Indigenous maize seed storage using buffalo dung ash practiced by smallholder farmers in Kisar Island

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Abstract. Kisar island is a small island located on the tip of Timor island. Corn is the main agricultural crop, and livestock husbandry also plays an important role in the livelihood of the farmers as a source of income, provide mainly manure for maintaining soil fertility and in the local culture as a 'bride price' and for the exchange of goods. Considering periodical seasonal hazards, during eight months dry season people suffer from a serious shortage of water. Failure of the harvest is not an unusual phenomenon on the small, dry, eroded coral island. Seasonal pest invasion on maize cultivation threaten their seed security and food security. The objective of this review is to describe the validity of farmers' indigenous knowledge (IK) of using buffalo dung as a preservative agent in maize storage and its relevancy in the contemporary living of farmers in the island. A phenomenological study was held in June to August 2018. The results showed that applying buffalo dung ash makes the maize dry faster, cleans and kills maize weevil and preserves the grain. It was concluded that the knowledge and practice is scientifically valid and benefited community in the past but has less relevancy to the contemporary living of the farmers in the island.

1. Introduction
The small island of Kisar is located in the most south-western part of the Province of Maluku, Indonesia just 15 miles north of the eastern tip of Timor island. Upon arriving at Kisar via a sea going vessel, the island looks like a fort. The outer perimeter is a coral rock cliff with a hill separating the inner island (where everyone lives) and this outer cliff. Moving around the island, the occasional corridor cuts through the outer hill to the interior. The only town, Wonreli, is centrally located and facilitates government officials.

Kisaresses depend mainly on activities that utilize their natural resources to generate income for their living. Approximately 80 percent of population of Kisar were farmers. Corn is the main agricultural crop, and is the staple diet supplemented by beans, green vegetables and root vegetable
(cassava) for Kisaresse. Data from the [1] shows that the total area used for cultivation for food crops was approximately 3,510 ha, and it accounted for 30 % of the total area of Kisar, while the area for cash crops was approximately 720 ha or 6 % of the total area. Corn is traditionally planted in the homestead twice a year, just before the westerly and easterly monsoons. Other crops such as coconut and oranges are also planted for cash.

Furthermore, livestock husbandry also plays an important role in the livelihood of the Kisaresse. Besides being a source of income, livestock provide mainly manure for maintaining soil fertility. Livestock also have a ritual meaning in the culture of the Kisaresse as a 'bride price' and for the exchange of goods. Domestic pigs are also kept in the village, whereas goats are kept in fields outside the village. Goats dominate the population of livestock on Kisar Island, and it accounted for around 52 % of the total livestock in Kisar. Besides goats and sheep, pigs, buffaloes and chickens are also raised by farmers, accounting for the remaining 48 % of livestock.

Considering its geographical aspect and periodical seasonal hazards, during eight months dry season people suffer from a serious shortage of water. Failure of the harvest is not an unusual phenomenon on the small, dry, eroded coral island. In the past, hunger was an almost annual occurrence. It is exacerbated by other conditions such as seasonal pest invasion on maize cultivation, which potentially affect their food security. Seed security is key to the attainment of household food security among the farmers in Kisar island. In the tough conditions arising from shocks caused by drought, pest, and other vulnerable situations which attack their seed security, the farmers as conscious beings have the capability to overcome the situation. Through their praxis capability, expressed as critical reflection on the crises and assets they have, farmers build their indigenous knowledge of seed storage as a part of adaptation mechanisms in the island. The objective of this review is to describe the validity of farmers' indigenous knowledge (IK) of using buffalo dung as a preservative agent in maize storage and its relevancy in the contemporary living of farmers in Kisar island.

2. Methods
The notion of the research was a phenomenological study by which the farmer’s IK of using buffalo dung ash in maize storage as a focus phenomenon to be explored. Here, every knowledge holder was considered possess unique experience and knowledge to be explored. The visit into the island was held in June to August 2018. The research that conducted the field activities was made up of nine people, five university academics, two third year undergraduate students and two farmers. The academics had a background in agronomy, agriculture economics, rural sociology and animal husbandry, whereas the farmers had an intimate knowledge of their situations. In addition, a number of individuals contributed their knowledge through some casual discussions. The researchers worked with individuals and small group of farmers, locally named *rososon*, as a ‘pilot’ group to avoid raising local expectations about what the research might yield. Accidental sampling was applied which rely heavily on snowball technique to find the knowledge holders. In an effort to explore the reality, the ‘*Apa itu ?*’ principle, that is asking ‘what is it ?’ question, was an important technique. This question proved effective in encouraging the farmers to express their experiences and knowledge about particular practices, and as an entry question for the ‘how’ and the ‘why’ questions. The qualitative data collected were analysed by manual content analysis and descriptive statistics, such as frequencies. Content analysis is a systematic, replicable technique for compressing text into content categories based on explicit rules of coding and identifying themes or patterns.
3. Results and discussion
3.1. Maize Seed Storage
There were four ways of maize storage practiced by farmers in Kisar island, namely using “bising” (a traditional storage container made of dried sugar palm leaf), using aluminum drum, hanging over fireplace and store in the upper-room. The most traditional storage treatment was applying buffalo dung ash.

Indigenous practice of using buffalo dung ash as preservative agent for indigenous corn storage, locally called "bising" practice. Dried buffaloes' dung collected and burned to produce dusts. The dusts then applied by using a 'sandwich' method by which the dust was placed a layer by a layer. The theory behind using the dust produced by buffaloes' dung rather than others, as the farmers believe, because it was softer than others, and easier to penetrate into the spaces between the grains but also more 'strong' to kill the pest. Using buffalo dung ash is considered as the oldest fashion of maize seed storage has been practiced by the farmers in Kisar island for centuries. The detail process as showed in the Figure 1 below.
Figure 1. Steps in maize seed storage treatment using buffalo dung ash

1. Collect buffalo dung from common pasture area
2. Combus buffalo dung
3. Collect ash
4. Centrifuge (riddle) ash
5. Spread ash to the surface of maize layer by layer while pound gently to compact it
6. Store the maize seed in warm and dry place (barn or storage room)

According to the farmers, applying buffalo dung ash has several advantages. Buffalo dung ash makes the maize dry faster, cleans and kills the bug [maize weevil] and preserves the grain, Furthermore, it has no toxic because it has burnt completely, so the maize is safe to consume, no effect on the odor, no effect on the color of maize (compared to use goat dung ash, maize color changed reddish). A key respondent farmer explained in an informal conversation that: “the key of success in applying buffalo dung ash as a preservative ingredient is that we have to spread the ash in balance to the volume of the maize, approximately a half of maize volume would be better, so it has enough capacity to adsorb the water of maize and make it dry faster and our maize seed will safe until next season…beat it properly so maize and ash become tightly cemented…then at the end, the bising [container] should be tightly closed and placed in warm room to avoid water or rain…if we placed into wrong room it would be useless because when it wet the mold will grow soon and destroy the maize then we have no seed to plant next season, meaning ready to starving next season or buy rice if we have money”

The farmer commented further that in practice preserving maize seed by using buffalo dung ash treatment produced higher germination capacity than by just hanging the maize seed over the fire-stove because the heat and smoke from fire-stove is detrimental to the seed.

Scientific findings have been proved the validity of farmers’ IK of applying buffalo dung ash to maize seed preservation. However, there are some debates among the scientists on the effects of using buffalo or cow dung in seed preservation, particularly its effects on moisture content, insect damage and germination capacity. In the practice of maize storage treatment using buffalo dung ash, ash is used both as an inert filler and for its other negative effects on insects. As an inert filler, ash works by filling up the space around the seed and impeding the movement of insects as well as, in sealed containers, reducing the volume of air available to the insects for respiration [2]. Animal (buffalo) dung ash contain silica which behave as adsorbent to absorb water content [3,4] and become unavailable to microbes to live and damage the cuticle of insects causing them to dehydrate and also has detrimental effect on egg development [5-7]. In addition, it prevents the seed from insect attack and maintain seed rigour [8].

Further [2] found that the effectiveness of ash to damage insect and viability of the seed possibly influenced by the kind and amount of ash used and method and time of application. He suggested that the thickness of ash/grain layer 3 cm may maintain viability of seed for long period of time. Meanwhile, [9] and [5] suggested that the quantity of ash used should be around 25-50% of maize volume in order to effectively damaging insect.

3.2. The Shrinkage of Farmer IK and Practice

However, utilization of buffalo dung ash has been shrunk. The practice was famously applied when buffaloes were raised by majority farmer households in the island. One of the key respondents responded that it lost its famous when huge degradation of buffaloes happened in the island because of the value of buffalo in Kisar culture as bride price has been replaced mostly by pigs and other material things. This situation reflected that the farmers’ knowledge is not static but dynamic. New meaning of farming practices continually emerges during farmers’ interaction with other farmers and with their environment. It may result in two-folds: expands or the shrinkages of IK and practice.
Currently, there are only few farmers who are still practicing using buffalo dung to preserve maize seed. The practice of using buffaloes dung for grain preservation has been changed by using drum. Since buffaloes have been almost extinct, farmers were no longer relied on buffaloes dung anymore for grains preservation. The farmers are using drums combined with sun drying to store their grains including corn, beans and rice. It was seen more effective in terms of time required for preparations. However, the disadvantage of using drums was due to the obligations for sun drying the grains as dry as possible in order to ensure the longevity of the storage grains. In other word, as long as it was evaluated satisfied their need and relevant enough for storing grains including maize and beans, the technology in term of technique, knowledge, and product management, will be continuously framed into daily practice of the farmers. In this case, the inherited knowledge may shrink or expand depending on the need and relevance of the knowledge in its realm of everyday life of a given generation [10]. "shrinkage ensues when one sort of knowledge becomes superfluous to the everyday requirements of a successor generation. Expansion may be due to either of two factors. On the one hand, new social conjunctures, new social demands generate new social experience takes root in the form of everyday knowledge. This new intake is then transmitted to the successor generation as part of the ancestral estate. In the second place, knowledge may infiltrate or may be consciously induced into the realm of everyday from the sphere of species-essential objectivation for itself... which arise from the intention of satisfying needs felt by members of a given society " [10].

4. Conclusion
Farmer indigenous knowledge of using buffalo dung ash as inert filling in maize seed storage processing has been benefited the community in Kisar island for century in terms attaining seed and food security. Such practice has been proved scientifically valid to reduce moisture content, reduce insect damage and maintain seed viability. However, it has less relevance to the current living situation in the island and has been replaced by the combination of using drum and sun dried which considered easy to apply now and satisfied the need of the farmers to secure their maize seed for seasons of planting.

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