Welia: Ethno-Agronomy on Small Islands

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Abstract: - This research was motivated by an interest in the ethno-agronomy of the Wangi-Wangi Island community in Wakatobi Regency, Southeast Sulawesi Province, Indonesia. Wangi-Wangi Island as small islands has a determination of dry land resources with a dry climate. On this island there are relatively agricultural products that can support the community's food security in a sustainable manner. This sustainability based on the community of local wisdom in the traditional agricultural system which is *welia* manifest. This research aims to finding *welia*'s resilience as ethno agronomy in small island community. This research has a case study design, and was conducted in April 2018 to August 2019. Data was collected through observation, interviews, literature study and laboratory test with the triangulation method. Informants are determined by certain criteria, consisting of 1 key informant and 63 key informants. The results showed that *welia* is local wisdom in cultivating plants on dry land and dry climate. This system was born from a farming culture (ethno-agronomy) and centered on land (agro-centric). *welia* with a pair of red bean and corn by 100% canopy follow lighting will have optimal crop production. The vegetation in *welia* consists of climbing poles or stakes and shade trees (*toropanga*) in maintaining soil fertility to support plant productivity. *Welia* is a land management system that relies on vegetation and fire. Farmers should use fire wisely as agro-technology in burning land. The wise use of fire can support the sustainability of *welia*'s vegetation.

Key-Words: - Ethno-Agronomy, Island, Small, Wakatobi, *Welia*

1 Introduction

Small islands dominate the spread of Indonesian islands. Thus, they are potential to be developed as new center for plant cultivation systems. Referring to Law Number 27 of 2007 concerning Management of Coastal Areas and Small Islands; a small island is an island with an area smaller than or equal to 2,000 km2 along with a unitary ecosystem. Manez et al. (2012) stated that “very small” islands (100 km2 or 10 km x 10 km) generally have no surface freshwater sources such as rivers or lakes. The main sources of freshwater in the small island are groundwater and rainwater. Priosambodo (2018) explained that a collection of water is in a convex "pocket" like a thin lens floating on salt water, which is heavier in the ground. Freshwater in the ground on small islands is generally near the surface of white sand (coral sand) or limestone. Small islands have dependence on large islands around them (de Agueda Corneloup and Mol, 2014) but dependence needs to be managed by exploiting all the agroecosystem potential. Small island agroecosystems are currently not seen as a multidimensional crop cultivation system that contains ecological aspects for food security (Leunufna and Evans, 2014), but is limited to tourism economic production assets (Williams et al., 2020). The development of a crop cultivation system in small islands is neglected in the national budget policy when compared to the development of a crop cultivation system in large islands.

Small island agriculture begins with slash and burn cultivation. Swidden agriculture, shifting cultivation, rotational cultivation, farming, slash and burn systems are the names of farmer activities which consist of a cultivation phase and a fallow phase. The cultivation phase begins with slash and burn found in Southeast Asia (Schmidt-Vogt et al., 2009; Li et al., 2014) such as in Oceania (Roos et al., 2016), Solomon Islands (Iese et al., 2017; Versteeg et al. ., 2016), Palawan Island, Philippines (Dressler and Pulhin, 2010), Hainan Island, China

(Lu et al., 2016; Lin et al., 2016), Westham Island, Canada (Zhang et al., 2017), Vanuatu Island, Pacific (Blanco et al., 2016) or Sulawesi Island (Henley, 2011).

Allegedly, *Welia* is an ethno-agronomic slash and burn in the cultivation of the oldest red bean plant with land that Wolio (Buton) farmers and their supporters have ever practiced in dealing with natural conditions in the form of dry land, dry climate, and rocky karst. *Welia*'s existed before foreign nations discovered the Wolio Kingdom on Buton Island in the XVI century. *Welia* in the Wolio (Buton) language is defined as the activity of cutting trees associated with opening a garden.

Management of *welia* principally similar to traditional agroforestry system management carried out on small islands such as the Dusun, Lawa, and Lela systems in the Maluku Islands and traditional agroforestry systems on large islands such as the Talun system in West Java. Management based on local wisdom is the result of farmer trials which are transmitted from generation to generation orally. These trials are known as local knowledge and form the basis for site-specific agricultural techniques. Local wisdom becomes an identity for the community (Haba, 2006; Sumitri, 2015). Welia management is a justification for the full commitment and responsibility of farmers in the linear relationship between culture, society, farm, and vegetation.

2 Methods

The research was conducted from April 2018 to August 2019 in the Wangi-Wangi Island, Wakatobi archipelago, Southeast Sulawesi Province, Indonesia. The research began with a vegetation analysis and a survey to determine the location and plants. The location research was determined by purposive sampling. Based on the results of observations and interviews, the selected farming locations were in Matahora Village, Wangi-Wangi Island. Matahora Village is considered representative in representing the similarity of the welia system carried out by farmers, geographical, economic and social conditions throughout the village area in the Wakatobi Islands.

The technique of collecting information was carried out by snowball, began with determining the base informants and then leading to the selection of several key informants. This study involved 2 informants namely base informant and 63 key informants. The key informants consisted of 38 men and 25 women ranging from 48 to 75 years old. The base informants were determined purposively, and considered knew most about the conditions of the research area. The informant was also able to direct researchers to obtain data and information according to research objectives. The key informant has the criteria, namely head of the family, at least 45 years old, farming in *welia* land and knowing about the *welia* system. The subjects of this study were farmers who implement the Welia system, community leaders, and agriculture government officials.

Primary data obtained through observation, interviews and measurement results of rainfall, microclimate, temperature, and solar radiation. The physical and chemical analysis of soil at the Soil Research Institute, Balitbang, Ministry of Agriculture, Republic of Indonesia. The components of soil fertility analyzed consisted of texture, pH, C-organic (%), N-total (%), C / N ratio, P (ppm), K (me 100 g-1), Mg (me 100 g- 1), CEC (me 100 g-1), base saturation (%) and very thin soil depth (<20 cm). Furthermore, data triangulation was carried out to assess the validity of the data through observation, interviews, data from laboratory analysis and literature search results related to the object of research..

3 Results and Discussion

Welia as one of the indigenous plant cultivation on Wangi-Wangi Island based on local wisdom. Farmers' local knowledge is developed from simple experiments (Hawkins and Van De Ban, 1999) built from and on the basis of everyday natural-contextual experiences (Galib, 2006). Local knowledge is still held firmly by farmers of Mount Tunuri, Bolivia (Boillat and Berkes, 2013), Mamberamo farmers, Papua (Boissière et al., 2013), and Tibetan farmers (Hopping et al., 2016). Upadhaya et al. (2013) argue that understanding the various modifications and integration of traditional agricultural practices has the potential basic form for sustainable agricultural systems.

Welia literally means "slash". Slashing is the initial activity in clearing land on pole-sized vegetation. The word *welia* is a vocabulary in Wolio. Wolio is known as the center of the Buton Kingdom Government. In the past, this kingdom was based on Buton Island, which is located in the east of Sulawesi Island. The Buton Kingdom Supporters consisted of an alliance in surrounding kingdoms known as the four *barata* and seventy-two *kadie*. *Barata Muna* (Muna Regency), *Barata Kahedupa* (Wakatobi Regency), *Barata Kulisusu* (North Buton Regency) and *Barata Tiworo* (West

Muna Regency) are the defense systems of the Buton Kingdom. *Barata Kaledupa* covers the "Tukang Besi" Archipelago (Wakatobi Regency) with 18 *kadie* including *Kadie Mandati, Wanci* and *Liya*, each of which are on Wangi-Wangi Island. In this time, *welia* can also be found in Muna Regency, North Buton Regency, and West Muna Regency as the central *Barata* areas.

Welia is the most common model of slash and burn activity for rainfed cultivation on dry land, dry climates, vegetated in the Savana, and rocky karst soils. These activities are still being developed by local farmers and produce most of the food consumed by farmer households (subsistence). Currently, *welia* farmers are people who still depend on the agricultural sector to full fill their daily needs, both by farming on land and gathering seafood. As foodstuff approach, *welia* aims to produce protein from the red bean plant for the community and ensure the intake of vegetable protein for farmer household.

Welia is a technology system as an adaptation strategy for the people of Wangi-Wangi Island (Arafah, 2009). Local wisdom is an adaptation strategy for managing dry land, so that agricultural products can relatively sustainably support food needs (Hidrawati, 2016). Local ecological knowledge has a contribution to community resilience (Salampessy et al., 2017). According to Adger (2000) resilience is the capacity of individuals to overcome livelihood disturbances resulting from social, economic or ecological changes. Resilience is related to subsistence activities and lifestyle (Blanco and Carrière, 2016). Local wisdom is not only sustainable from the production aspect, but ecologically in harmony with nature, socially and culturally acceptable to the supporting community.

The description of *welia*'s ethno-agronomic characteristics in the Wangi-Wangi Island agricultural model, starting from land preparation to harvest (Table 1). Ethno-agronomy in *welia* is processed flexibly, along with the development and changes in the vegetation composition of a land. Climate change, especially changes in the beginning of the rainy season, affects land preparation until harvest.

Table 1 Characteristics of *welia* in Wangi-Wangi Island

Stages	Activities
Land preparation	The land is marked (*totari*) on the first day of land preparation
Land clearing	Uprooting grass, cutting down trees and burning
Planting preparation	• The seeds are soaked in the *Kalumpa* fruit juice • The seeds/seedlings come from another farm (*bhali wuta*)
Time of Plant	The time of plant is based on traditional meteorology (*kutika*), natural phenomena namely the position of the moon and stars, the appearance of vegetation and animal behavior.
Cropping Pattern	Intercropping, namley Red Beans-Corn-Cassava; Uwi-Corn-Cassava; Red Beans-Corn
Planting	Using a crowbar with spacing and seed requirements adapted to land conditions
Plant Maintenance	No pesticides and herbicides, no irrigation
Weed control	Mechanical weed control
Pest and Disease Control	Agronomic disease control (use of *rang-rang* ants and cultivar selection) and agrocentric (*bhori* system)
Harvest	Gradually, according to family needs or to sell in the nearest market. The tubers are save in the cultivation area

Welia's agro-technology is a red bean cultivation cycle starting from land preparation and land clearing. Further of activity namely modification of vegetation canopy, burning of vegetation, prepare of planting, cropping patterns and types of plants, and planting. After planting, the plants will be care for and harvested. All of these stages are developed based on local wisdom. The stages are described as follows.

3.1 Land Preparation and Clearing

Land preparation is the most important process in *welia system*. Farmers have several gardens in several places which vary during each growing season. This is a selective and sustainable effort in accessing appropriate land preparation based on farmer preferences. Farmers observe each farm, monitor the development of *Motokau* land fertility, view the development of land cover, the development of bird nests, and other animal activities. This information becomes a reference for farmers in deciding whether the land has the potential to be cultivated in each planting season.

The fertile soil is characterized by the species *Balande*, *Karihu-rihu* (*Lantana camara* L.), Melinjo (*Gnetumgnemon* L.), and *Tomboloruha* species. The less fertile soil is characterized by *Alang-alang* (*Imperata cilindrica* L.) and *Komba-komba* (*Eupatorium odoratum* L.) and pasture spesies vegetation. Land which is dominated by pile vegetation, saplings and a few trees is the selected land. Soil depth is measured based on forecast analysis of the sound of ground knocking using a small crowbar. Differences in depth that produce different sonar sounds. Community farm are a legacy from previous generations, in order to avoid land conflicts, the selected land is marked (*totari*) on the first day of land preparation. The sign is a piece of vegetation that is placed on the ground and pressed with a stone.

Land clearing is carried out by pulling grass, cutting affordable grass, and then cutting down trees and land (Table 1). The vegetation of the seedlings in the form of grass is removed and then collected. Vegetation the size of poles, stakes, or trees in the pruning of lower branches, and branches is then collected. Clearing the land is then followed by trimming the branches and branches in the middle to provide access for farmers to all parts of the land. Vegetation poles, stakes or dense trees will be felled to adjust the spacing. The eliminated saplings or trees will be brought in the farm outside and used as a source of firewood.

The next land clearing is by trimming the upper branches, and branches of vegetation with the size of poles and trees. The pruning results in the form of chopping are cut into one cubit size and then collected in one place. The felling is allowed to dry and rot naturally. The pole-sized vegetation can be used for climbing plants for Red Beans, Long Bean plants, and Uwi plants. This means that the climbing pole or living and / or stalking pole comes from naturally growing vegetation. Farmers grow wild trees in the fields for food, traditional medicine and ceremonies materials, as well as farmers' perceptions of their availability in nature (Assogbadjo et al., 2012), and land tenure security (Ruseva et al., 2015)..

3.2 Modification of the Vegetation Canopy

Modification of the vegetation canopy after drying and weathering of the trimmings of branches and twigs due to changes in weather and activity. The selected vegetation with modified crowns is vegetation that has been tested and developed by farmers from generation to generation. The process of modifying the vegetation canopy begins by taking the selected cardinal directions, namely north-south or south-north. The direction and position of the farmer-vegetation chosen aims to maximizing lighting, both before modification of the vegetation canopy and after modification of the vegetation canopy. Lighting prior to modification of the vegetation canopy is important for the farmer in determining the vegetation pruning point. Lighting after crown modification is important for plant growth and production in the *welia* soil-crop system.

Modification of the vegetation canopy by slashing or cutting the canopy as high as 150-180 cm. Cutting the crown is done from the top to the bottom. The result of slashing or cutting the vegetation is used as a climbing platform for Red Beans in the local language called *weli*. The remaining branches and twigs of vegetation that are not used as climbing poles or stakes are cut into several parts which are then collected on the ground surface among the *weli* candidates.

The results of field observations show that there are several levels of vegetation piles on the ground. It places between the prospective climbing poles or stakes. First, the pile of vegetation on the ground consists of a grass pile that is almost decaying. Second, a pile of dried branches and twigs. Third, the final pile is a top vegetation canopy of pile as a felling result from the vegetation canopy modification process. Each level of vegetation pile on the ground surface shows a different color due to the interaction with environmental elements.

Vegetation of poles has been modified for climbing poles or stakes. It is according to farmers' preferences or at most the height of the person cutting them. The climbing pole or stake starts at mouth level to the highest end of the owner welia hair's. Vegetation found in the boundary area is used as a climbing pole or stake. Therefore, the height of the climbing pole or stake can be a land ownership feature. *Welia* have not a stone fence. The farm boundary consists of some vegetation. Each farmer has certain preferences in designing climbing poles or stakes such as height and cutting patterns. The cutting pattern of climbing poles or stakes is influenced by being left-handed or right-handed.

The results of interviews with farmers show that to facilitate the cutting poles process, the best body position is in a position perpendicular to the pole vegetation. Farmers can save the kinetic energy of cutting the pile and create the optimal force moment for cutting the pile. *Welia* cannot be practiced in secondary forest which is dominated by vegetation the size of saplings and trees or on land that has no vegetation. This indicates that the growing vegetation must be maintained in preparation for the prospective climbing pole or stake vegetation in the

coming planting season. Selectivity allows prospective climbing poles or stakes to develop and dominate a land.

3.3 Burning of Vegetation

Burning of vegetation piles in *welia* is a sensitive activity in optimizing the success of crop production. Important aspects of land burning are the decay level of the logged vegetation on the soil surface, the volume of vegetation burned, and the characteristics of *welia*. Weathering of logged vegetation on the soil surface can be seen from the growth of grass. Fuel volume regulation is carried out by evenly spreading the felling over the ground of entire surface. The characteristic of Welia that is ready to burn is that a shoot has appeared at the end of the climbing pole or stake.

Figure 1 *Welia* ready to burn

Before the land is burned, the farmer made a control line or illusion on the land edge. Control line or illusion is an unburned area on the land land. The size of the control line or illusion is adjusted to the needs. Several things cause differences in the width of the control line or illusion. The difference is caused by the degree of the burned vegetation dryness, the thickness of the burned vegetation, wind speed, land characteristics, and farmer characteristics..

The dryness degree of the burned vegetation determines the width of the control line or illumination. The burnt vegetation drier, then wider of control line or illuminance is made. Ottmar et al. (2007) reported that the characteristics of the fuel influence fire behavior include moisture content and chemical composition. Rainfall and temperature affect the moisture content of the burning material (Ramberg, 2020). The thickness of the burnt vegetation and the wind speed, the thicker the vegetation that is burned, the wider the control line or illusion is made, as well as the wind if it blows hard, it can be done widening the control line or illusion. Figure 1 shows *welia* ready to burn. Logging of vegetation that is the size of saplings and trees. It is set aside in the area around the control line or shade, so that it does not become part of the burn. Derik (2019) stated that land fires did not occur during the cultivation practice period.

Burning starts from the direction opposite to the wind direction along the control line area or illusion. It make fire can be controlled. The flames have met in the entire control line area has been burned, so the combustion is carried out from the direction of the wind. This action is expected to bring together hotspots in a land, promote the conductivity of fire or heat to parts that have not been burned. Burning is carried out after rain has wetted all the cut vegetation that has long dried up to the surface of the soil, filling pores in the soil and rocks. Farmers use fire to clear land under cultivation (Wallenfang et al., 2015; Jacobson, 2014; Rösch et al., 2017). The results of field observations indicated that in the burned land, many new shoots appeared on the lateral roots and more seeds were found in new vegetation, if compared to the land that was not burned. Darwiati and Tuheteru (2010) state that the adaptation of vegetation to fire includes shoot protection, stimulation of flowering and seed retention. Water that is in the clearing of dry vegetation can stimulate the formation of smoke where the more moisture content in the leaves and branches is burned, the greater the amount of smoke formed.

Figure 2 Impact of Burning in *welia* on the Rhizosphere

Figure 2. shows the impact of welia's internal combustion on the rhizosphere. The controlled burning indicators of soil and rock are not change color and burn. The process of burning land is a wise and measured activity in which burning the land by heating the soil but not scorching the soil, the stones and troots in the soil, climbing poles or stakes and forming charcoal. In addition, it does not damage the ecological structure of the soil, burning the land even if necessary does not kill soil microorganisms. According to farmers, these things have a positive impact on the growth and production of Red Beans and Corn plants.

According to farmers, uncontrolled burning has a negative impact on the growth and production of

kidney beans and vegetation after burning. The characteristics of a fire that soil scorches are blackish color on the ground disappears, shifts to a reddish color and scorches the rock (*kepuo*), burning the lateral roots that are below the ground surface and the twigs, and branches to ashes. The impact of uncontrolled burning gave rise to seedling vegetation in the form of grass or alang alang which was dominant over woody seedling vegetation. The dominance of grass vegetation in a land after land burning indicates that the heat oxidized in the combustion exceeds the carrying capacity of soil and rock.

Empirical burning of land which actually contributes positively to Welia which supports the research results of Kukla et al. (2019), Mulyoutami et al. (2010), Sasaoka et al. (2014) and Dressler and Pulhin (2010). They can prove that in the end, controlled fire cultivation does not lead to land and forest degradation. The combustion specified must be carefully planned to prevent long-term disruption of the Carbon and Phosphorus cycle (Merino et al., 2019) as well as land fires.

3.4 Planting Preparation

Determination of planting time according to traditional meteorological calculations (*kutika*). It is followed by natural phenomena, namely the position of the moon to the sun and stars, the appearance of vegetation, and animal behavior. Farmers can predict the amount of rainfall in a year with traditional meteorological calculations and astrology. This amount is known from the cloud concentration at the position of the Pari Star (*sangia*) and the moon. Observation time is when *Sangia* rises to sets at the beginning of the western season. The concentration of clouds around *sangia* has a positive correlation with the amount of rainfall in the western monsoon. The Rakai tribe in Uganda understands four important components in a knowledge system [43]. The four important components namely long-standing familiarity with seasonal patterns of rainfall and temperatura; a set of traditional local climate indicators; observation of meteorological events, and information about shifting seasons. Forecasts for planting preparation in relation to the availability of rainwater are the basis for determining the appropriate planting year.

The ideal planting time is done a few days after rain and after burning the land. Rainwater pressure can facilitate the entry of ash into soil pores and the nature of water is able to penetrate rocks. Information on rain will fall in the next week for planting time, if the sun's sunset distance from the Cape of Kapota Island is almost 1 meter accompanied by lightning and reddish clouds. Information on natural phenomena is supported by the condition of flora such as *Kalele* fruit which is released from the fruit stalk, and then blown by the wind until it reaches the atoll (*pasi*). The information stability on natural phenomena and the condition of the flora is supported by information on the fauna state in the form of animal behavior, namely the migration of *Boronang* fish (*Siganus* Sp) to coastal areas to spawn. Other flora information such as *Laron* (*Macrotermes gilvus*) gather around the light source at night.

3.5 Planting Patterns and Types of Plants

The general cropping pattern can be categorized as intercropping. Intercropping begins with the planting of red bean and corn plants, which spacing following the climbing pole or stake. Based on Figure 3, it can be seen that the planting pattern and types of plants depend on the farmers preferences. Cassava planting when the corn has five leaves (*tombolo*). Irregular spacing follows the contour and landscape (Figure 3). Red bean plants are not planted with uwi plants, while corn and cassava plants are in one cropping pattern. Types of vegetable crops come from Long Beans and the *Cucurbitacea* group such as Pumpkin, Cucumber, and luffa (Figure 3.c). Cassava and uwi (*Dioscorea* spp) plants are types end cropping patterns. Vegetables are grown when lightning and thunder go hand in hand.

Figure 3. Planting Patterns and Plant Types in *welia*; (a)Corn-Red Beans-Cassava, (b)Corn-Red Beans-Cassava, (c)Corn-Red Beans-Cassava-Pumpkin, and (d) Corn-Cassava-Tubers

Red bean and corn plant populations were higher than those of cassava and Uwi plants. Seeds are prepared at the growing season ended or shortly after harvest. Welia prepared pithy seeds from Red Beans (*Phaseolus vulgaris* L.), Tubers, and Corn

(*Zea mays* L.) while the seeds prepared were vegetables, Coconut (*Cocos Nucifera* L.), Jackfruit (*Mangifera indica* L.) or tree species such as biti wood (*vitex copasus*). Vegetable and coconut seeds are prepared through a nursery, while fruit or wood is obtained from yards, farm, or around the forest. Tubers and kidney bean seeds are stored at home in dry and cool conditions. This aims to protect the tubers and seeds from physical damage.

3.6. Planting

Planting is an investment of plant seeds into the soil. Indirect planting using a crowbar or stick wooden (*tugal*). Planting begins with the uwi plant a week before it rains. Place the planting hole in the find direction from the climbing pole or stake, so that the young shoots can propagate and climb easily, or not against the wind direction. The people of Wangi-Wangi Island collect uwi 23 cultivars (Bahrun et al., 1998), Cassava (*Manihiot utilissima* L.) collected 12 cultivars (Harviyaddin, 2005) and Corn (*Zea Mays* L.) collected 36 cultivars (Safuan and Hadini, 2012). The cultivar collection increases with each growing season. This is due to the entry of cultivars from the area around Wangi-Wangi Island every planting season.

Red bean plant seeds are placed in the direction of the wind from the climbing pole or stake so that the young shoots propagate and climb easily to wrap around the climbing pole or stake. Corn plant seeds are placed in front of the red bean plant seeds, but between them with climbing poles or stakes. So that young red bean plant shoots do not reach the corn plant to be crawled. There is already a barrier in the form of a climbing pole or stake. Climbing poles or stakes that have been planted with uwi plants cannot be used for red bean plants. *Welia*'s limitation is the culture of choosing the plants types that are developed, namely staple plants, red beans, corn plants, and tubers. Local culture limits farmers from integrating superior varieties and species (Fernández-Ferrín et al., 2018, Berkes et al., 1995) but is open to the entry of local superior varieties and species of red bean and tuber crops.

3.7 Plant Maintenance

Red beans, corns, and growing tubers are maintained by applying fertilization, controlling weeds, controlling pests and diseases, and without watering. Red Bean plants are sure to be wrapped around a climbing pole or stake. The fertilizers used are organic fertilizers such as manure, combustion residue, household organic waste, and soil under the house.

Weeds are controlled mechanically using a special tool which in the local language is called *ka'ofu* or *kali*. Weed control, especially grass vegetation, is carried out once during the harvest. Weeds that have been uprooted collect at the surface of the soil. Weed control in the form of seedling vegetation selectively. Red bean plants, corn plants and seedling vegetation are allowed to grow together, so that they become the initiators of climbing poles or stakes (Figure 3.b and Figure 3.c).

Pests commonly encountered by farmers are Grasshoppers (*Caelifera*), Termites (*Isoptera*), Rats (*Muridae*), Ants (*Hymenopter*a), Older Parrots (*Cacatuidae*), Parrots (*Psittacoidea*), and Sangit Walang (*Leptocorisa oratorius*). Rats are the most harmful pests for farmers. Farmers have agronomic control. Walang Sangit is controlled by using natural enemies, namely *Rang-rang* Ants (*Oecophylla*) which are placed on climbing poles or stakes. *Rang-rang* Ants population can be increased by placing fish bones on climbing poles or stakes. Farmers control the fungus by applying kitchen ash to the affected parts of the plant. The interviews results with farmers showed that the ants were controlled by watering the *Kalumpa* fruit juice.

3.8 Harvest

Kidney beans are harvested when the pods have dried. This indicates that the seeds are physiologically ripe and marked by dry ripe seeds. Picking the pods should not be too late, because the pods are broken and lost a lot of seeds. There is no fruit picking when it rains, because it can reduce productivity. Low quality seeds are wrinkled seeds. The red bean plants that have been harvested are left to rot in *welia*. This means that the produce that is brought home is only in the form of pods, while the rest is left to remain on *welia*'s land.

The corn crop yields are separated into several groups, namely for consumption, sale and those stored as seeds in the following planting season. Corn for seed or sold in the market is stored in the kitchen or around the stove. The interview results with farmers found that storing the corn crop in the kitchen or around the stove can reduce the attack of fungi that can potentially damage the seeds. The results of testing the moisture content of seeds at the Laboratory of Seed Technology, Faculty of Agriculture, Halu Oleo University, showed that the red bean plant seeds had a moisture content of 13.37% while corn seeds had a moisture content of 12.67%.

Cassava harvest ages range from 8 to 18 months, depending on cassava cultivar. This means that tubers can be delayed harvest time. Farmers persist

and persevere in managing *welia* even though physically it appears as dry and rocky land. Hidrawati (2017) states that the intrinsic motivation of the community that supports subsistence food security in a sustainable manner. It is the desire to be a winner (*hoppotallo*) in conquering nature on land, namely karst rock terraces and steep waves in the ocean. Farmers always adhere to the principles of local wisdom as a characteristic of *welia* starting from land preparation, planting, maintenance and harvesting. Characteristik of *welia*'s create by farmers' life experiences and are used by farmers for the continuity of social interactions and interactions with environmental changes.

Today, the techniques maintained ethno-agronomically in *welia* are techniques that have proven to be better than other techniques. Observations over a long period of time (Sunaryo and Joshi, 2003). This is intended to ensure that local people inherit local knowledge and local wisdom such as local knowledge in the Moronene community in rice cultivation (Arafah, 2002; Limba et al., 2017), lowland rice (Sumitri, 2015), Cashew (Widiatmaka et al. , 2015). This practice fulfills primary needs through agricultural activities and the basic assumptions of managers and analyzers (Mitchell et al., 2000) for planning agricultural system development (Husnah et al., 2015).

The characteristics of welia are rainfed and slash-and-burn by maintaining tree-sized vegetation as a shade tree (*toropanga*). Modification of the vegetation canopy or shoot architecture for climbing poles or stakes. It is for secondary crops according to plant preferences. This climbing pole or stake is actually intended for conservation purposes. Climbing poles or stakes are made stakes as well as acting as stakes when farmers plant Red Beans. Although the main goal is to make vegetation succession rapidly, so that soil fertility develops even faster as well as to maintain species diversity. *Welia* divides the light spectrum through cropping patterns or canopy pairs in intercropping, and integrated cropping patterns with developed agriculture, especially mixed agriculture such as plantation crops or local forestry crops.

4 Conclusion

Welia is local wisdom in cultivating plants on dry land and dry climate. This system was born from a farming culture (ethno-agronomy) and centered on land (agrocentric). *Welia* with a pair of red bean and corn by 100% canopy follow lighting will have optimal crop production. The vegetation in Welia consists of climbing poles or stakes and shade trees (*toropanga*) in maintaining soil fertility to support plant productivity. *Welia* is a land management system that relies on vegetation and fire. Farmers should use fire wisely as agrotechnology in burning land. The wise use of fire can support the sustainability of *welia*'s vegetation

Ethno-agronomic studies, the development of soil fertility, and plant productivity on dry land with dry climates in *welia* are important to add scientific information for scientific publications. The results of this study also have important benefits in the transformation, transmission and development policies of *welia* according to civilization. Based on the description above, the conceptualization of *welia* as an alternative land use for Wangi-Wangi Island based on the problems of land, forest, and household food for farmers.

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