the fermented “tubog” with “kuhol” juice, and the fermented “tubog” with sunflower leaves.

*Fermented “Tubog” with “Kuhol” Juice.* Fermented *Ficus nota* or “Tubog” with kuhol juice was formulated from the water exudates of “tubog” tree and “kuhol” or golden apple snails. According to Mr. Eugenio Geraldo who formulated this foliar fertilizer, he added 1 gallon (approximately 4 liters) of *Ficus nota* exudates to 1.5 – 2 kg of crushed golden apple snails added with one liter of molasses. The mixture was fermented for 10 days before use. He mixed 1 “tinapa” (approximately 200 ml) of the fermented solution to one gallon of water and applied to the plants early in the morning using a knapsack sprayer.

*Fermented “Tubog” with Sunflower Leaves.* This fertilization practice was used by Mr. Fedilito Agot and Mr. Renante Sumilhig. It was formulated from “tubog” fruit and sunflower leaves which was fermented for 14 days before use. It was applied to the plants at a ratio of one part water to 1 part of the extract which was applied to rice plants early in the morning.

**Pest Management Practices.** The farmers said that they had not observed significant damage of insect pests in foxtail millet. However, the presence of the following insect pests were noted:

Fire ants were observed during planting. These insects gathered the seeds of foxtail millet and bring it to their colony. According to a farmer informant, he used bait to control fire ants such as coconut meat to divert the attention of ants. During planting, he opened mature coconut fruits leaving a little juice and scattered this in the area so that the ants eat the bait instead of the seeds.

Stem borers, inch worms, rice bugs and aphids were also observed in the field planted to millet. However, the farmers did not employ any measure to control the pests since their effect on plants was negligible.

At maturity stage, birds were a problem thus, farmers used scare crow to drive them away. Some of them practiced multiple cropping so that damage brought by birds would not be concentrated on one crop.

One of the major competitors of foxtail millet in the early vegetative stage are the weeds. According to the respondents, the area should be kept weed-free. Weeding was done at three weeks after planting when foxtail millet is as tall as rice. In areas implementing conventional tillage, off barring was done when the height of the crop or the rice plants in mixed cropping was around 30 cm.

**Harvest and Post-Harvest Practices.** Harvesting is usually done at four to five months after planting. Maturity index includes change color of the panicle from green to golden brown. Unlike rice, the vegetative parts of foxtail millet like leaves and stems remain green even if the panicles are mature. Manual harvesting using bare hands, with simple tools such as “kayog” and sickle were the methods in harvesting of foxtail millet. Panicles are usually cut at the panicle neck and harvested panicles are gathered using sacks.

After harvesting, panicles are sundried before threshing. The grains are removed from the panicles by foot on hand threshing. After threshing, inert matter and other foreign materials are removed by winnowing. In the absence of the milling machine, the farmers milled or separate the hull from the grits using a mortar and pestle. In some areas, they are using the corn stone mill. According to the respondents, they have difficulty in milling the grains because of its size. To have efficient milling, they mixed dried banana leaves, coconut husk or even corn husks to avoid spillage during pounding. In some areas, they covered the rim of the mortar with cloth, and after pounding, grits were cleaned by winnowing. On the other hand, seeds for the next cropping are stored by hanging the panicles above the ordinary fire place. Some farmers use cloth bags as container, but Mr. Gabriel Diaz stored the foxtail millet seeds in a bamboo pole or “sugong”.

**Utilization Practices.** Foxtail millet has varied folkloric uses which include as food for humans and animals, and for medicine. For animals, it is use as feed of the newly hatched chicks. As to food utilization practices, it is boiled as alternate to rice and corn. It is also processed into “biko”, “suman”, “puto”, “binignit” (puddings), porridge with chicken, hotcake and wine. Similarly, foxtail millet grains can be cooked in the same procedure as rice and can be prepared as porridge and puddings [16].

*Biko.* It is a traditional food for Filipinos usually offered during special occasions like All Souls Day. It is usually made of glutinous rice but according to the informants, foxtail millet is also processed into “biko”. This is done by cooking the grits of foxtail millet. Cooked foxtail millet grits are mixed with the “latik” made from caramelized sugar in coconut milk. There is no specific ratio of the ingredients as mentioned by the respondents, but it depends on the preference of the cook who made the “biko”.

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*Suman*. This is another Filipino food and like “biko”, it is offered during special occasions. The preparation of “suman” includes cooking the milled foxtail millet. When done, “latik” is added and thoroughly mixed with the cooked food. The cooked set-up with latik is wrapped with banana leaves and cooked again until done.

*Dawacaldo*. According to Mr. Jeonard Santillan, foxtail millet is cooked as porridge in B’laan tribe but is added with chicken meat cuts and grated young bamboo shoots which is an innovation of “arroz caldo”.

*Hotcake*. This is also called pancake which is made from powdered grits of foxtail millet. According to Ms. Zosima Abonete, the following ingredients are needed to make pancakes: for every 1 “gantang” (2kg) of foxtail millet flour, add 4 pieces of eggs and 1 cup (200 ml) fresh coconut wine (tuba) as substitute to yeast, and coconut milk from three pieces matured coconut. The delicacy is prepared by mixing all ingredients which is allowed to stand for three hours. After three hours, this is ready for frying using very little oil and cook in low fire.

**As medicine.** It is used as anti-suppressant of fever, for viral infection and measles. It is also used to cure indigestion, boost the immune system of teething infants and as aroma therapy to prevent the spread of air borne diseases. foxtail millet is mixed with cow’s curd for treatment of measles in Western Himalaya. Cooked grains are also used to treat diarrhea in Chhattisgarh, India [18]. *Anti-Suppressant.* Seeds of foxtail millet together with “busikad” (*Cyperus kyllengia*) are soaked in water overnight. The liquid will be decanted and introduced to the patient with fever, measles, flatulence or skin allergies due to air-borne viral infection.

*Aroma Therapy.* According to Mr. Valleriano Santillan, his mother prepared an aroma therapy to prevent the spread of diseases specially measles which was prepared by burning leaves of “imyam”/ “dinog” with foxtail millet seeds. Individuals with that affliction has to come near the smoke to obtain much of the aroma.

## CONCLUSION AND RECOMMENDATION

Foxtail millet was grown in some parts of Northern Mindanao but loss its circulation due to difficulties in the processing, lack of processing equipment like the thresher and milling machine, unavailability of buyers and the application of synthetic fertilizers as promoted in mono-cropping system. The crop was then planted as part of crop diversification without fertilizer application. There were five planting methods were used by the locals, namely: hill method, drill method, broadcasted, dibble and transplanting. Most farmers were not using any soil ameliorants but four fertilization practices were recorded such as the incorporation of goat manure, use of synthetic fertilizers, fermented “tubog” with “kuhol” juice and fermented “tubog” with sunflower leaves.

Foxtail millet has varied folkloric uses which include food for humans and animals, and medicine. For animals, it is used as feeds of newly hatched chicks. As to food utilization practices, it is boiled as alternative to rice and corn and is processed into “biko”, “suman”, “puto”, “binignit”, “dawacaldo”, hotcake and wine. As medicine, it is used as anti-suppressant of fever, viral infection and measles. It is said to cure indigestion, boost the immune system of teething infants and as aroma therapy to prevent the spread of air-borne diseases.

Foxtail millet is climate-resilient, and with low input requirements not to mention the various benefits which could be derived from its grains and agri-leftovers. Since it has been under-cultivated and underutilized, research undertakings may be geared on the re-introduction of the crop to be spearheaded by the agriculture sector, with strong adoption policy. Moreover, collection, identification and multiplication of the remaining foxtail millets in the region and nearby provinces should be undertaken. Along with that, development of processing equipment such as thresher and milling machine should also be undertaken.

## REFERENCES

- [1] Aidoo, M. & Bdolach, E., Fait, A., Lazarovitch, N. and & Rachmilevitch, S. (2016). Tolerance to high soil temperature in foxtail millet (*Setaria italica* L.) is related to shoot and root growth and metabolism. *Plant Physiology and Biochemistry*. 106. 73-81. 10.1016/j.plaphy.2016.04.038.
- [2] Altieri, M.A. (1995). *Agroecology: The Science of Sustainable Agriculture*. 2nd Edition. London.
- [3] Bandang, S.W. (2017). *The Art and Culture of Foxtail Millet (Setaria italic (L.) P. Beauv) by Manobos in Pngantucan, Bukidnon*. Unpublished Undergraduate Thesis. Central Mindanao University, Musuan, Bukidnon.
- [4] Chambers, R., Pacey. A. and Thrupp, I. (ed). (1989). *Farmers first: farmer innovation and agricultural research intermediate*. Intermediate Technology Publications, London.
- [5] Dewalt, B. (1994). Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management. Human Organization: Summer 1994, Vol. 53, No. 2, pp. 123-131. Retrieved from <https://doi.org/10.17730/humo.53.2.ku60563817m03n73>.
- [6] Gilbert, E., Norman, D. and Winch, F. (1980). *Farming Systems Research: A Critical Appraisal*. MSU Rural Development Paper. No. 6, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan, USA.



- [7] Haverkort, B. and De Zeeuw, H. (1992). Development of Technologies towards Sustainable Agriculture: Institutional Implications. 231-242, In W.M. Rivera and D.J. Gustafson (eds.), *Agricultural Extension: Worldwide Institutional Evolution and Forces of Change*. New York: Elsevier Science Publishing Company. Kegan Paul International, New York, USA.
- [8] Haviland, W.A., Prins, H.E.L., Walrath, D. and McBride, B. (2005). *Cultural anthropology: The Human Challenge* (11<sup>th</sup> ed). Canada. Thomson Learning Inc.
- [9] Lata, C., S. and Prasad, M. (2013). Foxtail Millet: A Model Crop for Genetic and Genomic Studies in Bioenergy Grasses. National Centre for Biotechnology information. US National Library of Medicine. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/22985089>.
- [10] Li, Y. and Wu, S. (1996). EUPHYTICA. 87:33. Retrieved from <https://doi.org/10.1007/BF00022961>.
- [11] Mapara, J. (2009). Indigenous Knowledge Systems in Zimbabwe. *Juxtaposing Post-Colonial Theory. The Journal of Pan African Studies*. Vol. 3, No. 1, pp. 130-155.
- [12] Naveena, K.P., Mouzan, S.M. and Bellundagi, V. (2016). Economic importance and consumer preferences for neglected and underutilized crop species in Karnataka. Retrieved from <http://ndpublisher.in/admin/issues/EAV61N1r.pdf>.
- [13] Prasad, P.V., V. and Staggenborg, S. (2009), Growth And Production Of Sorghum And Millets, in *Soils, Plant Growth and Crop Production*, [Ed. Willy H. Verheye], in *Encyclopedia of Life Support Systems (EOLSS)*, Developed under the Auspices of the UNESCO, EOLSS Publishers, Oxford ,UK, [<http://www.eolss.net>].
- [14] Rajasekaran, B. (1993). A Framework for Incorporating Indigenous Knowledge System into Agricultural Research and Extension Organizations for Sustainable Agricultural Development in India. Ph.D. Dissertation, Iowa State University, Ames, Iowa.
- [15] Ramprasad, V. (2006). *Rediscovering Foxtail Millet*. GREEN Foundation. Bangalore, India. 25 p.
- [16] Sapkota, M., Pandey, M.P. and Thapa, D.B. (2016). Agro-morphological Characterisation of Foxtail Millet (*Setaria italica* L. Heuze, V., G. Tran, D. Sauvant, D. Bastianelli, and F. Lebas. (2015). Foxtail millet (*Setaria italica*), grain, Feededia a programme by INRA, CIRAD, AF Zand FAO. Retrieved from <http://www.feedipedia.org/node/725>.
- [17] Sheahan, C.M. (2014). Plant guide for foxtail millet (*Setaria italica*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center, Cape May, NJ. Retrieved from [https://plants.usda.gov/plantguide/pdf/pg\\_seit.pdf](https://plants.usda.gov/plantguide/pdf/pg_seit.pdf).
- [18] Stuart, G.U. (2006). Daa. Retrieved from <https://www.stuartxchange.com/Daa.html>.
- [19] Sumingit, V. (1997). Indigenous Knowledge Systems of Agroforestry and their Restoration of a Despoiled Environment: A case study in Northwestern Mindanao, Philippines. Doctoral Dissertation. University of Kentucky, Lexington, Kentucky, USA.
- [20] Upadhyaya, H.D. & Pundir. R.P.S., C.L. Gowda, C.L., Reddy, V.G. and Sube, S. (2009). Establishing a core collection of foxtail millet to enhance the utilization of germplasm of an underutilized crop. *Plant Genetic Resources*. 7. 177 - 184. 10.1017/S1479262108178042.
- [21] Warburton, H. and A. Martin. (1999). Agro-biodiversity and Local Knowledge. Retrieved from <http://www.fao.org/dorcep/007/y5610e01.htm>.
- [22] Warren, D.M. (1987). Linking Scientific and Indigenous Agricultural Systems, pp. 153-170, In: J.L. Compton, (Ed.), *The Transformation of International Agricultural Research and Development*. Boulder: Lynne Rienner Publishers, Boulder, USA.

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