BU R&D Journal
23 (2): 78-86, December 2020 | ISSN (Print): 0016-4139
journal.bicol-u.edu.ph | ISSN (Online): 2719-082X

Indigenous Knowledge System (IKS) in Crop Farming in Albay Province, Philippines: An Analysis for Validation Studies

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Abstract

The study aimed to identify, analyze and recommend validation studies for the indigenous knowledge systems (IKS) in crop farming in the province of Albay. Indigenous knowledge in farming refers to the knowledge that has been developed in the community which resulted from the farmers' farming practices and experiences through time. Studying the IKS in farming can provide wider perspective and understanding of a particular community's culture and history of survival in terms of food production. Validation studies may be conducted to confirm efficacy and then package IKS-based technologies that may contribute to sustainable crop production. Purposive sampling of sites and respondents was adopted since Albay has already been influenced by modern agriculture. Sets of data were gathered from the different sites in the province through focus group discussion (FGD) involving the most senior as well as long time farmers in the FGD sites. The data were used to analyze the validity of the IKS based on known scientific principles for qualitative discussion. The same data were used to recommend experimental research for the purpose of validation and technology packaging. IKS on planting, flower and fruit set induction, sex expression manipulation, pest and disease management and seed storage were identified. Some of the identified IKS can possibly be validated through experimental research but some can be considered superstitious. Moreover, many of the IKS are no longer practiced because of the influence of modern agriculture.

Keywords: *Crop farming, Indigenous knowledge system, Validation study*

Introduction

UNESCO (2010) defined indigenous knowledge (IK) as a "local knowledge that is unique to a culture or society". IPCC (2007) also defined IKS as a "knowledge system developed by a community as opposed to the scientific knowledge that is generally referred to as "modern" knowledge". Indigenous knowledge may differ from place to place because its development emanated from a community's experiences and history of survival.

Before the development of modern agriculture, early land tillers have already adopted practices which they discovered through years of actual farming. Some of those practices have even become the foundation of some of the modern agricultural technologies. Pruning for instance is an old grape farming practice which was even documented in biblical accounts and still practiced at present. Science explains that pruning or the judicious removal of some parts of a plant results in the partitioning of more photosynthates to the fruits thereby making fruits bigger and better in quality.

Sustainable technologies in farming may be developed from IKS by studying, validating and providing scientific explanations to it. There could be IKS in crop production systems that are effective in improving crop yield, pest and disease management, soil fertility management and other aspects of farming. IKS cannot be underestimated because many of them have been developed as a means of survival in farming communities in the past. In Deagan Island, Dimasalang, Masbate for instance, cassava, sweet potato and banana are planted during full moon for a bountiful harvest. In addition, to ward off rodents and birds from the rice field, cuttings of coconut petioles are pegged across the field in an upside-down position to look like owls or vipers, which are predators (Candelaria, 2015). The IKS on starting the planting season on a full moon must have developed from farmers' multiple experiences of successful farming on the same period. Perhaps, the climatic condition that prevailed starting on a full moon and onwards was favorable to the crops they

BU R&D Journal, Vol. 23, December 2020
ISSN (Print): 0016-4139 | ISSN (Online): 2719-082X
journal.bicol-u.edu.ph

plant thereby, realizing copious harvest. On the other hand, in the absence of scientific pest management technologies during the early years, farmers resorted to scaring pests away by putting figures of predators in the field just like the coconut petiole that looks like an owl or viper. The scare crow technique was a popular one. These practices have served the farming communities before the advent of modern agriculture and some farmers still practice them until today.

IKS also plays important role in agriculture in other countries. In African countries for instance, animal behaviors like the croaking of frogs, unique sounds made by birds and the disappearance of termites are used by farmers as indicators of the coming of rain. Wide encirclement around the moon forecasts plenty of rain while the premature drying or dropping of flowers foretells the occurrence of dry season (Siambombe, 2018). IKS are used in deciding when to plant and when to prepare for unfavorable conditions.

IKS on all aspects of crop farming were investigated in this study but only IKS on planting, flower and fruit set induction, manipulation of sex expression, pest and disease management and seed storage were documented. Conducting experimental researches to validate the efficacy of IKS is necessary in order to develop it into a package of technology or purposely blend it with modern agricultural practices worthy of dissemination and adoption.

The objective of this study was to identify and analyze the indigenous knowledge systems in crop farming in the province of Albay and recommend research concepts for validation purposes. Albay is a predominantly agricultural province that has survived the challenges of volcanic eruptions, lahar and mud flows, floods and numerous climatic turbulences being in the typhoon belt. Hence, Albay province's IKS in agriculture is worth documenting.

Materials and Methods

This study was conducted in the province of Albay, Philippines, a first class province located 13°N and 123°E. It is situated in the central portion of the Bicol peninsula in the South of Luzon. It is bounded by the province of Camarines Sur in the North, Sorsogon in the South and the Pacific Ocean in the East. Albay is composed of 3 cities and 15 municipalities. The province has a total land area of 2,554.06 km^2 and agriculture is its major industry. Climate type 2 and type 4 of the Corona classification prevail along the Eastern and Western part of the province, respectively. Maximum rainfall occurs in October to January while minimum rainfall happens in April. Coconut, abaca, rice, corn, vegetables and root crops are the major crops produced in the province.

This qualitative research made use of focus group discussion (FGD) in gathering relevant data and information. The sites and participants to the FGD sessions were identified through purposive sampling since most of the IKS in the province are no longer widely practiced due to the influence of modern agriculture. With the assistance of the municipal and city agriculture offices, 28 farming villages (Figure 1) were identified as FGD sites. These farming villages are sporadically located in the municipalities of Malilipot, Bacacay, Daraga, Manito, Camalig, Guinobatan, Jovellar, Polangui and Libon and the cities of Tabaco, Legazpi and Ligao. These 9 municipalities and 3 cities are geographically scattered in the 3 congressional districts of the province of Albay.

The FGD sessions were conducted from May – October 2018 involving fifteen participants in each site which included the most senior and long-time farmers in the area. The age range of the most senior participants in all the FGD sites was 77 – 83 years old with more than fifty years of farming experience. Farmers in their 50's or 60's have also been accommodated to serve as sources of information about the continuity of adoption of the identified IKS. The same prepared FGD guide questions were used in all sessions. The FGD aimed to capture and document the IKS in the farming villages along the different aspects of crop farming from seed selection, land preparation, planting, pest and disease management and other cultural management practices up to the harvest and postharvest handling of farm products. The documented IKS were analyzed based on known scientific principles and research publications for the purpose of qualitative discussion and coming up with recommendations for validation studies.

Results and Discussion

IKS in planting

Planting of sweet potato (*Ipomoea batatas* L.) when cumulus clouds prevail. Cloud formation serves as basis of the planting schedule for some sweet potato farmers. Planting is done when cumulus clouds prevail. This type of cloud forms large cauliflower curd-like appearance. Farmers believe that the storage roots of sweet potato tend to grow bigger and plumper just like

BU R&D Journal, Vol. 23, December 2020
ISSN (Print): 0016-4139 | ISSN (Online): 2719-082X
journal.bicol-u.edu.ph

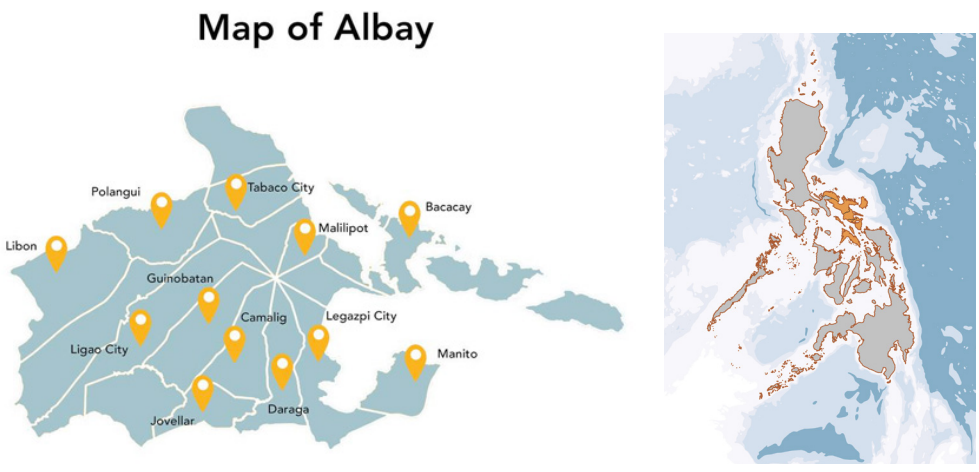

Figure 1. Map of Albay province showing the locations of the cities and municipalities where the FGD sessions were conducted.

the cumulus clouds when planting is done under such condition. The larger the heap of the clouds the better as it would mean development of storage roots of sweet potato to much bigger sizes. This belief is widely known in the province but many farmers do not adopt this IKS anymore. The major consideration of farmers nowadays in deciding on planting time for sweet potato is the opportunity of harvesting at the time when market prices are high. At present, sweet potato is planted all year round but many do the planting in August for the wet season and February for the dry season.

It is quite difficult to scientifically associate the effect of cumulus clouds to the storage root development of sweet potato because many other environmental factors can have an effect on it. Perhaps the planting of sweet potato when cumulus clouds prevail is favored by the rain that develops when cumulus clouds turn into cumulonimbus clouds. It happens when cumulus clouds get larger and extend higher into the atmosphere (Christensen, 2018). It could be that the vegetative growth of sweet potato is favorably affected by the occurrence of rainfall. Plants that have good vegetative growth can have better yields.

If scientific study would be conducted to validate the efficacy of such IKS, the effect of cumulus clouds on rainfall occurrence as well as on other factors affecting plant growth such as soil moisture, sunlight and temperature should be determined and correlate such to the requirement of sweet potato for better vegetative growth. Then again, the vegetative growth performance should be correlated to sweet potatoes' storage root initiation and development. However, it would be tedious and impractical to do such research since the occurrence of cumulus clouds is oftentimes short-lived. Furthermore, the effect of thunderstorm resulting from cumulus clouds during its life cycle may only be observed in a not so wide area. Simulating a model in small space and time scale is extremely difficult (NASA, 2005). Therefore, developing a simulation model for decision-making purposes in farming that involves the cumulus clouds would not be easy too. It would rather be easier to study the differences in sweet potato production during the dry and wet seasons and characterize the weather conditions, including the frequency of occurrence of cumulus clouds when better yields were achieved. In addition, other factors that affect sweet potato production like the changes in soil nutrient status and the dynamics of pests (e.g., weevil) during the wet and dry seasons should likewise be studied. Such can lead to the development of planting calendar for sweet potato.

Patubak. *Patubak* is a local term which refers to the farmers' practice of planting sweet potato between rows of either upland rice or corn plants. Sweet potato stem cuttings are planted after every 3 to 5 rows of rice plants when the latter are already on their early ripening stage. On the other hand, sweet potato cuttings are planted after every 3 rows of corn plants intended for green corn production when the latter are already knee-high or around 1 month after planting. Farmers narrated that poor yield of sweet potato is sometimes observed and

BU R&D Journal, Vol. 23, December 2020
ISSN (Print): 0016-4139 | ISSN (Online): 2719-082X
journal.bicol-u.edu.ph

they associate it to the shade produced by corn plants. Hence, some farmers prefer to plant either corn only or sweet potato only. Patubak is done to suppress growth of weeds and to augment source of food and income. The farmers attested that patubak has been a practice in their community for a long time and this was handed down to them by their ancestors. This IKS is similar to relay cropping in modern agriculture.

Many studies on relay cropping and intercropping have been conducted and showed positive effect in increasing farm productivity and consequently, augmenting farmers' income. According to Yildrim and Guvenc (2005), "relay cropping is an efficient crop production system that sustains the income of small farmers through increasing crop productivity and net return per unit area". Success in relay-intercropping can be dependent on the technological practices adopted by farmers. Antonio and colleagues (1981) found out that higher return on investment can be achieved when relay-intercropping of sweet potato with corn is done after hilling-up. Moreover, in a study on maize and sweet potato relay cropping Kidane and colleagues (2019) concluded that increased maize plants' population resulted in lower sweet potato storage root yield due to the shading effect of maize canopy and shortage of soil moisture due to the delayed planting of sweet potato cuttings towards the end of the wet season. Spatial and temporal arrangement of crops are issues that need to be considered in this kind of cropping system.

If this IKS will be validated through an experimental research, the following should be validated; (1) the timing of planting the relay crop, (2) the planting layout, (3) planting distance, (4) the effects of fertilizer application on crop productivity; (5) the density and proportion of main crops and relay crops; (6) yield advantage of the crops grown as relay crops in a given area and the (7) effect on the soil quality. The output of the validation research should prove that relay cropping of upland rice or corn with sweet potato is more advantageous in terms of the quantity and quality of food produced as well as on the condition of the soil. Moreover, relay cropping with different combinations of crops should also be studied under Albay condition.

Planting of banana during the "ber" months. Planting of banana only in the "ber" months, meaning from September to December of the year is an IKS in Albay. Banana farmers asserted that such practice results in better growth and yield of banana and attributed it to the frequency of rainfall. The "ber" months are normally rainy in the province of Albay and that condition is favorable for the growth of banana plants. Type 2 and type 4 climate of the Corona classification prevail in the eastern and western part of Albay, respectively. These climate types are commonly characterized by no distinct dry season. According to FAO (2019), "adequate water and sufficient nutrient supply at early vegetative stage is necessary since this growth stage of banana determines the potential for growth and fruiting. Water deficit in the vegetative period affects leaf development which in turn influences the number of flowers in addition to the number of hands and bunch production".

This IKS can be validated by planting banana during the wet and dry seasons or the "non-ber months". Varietal responses as well as the reaction of banana to fertilizer application during the wet and dry seasons should be studied. Likewise, the effects of temperature and relative humidity that prevail during each season on the growth and yield performance of banana must be investigated. The validation studies should come up with recommendations on the best planting season for banana under Albay condition.

Using the seeds in the middle part of the maize/ corn cob as planting materials. Maize farmers used to collect seeds for planting from their previous cropping. Seeds are taken from the best ears produced. The ears are allowed to dry while still in the plant. The ears are then harvested and allowed to dry further and protected from pests by hanging them above the firewood stove. The seeds are then shelled from the cob manually and only the seeds in the middle portion of the cob are collected for planting. The seeds 1-2 inches from both ends of the cob are discarded because farmers believe that those seeds have low germination rates and the surviving plants have poor growth performance.

A scientific study conducted by Cheyed and co-workers (2018) showed that maize kernels taken from the lower third of the cob gave higher protein and field emergence percentage than the upper third. Seebauer and colleagues (2010) found out that individual kernel weight was highest at the base particularly from the second decile and steadily decreased towards the tip of the ear regardless of nitrogen supply. Moreover, a decrease in starch and an increase in protein in the kernels was observed with increased nitrogen supply. The concentration of the starch and protein in kernels was relatively similar along the length of the ear regardless of nitrogen fertilization.

To validate, kernels taken from different parts of the cob may be grown in an experimental set up and analyzed

using the growth and yield characteristics as parameters. Inbred maize should be used in the experiment since using planting materials harvested from a hybrid plant is not recommended. The effect of nitrogen application in the inbred plants where planting materials are to be taken should also be studied as literatures proved the effect of nitrogen fertilization on the quality of seeds. Comparison on the growth and yield response of corn to varying rates of organic and inorganic fertilizers may likewise be studied. Validation studies must be repeated at least thrice to come up with more reliable results.

IKS in inducing flowering and enhancing fruit set

Use of grated coconut meat as flower inducer and fruit set enhancer of calamansi (*Citrofortunella microcarpa*). To induce flowering and fruiting in calamansi, grated coconut meat is broadcasted all over the calamansi trees. This IKS is still being widely practiced in Albay. Farmers compare the pieces of grated coconut meat that cling to the leaves and branches of the tree to plentiful blooming white calamansi flowers. The rationale behind such IKS sounds superstitious. However, FGD participants who have knowledge in basic science explained that when grated coconut meat are broadcasted all over the tree ants are attracted to climb up and wander around the tree which could possibly enhance pollination resulting in greater fruit set. Such reasoning makes sense but the same is seemingly not applicable for flower induction. Perhaps, the IKS validation study may start by observing the dynamics of ants and other organisms in a calamansi tree after having been broadcasted with grated coconut meat. The effect on soil fertility of the pieces of grated coconut meat that have landed and decomposed on the soil may also be studied.

Pinning the vines of squash and bottle gourd with coconut leaf midrib or twig. Squash and bottle gourd plants that have poor fruit set are pinned with a piece of twig or midrib stick from coconut leaves on the main vine to enhance fruit set. Perhaps, by pinning the vine with a coconut leaf midrib or a twig can somehow reduce the flow of photosynthates below the pinned portion. Thereby, the photosynthates are directed to the sinks above, the fruits. It is also possible that hormonal reaction resulting from pinning on the stem happens. This can be validated by comparing the fruit set in pinned and unpinned plants. When, how and where exactly to pin are issues that need to be addressed if experimental study will be conducted. If the experiment would show efficacy of the treatment a more advance study considering the translocation of photosynthate and possibly the hormonal reactions may be carried out.

Assisted pollination in squash. Poor fruit set in squash is attributed to unsuccessful natural pollination. Hence, manual pollination is being carried out. The old practice of manual pollination was simply done by placing a male flower of squash upside down on top of the female flower to ensure pollination and fruit set. The process is done in the morning when the flowers open. This practice is now being recommended by the Department of Agriculture and agriculture experts. However, at present, manual pollination in squash is being carried out by collecting a male flower of the same age with the female flowers to be pollinated (Tepper, 2013). The petals of the male flowers are being removed to expose the pollen-bearing structure, the anther and allow easy brushing of it to the stigma of the female flower (Johnson, n.d.). This is done between 6:00 a.m. to 8:00 a.m. (Tepper, 2013).

Vine pruning in cucurbits. Pruning is a very old practice. As an IKS in Albay, farmers prune squash and bitter gourd by removing the sub-lateral or the small unproductive vines that originate from the lateral vines of the plant. Presently, the Philippine Department of Agriculture (DA) recommends pruning in bitter gourd by removing lateral vines when about one-foot long and old leaves from the base up to one meter above (DA-RFO 2, 2017). Science has proven pruning as an effective method of improving the quality and yield of the crops. However, in a study with grapes, under pruning and severe pruning can both result in yield reduction and quality (Sabbatinin, 2015). Hence, further studies on pruning in cucurbits may still be conducted to determine a method of pruning that would give the best results in terms of fruit yield and quality.

Wounding the trunk of jackfruit (*Artocarpus heterophyllus*) to induce flowering. Wounding the trunk of jackfruit to induce flowering is an IKS which jackfruit farmers in FGD sites affirmed to still practice because it is effective. Wounding is done by making bark deep cuts on the trunk of the jackfruit tree. The cut is not done completely around the circumference of the trunk unlike in girdling but the purpose must be similar. In girdling, a ring of bark around the trunk is being removed to prevent the conduction of photosynthate from the source to the parts of the tree below the girdle. Hence, photosynthate is concentrated in the upper part of the tree until the girdle heals. This practice is known to help some species of trees produce more flowers and fruits (Romero, 2006).

BU R&D Journal, Vol. 23, December 2020
ISSN (Print): 0016-4139 | ISSN (Online): 2719-082X
journal.bicol-u.edu.ph

Flower induction by wounding the trunk of jackfruit tree can also be a reaction to a mechanical stress. In apple trees, stress is induced mechanically by bending the horizontal shoots upward and the vertical shoots downward. This results in significant increase in ethylene production in tissues under stress and a decrease in cytokinin levels and polar auxin transport. Consequently, such phytohormonal change increases the percentage of floral buds in the shoots (Sanyal *et al.* 1998).

The IKS may be validated by making different cuts on the bark of the trunks of jackfruit trees of similar reproductive ages and find out how it would affect the flowering and fruiting behavior of the trees. If wounding would show significant effect in flower induction deeper understanding of the science behind it may be achieved by studying the mechanism involved at the hormonal level.

IKS on Pest and Disease Management

Smudging. Smuding or "*pagpa-aso*" in local dialect is the practice of burning materials that are readily available in the farm to produce smoke and repel plant pests. Farmers in Albay use different smudging materials. Dry coconut husks, newly cut betel nut leaves and madre de cacao/ kakawate leaves were the smudging materials documented from vegetable farmers. On the other hand, mango farmers make use of dried mango leaves. All of them practice smudging in the afternoon when the wind movement is gentle for a concentrated and better dispersion of the smoke in the area. However, it is important to note that very few farmers still practice it because most of them are already dependent on chemical pesticides. The tendency of insect pests to return a few days after smudging necessitates frequent smudging making it inconvenient to some farmers. Thus, the shift to chemical sprays by those who have the means.

Validation studies on smudging using the identified burning materials may be done just how it is practiced by farmers as an IKS. The efficacy may be determined by taking into account the population of insects before and after smudging. Identification of pests that are effectively repelled by a particular smudging material is important. The number of days after smudging when the reappearance of pests to an economic threshold level should also be documented to determine the frequency of doing smudging. In addition, the right timing of doing smudging with regard to time of the day, stage of growth of the plants, kind and population of the pests should likewise be determined. Comparing the effects of smudging with chemical pesticides may also be conducted.

Use of Tagbak stem cuttings against tungro. Stem cuttings of herb locally known as tagbak (*Alpinia elegan*s K. Schum.) are sporadically pegged on the ricefield to prevent tungro infestation. Tungro is a viral disease of rice. The farmers however oftentimes call almost all diseases of rice as tungro. Hence, it is not certain if it was really tungro that was being controlled by tagbak. This IKS is not being practiced anymore. Nevertheless, the chemical composition of the stem cuttings of tagbak may be studied to know if it has anti-viral, anti-fungal or anti-bacterial properties. If chemical analysis of tagbak extract would be proven to contain anti-microbial properties, then an organic anti-microbial against plant diseases may be developed from it.

Planting of rice pest repellents in the rice field. Oregano (*Origanum vulgare* L.), marigold (*Calendula officinales* L.) and kamagkaw or spearmint (*Mentha spicata* L.) are used by farmers as insect repellents in rice fields. They grow any of these plants in the levees so that when wind blows the natural aroma of these plants serve as repellent to rice pests. The farmers said that it was an effective practice of driving away pests. However, all of them have resorted to chemical pesticide use because they find it more effective not just in driving away pests but killing them.

Validation study for this IKS may be done by planting the aforementioned insect repellents. It has to be done in paddies of different sizes or dimensions to determine how far the natural smell of the plants can affect the insects. The insects and other organisms that are repelled by the plants should be identified and those that are attracted by it should likewise be documented. Comparing the efficacy of these insect repellents with chemical pesticides may likewise be investigated. The effect of insect repellents should be thoroughly studied through field trials and analyze its advantages and disadvantages in terms of economic and environmental aspects.

IKS on Identifying or Manipulating Sex Expression of Papaya (Carica papaya L.*)*

Papaya is a dioecious plant. Its male and female flowers are in separate plants. There is no way of distinguishing the male from female papaya at seedling stage. Hence, whether the papaya plants in a plantation are male or female cannot be ascertained until the reproductive stage ensues. An advanced method in predicting sex in papaya using Polymerase

Chain Reaction (PCR), an in vitro technique involving the DNA is already in place (Magdalita *et al.* 2003). However, such is a complex method which ordinary farmers cannot just avail of. Hence, the availability of an effective IKS on sex determination of papaya would be more practical.

One of the IKS documented was the selection of female seeds based on its location in the fruit. There were two different IKS documented for this. Some farmers said that the seeds in the middle of the fruit are female while other farmers said that seeds in the lower portion (blossom-end) of the fruits are female. The latter seems to agree with the findings of Mojica (2012) that papaya seeds taken from lower end portion of the fruit produced more female plants than those seeds from the middle and upper portions. The middle and upper portions produced more hermaphrodite plants. The same study revealed that the seeds from the upper portion of the fruit produced both hermaphrodite and female seedlings that were distinguishable in size. Hermaphrodite seedlings were bigger than female seedlings.

Another IKS is the manipulation of the sex expression of papaya done by cutting the main root of the papaya seedling to make it female. Cutting the tap root of seedlings results in branching of the root system. However, the study of Mojica (2012) showed that both seedlings with prominent tap root and those with branchy root system did not affect the sex expression of the papaya plants.

A study with *Cannabis sativa* L. revealed that Gibberellic acid promoted maleness, while IAA, ethylene and kinetin had a femaleness effect on hemp. No direct effect on sex expression was observed with abscisic acid, but it showed incompatible effect on GA3 and IAA. Auxin and ethylene were found to act differently on the sex expression in hemp (Galoch, 2015). Moreover, a study of Mojica (2012) revealed that increasing auxin by 50 ppm resulted in the production of more hermaphrodite seedlings from seeds taken from the lower portion of the papaya fruit. These studies offer an idea that the sex expression of dioecious plants is affected by phytohormones.

Considering the above cited literatures, validation studies on the IKS should be conducted on papaya under Albay condition. A study that would provide information about the possible concentration of any of the plant hormones in each section of the papaya fruit and the sex expression of seeds that are in those sections can help explain the IKS. However, it is quite complicated. Perhaps an initial study which is simpler may be conducted. Validation should start by growing papaya seeds taken from different parts of a fruit following the IKS and determine the frequency of seedlings that would turn male or female. Hormonal concentrations in the fruit that possibly influence the sex expression of seeds may be done later if the results of the initial study would yield a hint of IKS effectiveness.

A validation study on the IKS in cutting the tap roots of papaya seedlings to make them female can also be conducted. How to do the root cutting, how long should be cut and at what age of the seedling should it be done are technological questions that need to be addressed. To prove the efficacy of the IKS, close to or 100% of those experimental seedlings with cut roots should turn female since those will be compared to seedlings with uncut roots which sex expressions are not known.

IKS on Seed Storage

It had been a practice of farmers to obtain seeds from previous cropping for planting during the succeeding croppings. The following are some of the indigenous practices of farmers in storing seeds intended for planting:

Storing dried seeds in a container with wood charcoal. This IKS is commonly practiced by farmers in storing vegetable seeds after drying. The seeds are wrapped in paper or dried banana leaves and placed inside a container usually a clay jar, a glass jar or in a tin can. The charcoal placed in the container serves as desiccants thereby keeping the seeds dry and viable for a longer time. Keeping the moisture in the seed container low prevents fungal reproduction thus protecting the seeds from potential damage.

The Food and Agriculture Organization (n.d.) recommends using dry charcoal, wood ash, cooled toasted rice, powdered milk, or small pieces of newspaper as desiccant. The drying material should take up about one-fourth of the container space. Commercial seed producers make use of silica gel as desiccant in a seed container instead of charcoal and other materials.

A validation study may be conducted considering the following: (1) the moisture content of the seeds at time of storage, (2) the volume of charcoal in proportion to the size of the container and quantity of seeds to be stored (3) type of charcoal materials and size, (4) initial moisture of the charcoal material to be used (5) compare the efficacy of different charcoal materials to commercial desiccants (e.g. silica gel) and (6) the

BU R&D Journal, Vol. 23, December 2020
ISSN (Print): 0016-4139 | ISSN (Online): 2719-082X
journal.bicol-u.edu.ph

effect of charcoal materials as storage desiccants on the viability/ germination of different seeds.

Hanging of string bean pods and corn ears above the traditional firewood stove to protect the enclosed seeds from pests. The three-stone firewood stove is a traditional cooking devise which is still commonly used in farming communities up to this time. Fire woods are used to produce the heat needed in cooking. The mature and dry string bean pods and corn ears with husks still intact are being hung above the stove or somewhere nearby the stove that can be reached by smoke from the burning fire woods during cooking. The smoke serves as repellent for insects and other pests.

Dry and cool condition is normally required for seed storage. Longer seed storage time is possible with low seed moisture content and temperature. The intensity of seed respiration and the growth of molds and other microorganisms and storage pests depends on the seed moisture content and temperature condition in storage (Kaleta *et al.* 2013). Hence, this IKS may be validated by studying the effect on the viability of the seed as the temperature above the firewood stove when firewoods are burning is high. Likewise, the presence or absence of molds and other common pests attacking seeds must be monitored and compare it with seeds stored in another place away from the kitchen.

Treating seeds with achiote (*Bixa orellana* L.) as protection from fungal infection. Achiote/atchuete or sapran in local dialect is used as a source of natural food color. The color which ranges from dark orange to red is obtained from its seed powdery coatings. Vegetable seeds to be stored are being treated by coating it with the colored powdery substance from the achiote seeds. The practice is aimed at protecting the vegetable seeds from fungal infection. To validate, chemical analysis should be done to determine the presence of anti-fungal properties in the colored substance of the achiote seeds. Experiments that can provide scientific information on how to apply and how effective it is as a fungicide must be conducted. Achiote's effect as a fungicide must be compared with that of the chemical fungicides'. Achiote can potentially replace the chemical fungicides usually used by seed companies.

Putting lemon grass (*Cymbopogon citratus (DC.) Stapf*) in the container of dried palay and milled rice to prevent rice weevil attack. Shoots of lemon grass are taken from the plant and cleansed by removing soil particles . The roots are removed and the leaves are halved crosswise. The upper end of the leaves is discarded. Some farmers do not cut the leaves but form it into a knot. The base of the grass is gently crushed to release its natural aroma that serves as insect repellent. The lemon grass shoot is placed in the container to prevent rice weevil from attacking palay grains and milled rice during storage. Validation studies may consider the amount of lemon grass in proportion to the volume of rice or palay, the part of the container where to place the lemon grass and the duration up to which the lemon grass would be effective to repel rice weevils.

Conclusion and Recommendations

A number of indigenous knowledge systems (IKS) in crop farming in the province of Albay have been documented. Some of the IKS are still being practiced but some have just been documented based on the narration and description of the IKS which the FGD participants have observed from their parents and other farmers in the past. There are IKS in planting, seed selection, pest and disease management, manipulation of sex expression of plants, flower and fruit induction and post-harvest handling of crops. However, many of the IKS identified are not widely practiced anymore because of the influence of modern agriculture. Some of the IKS can be scientifically backed up. Hence, it is recommended that validation studies through experimental researches should be conducted. Validation studies can lead to the development of cheaper, environment-friendly and sustainable technologies in crop farming.

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