Support for animal feed innovation technology in the North Sulawesi border area

Agustinus N. Kairupan¹, Hasrianti Silondae¹, Herlina N. Salamba¹ and H Mubarak²

¹North Sulawesi Assessment Institute for Agricultural Technology (AIAT) Kalasey Agriculture Campus Street Manado, Indonesia
²Agricultural Engineering Department, Hasanuddin University, Makassar, Indonesia

E-mail: audikairupan@gmail.com

Abstract. One of the visions of the Nawacita Program proclaimed by the President of the Republic of Indonesia, Mr Jokowi, is to build Indonesia from the periphery by strengthening the regions and villages in the NKRI region and the developing of border areas. Each border area has the potential of diverse agricultural and cultural resources, but so far, most of the potential resources have not been managed well or even underutilized. The potential of livestock, land, feed and human resources is available enough to support the development of farms in the border areas. Livestock activities in general in border areas can contribute economically to farmer households. The current problem is that livestock productivity in this region is relatively low. This is due to several things, namely where farmers in raising livestock still use traditional cultivation systems and the use and mastery of technological innovations that are still very limited, especially in the provision of animal feed sources, as a production area of plantation crops and food that produces a lot of untapped side waste. Through several touches of technological innovation, side waste can be processed into a quality source of feed, so it is expected to increase livestock productivity and welfare of farmers in the border region of North Sulawesi.

1. Introduction

North Sulawesi is one of the provinces in eastern Indonesia with a border area with the outer islands. The location of the border area is Sangihe Islands Regency and Talaud Islands. Sangihe Islands Regency as the Gate and North Fort of NKRI, directly adjacent to the neighbouring Philippines, is also designated as a Cross-Trade Area.

The outer islands are usually remote areas, week and even unpopulated, and far from the government's attention. The existence of these islands geographically is very strategic because its existence determines the State's territorial boundaries. In general, the economic condition of the people in the border region with the Philippines is not very encouraging. Such conditions are due to regional development policies implemented so far tend to be oriented only to the development of border areas that are entirely inward, meaning that the existing domestic growth centres (Inward looking) and consequently the border areas only become the periphery and backyard of the Republic of Indonesia.

One of the visions of the Nawacita Program proclaimed by Indonesian President Mr Jokowi is to build Indonesia from the periphery by strengthening regions and villages in the Republic of Indonesia and developing border areas. Nawacita is a general term taken from sansekerta nawa, meaning nine, and
mind means hope, desire, dream. Nawacita is the nine hopes, desires, dreams of Mr. Joko Widodo for the welfare of the People of Indonesia. Border construction, contained in the third point of Nawacita. President Jokowi-JK added praise to build Indonesia from the periphery by strengthening regions and villages in the framework of a unitary state. Building a suburb is related to the region or geographical area adjacent to the borders of neighbouring countries and marginalized and economically disadvantaged people. The suburbs also showed the condition of the lack of development in the area. The result of the product-focused only on urban areas is considered a centre of growth [1]. This fact is the basis of thinking for the Ministry of Agriculture, in this case through Balitbangtan, to implement a technology innovation support program in the border region.

Each border area has the potential of agricultural resources and diverse culture, but most of the potential resources have not been appropriately managed. The advantages of regional resources in a sustainable manner must always be directed and utilized optimally [2]. Therefore the wisdom of agricultural development must be designed from an economic perspective.

The border area in North Sulawesi Province is known as one of the potential areas of agricultural commodities, especially in the livestock sub-sector. The potential of available livestock, land, feed and human resources supports livestock development in the region. The current problem, livestock productivity in the border area, is still relatively low. Livestock cultivation generally still uses traditional systems, and the use and cultivation of technological innovations are still minimal.

As one of the strategic components of the agricultural development system, especially in the development of sub-sectors of farmers in the border region required technological innovation. Through technological innovations that have been produced, a lot of research must solve problems in the sense that technology needs are available and quickly adopted by users. Related to this, the writing of this paper aims to discuss the support of animal feed technology innovation in the border region in North Sulawesi.

2. General conditions of the border of north sulawesi

2.1. Talaud islands regency
2.1.1 General profile of miangas special district (miangas island). Miangas Island is one of the leading Pacific Ocean Islands and is a member of the Nannusa Islands and is the outermost island in northern Indonesia, bordering the Philippines. Astronomis Miangas Island is located between 050, 34’ 02” LU and 1260 34’ 54” BT, with an area of 3.2 Km², with a length island of 6.0 km² (figure 1).

![Figure 1. Miangas island border map.](image)

Miangas sub-district is directly adjacent to the north of the Philippines, the northeast of the Pacific, the south of the Sulawesi Sea, and the west of the Philippines. While the distance of the District Capital to the Provincial Capital is 320 nautical miles, the distance of the District Capital to the Regency Capital is 110 nautical miles, the distance of the District Capital to the Village is 450 meters, and the distance to the border of the Philippines (Davao Island) is 48 nautical miles.
In the administration of the Government of the Republic of Indonesia, Miangas Island only has 1 Village (Miangas Village) and Miangas Special District, Talaud Islands Regency, North Sulawesi Province. The distance between Miangas Island and Manado (the capital of North Sulawesi Province) is around 320 nautical miles. Miangas Island and Melonguane (the capital of Talaud Regency) is ± 110 nautical miles. Meanwhile, the distance between Miangas and Dafau Island (Philippines) is only about 48 miles. Miangas Island can be reached by aeroplane from Manado's Samratulangi Airport once a week, by ship from the port of Bitung. This ship serves the Bitung-Siau-Lirung-Tahuna-Melong-Karatung route. -Miangas-Marone, twice a month with a voyage of 15 days. 

In addition to location accessibility, the availability of economic facilities in border areas also shows that conditions are still relatively inadequate. In border areas, the number of institutions or units that provide community needs for both daily and other needs, both food and non-food, is relatively left behind compared to non-border areas. On Miangas Island, there are no financial institutions, either macro or micro. Several small stalls provide basic daily needs. Various government facilities on this island are sub-district offices, border crossings, sea transportation posts, army posts, police posts, military command, immigration, health centres, navigation districts, PLN, junior high schools, elementary schools, docks, and airports.

The level of formal education of pig farmers on Miangas Island, relatively low where the most significant proportion are educated from elementary school (SD) to high school) with a percentage of 82.11%. Farmers who have a higher level of education will use more new technologies than those with low education, where the higher the level of education, the more response in using new inputs. [3], stated that the level of education influences the way of thinking on innovative responses and recommended changes.

The main occupations of the residents of Miangas Island are fishermen, livestock farmers, civil servants, and others working in other sectors such as members of the TNI, POLRI, retirees, and entrepreneurs [4]. This shows that the main livelihood of the people of Miangas Island is in the fisheries sector, while farming/raising livestock is still limited to a side job. Besides, it can be said that managing and raising livestock is a side job or a hereditary activity. This condition does not support livestock business development, especially in increasing income.

Land on Miangas Island is generally allocated for fields, plantations, community forests, housing, buildings, and temporarily not cultivated. According to 2013 data, the most critical land use on Miangas Island is coconut plantations with 173.50 ha and banana plants with 5.5 ha. For food crops, horticulture and livestock, data availability is still minimal, considering the island's natural conditions do not allow for its development.

2.2. sangihe islands regency

2.2.1. General profile of marore islands district (kawio island). Administratively, the Marore subdistrict belongs to the Sangihe Islands. Marore Islands subdistrict is an area greater than North Tabukan Subdistrict consists of three villages, namely Marore Village (Marore Island) area of 2.6 Km² (58%), Kawio Village (Kawio Island) area of 1.54 Km² (35%), and Matutuang Village with an area of 0.31 Km² (7.0%). Astronomically based on 40°03′17″–40°43′45″ North Latitude and 125°02′61″–125°03′45″BT East Longitude. The district of Marore Islands is directly adjacent to the Saranggani Sea in the north, with Talaud Islands Regency on the east, with Kendahedan Nusa Tabukan Subdistrict in the South with the Sulawesi Sea in the West. Marore Islands Subdistrict Map figure 2.
The distance of District Capital to Provincial Capital is 200 miles, the distance of District Capital to Regency Capital 80 miles, Distance of District Capital to Kawio Village 5 nautical miles, and Matutuang 22.1 nautical miles. The island closest to the Philippines, Balut Island, is ± 40 nautical miles with a travel time of 3-4 hours. Access to the Marore Islands can only be passed by sea transportation. The journey's starting point can be started from the Port of Bitung to Sangihe by using the pilot ship for about 10 hours. This transportation route is available twice a week.

The topography of Marore Island consists of remaining hills/mesa, planasi surface, gisik, marine terraces, and reef exposure platforms. The land component of this island consists of wetland forest, dryland forest, shrubs, shrubs, open land, and coral reefs. Most of the hilly areas are used as plantation land. The rest is overgrown with wild plants, except for areas inhabited by residents. The condition of Marore Island is almost entirely hilly. The soil mixed with rock/gravel with a height of about 150 meters above sea level, and the slope ranges from 30° -50°.

The weather conditions in the Marore Island region are erratic and change often. During the northern wind season, wind speeds can reach 40 miles/hour, and the sea is big waves. It has a wet climate with two kinds of wind patterns: the north wind that blows in November - April coincides with the arrival of the dry season and the west wind, with waves reaching 4 meters high. Generally, it consists of hilly areas and not coral islands. The hills are undulating with a height between zero meters from sea level to 110 meters above sea level.

The average temperature per month at the 2016 Naha Meteorological Station measurement is 27.8 °C, where the lowest temperature is 20.0 °C in March, and the highest temperature is 34.0 °C in July.

Rainfall in a place is influenced by climatic conditions, geographical conditions, and rotation or meeting of air currents. Therefore, the rainfall varies according to the month. The highest rainfall during 2016 occurred in November, namely 465 mm3 with the number of rainy days 24 days, while the lowest rainfall occurred in March, namely 40mm3 with the number of rainy days 16 days.

The source of income for most of the population works as fishermen. Based on the geographical conditions of the area, which is an archipelago. However, some people have livelihoods as farmers. Fishers are the main job for residents in Marore Village in financing their family needs and educational needs. The side livelihood for Marore Islands residents is gardening. However, gardening, which is done using this farming system, seems to have not been exploited optimally.

Land conditions in the border area of the Marore Islands are included in the Dry Land Agroecosystem Zone. Land for paddy fields is not available. The community's rice needs must be distributed outside the region, either from the Regency or Province. Generally, the garden lands in the Marore Islands are used for root crops such as sweet potatoes, cassava, and other local tubers.

The cultivation of plantation crops in the Marore Islands includes smallholder plantations. Coconut, nutmeg, and cloves are the crops most cultivated by farmers. According to 2016 data, the total area of coconut planted is 103 ha of coconut, 24 ha of nutmeg, and 4.5 of cloves. Ha, with production per year respectively 641.59 tonnes, 2.81 tonnes, and 6 tonnes. Coconut plantations are the dominant crop and are spread across the Marore Islands. The use of coconut for farmers is only limited to making copra and household needs.
The condition of the livestock sector in the border area of the Marore Islands District is not well developed. It was indicated by the presence of the types of livestock and the number of existing populations. According to data in 2016, there were livestock types, namely pigs, goats, ducks, and native chickens. The total population of pigs is 61 consisting of 24 males and 37 females), six goats, 171 ducks, and 900 native chickens [5].

Technological innovations have not much or rarely touched the livestock raising system in the Marore Islands District in both production, reproduction, and health management. Livestock cultivation generally still uses traditional maintenance systems, where livestock are still allowed to live freely outside. Livestock farming is still a side business or a side business. Savings.

The use of livestock cultivation technology is still minimal. To get production facilities such as feed and medicines, farmers find it difficult because they have to be imported from outside the region. Stores or kiosks that provide livestock production facilities in the Border Area are not yet available.

3. Existing conditions of farms in the border area
Generally, the dominant livestock that keeps people in the border area of North Sulawesi is pigs. Ownership of pigs is closely related to the needs and abilities of breeders in raising pigs. The average pig ownership per head of a family is 2-3. The number of livestock ownership is adjusted to the condition of land area and limited feed availability, and existing marketing. Generally using family labour, namely around 1-3 people, with the primary workforce being adult men assisted by adult women and children with an average time of 1-2 hours per day [6].

The main reason for raising pigs in border areas is socio-cultural factors, where the pigs raised will be used for religious festivals and family celebrations. While others argue that raising pigs is only limited to these reasons, breeders also think that they raise pigs and continue their inheritance from generation to generation and hobbies and fill time. They were raising pigs in border areas where most breeders kept their livestock in simple pens continuously. Housing is one means of production that will directly determine the business's success because the production and reproduction processes occur. Besides that, the enclosure plays a critical role in health, freshness, comfort, and protection from extreme environmental influences. The maintenance of pigs carried out by breeders on Miangas Island has generally placed livestock in pens. However, raising pigs in pens has not implemented management. Good housing. The construction of a pen is only intended to protect livestock and has not been oriented towards increasing productivity.

Housing is one means of production that will directly determine the business's success because the production and reproduction processes occur. Besides that, the pen plays a critical role in health, freshness, comfort, and protection from extreme environmental influences. The maintenance of pigs carried out by breeders on Miangas Island has generally placed livestock in pens. However, raising pigs in pens has not implemented management. Good housing. Making a cage is limited to safeguarding livestock and has not been oriented towards increasing productivity. Stables are built to protect pigs from harmful outside disturbances climate and allow good air circulation to limit dampness and odours that are not liked by pigs and facilitate maintenance pigs [7,8]. The existing conditions of raising pigs in the border area can be seen in figure 3.

![Figure 3. Existing conditions of pig breeding in border areas. Source: Kairupan (2018) [9]](image-url)
Most of the existing pig pens are made in two models: a fence with concrete and wood walls and a zinc roof. Likewise, some use concrete floors for floors, and some still use dirt floors and are not classified. The provision of cage equipment in the form of feed and drinking containers is made of used plastic materials and has not provided a place for collecting sewage waste. To produce maximum production, one factor determining the housing management includes a place for feeding, nozzle, floor, wall, manure storage tank, ventilation, type, shape, type, and size of the cage [10]—the number of pigs kept in pens regardless of the capacity of the pen. An average of 1 to 2 heads of both young, adult, and calving cows occupy the pen with an area of $1.0 \times 1.5$ meters. Besides, the distance between the cage and the breeder's residence is generally too close, between 5 and 15 meters, which affects the surrounding community's health. The minimum distance between the cage and the dwelling is 10 m [11,12]. The availability of feed is an absolute requirement as a determining factor for the success of pig farming. Artonang states that feed cost is the largest in livestock raising, reaching between 60-80% of the total production cost [13]. Cultivation technology has not been touched and adopted by many breeders. For feed needs, livestock is only given makeshift feed, namely from kitchen waste and local tubers, and marine waste products which are only for fulfilling basic life without paying attention to the nutritional value so that it cannot guarantee the nutritional elements that are entered and utilized in the livestock body.

Field conditions indicate that the food given to pigs comes from local tubers, kitchen waste, and marine waste products. The use of reinforcing food or concentrate is still minimal, and the price is relatively high because it has to be imported from the provincial or district capitals. Feeding only aims to meet the basic needs of life and has not led to production goals. Sihombing states that pigs are animals with simple digestive organs that cannot digest food ingredients with high crude fibre content, so pigs must get a lot of feed from concentrate ingredients [14].

4. Support for feed technology innovation
Optimal utilization of local resources is a strategic step to achieve efficiency in the livestock production business. It will be more evident if these resources are not a direct need for competitors, such as humans or other types of livestock. Because feed is closely related to productivity and production costs, the efficient use of local raw materials will affect livestock development. Prioritization of local raw materials needs to be based on efficiency, economic competitiveness, and quality considerations. Criteria that need to be considered for efficiency and competition are the amount and availability of feed ingredients. These feed ingredients must be available in large quantities throughout the year and be concentrated. Raw materials that have these characteristics are generally associated with industries, which produce various by-products or wastes.

4.1. Technology innovation for utilization of plantation plant waste
4.1.1 Banana stems. The utilization of banana stem waste for animal feed is generally for breeders without going through a processing process but is given directly to livestock after being chopped. Split stem waste without any treatment process; hence the digestibility and palatability of livestock are low. [15] stated that banana stems contain nutrients including Dry Material (DM) 9.8%, Total Ash 18.4%, Coarse Fat (LK) 3.2%, Crude Fiber (SK) 31.7%, and Crude Protein (PK) 8.8%. [16] reported the chemical composition of banana peels in the form of 68.90% water, 2.11% fat, 18.50% carbohydrates, 0.32% protein, 715 mg / 100 g calcium, 117 mg / 100 g, iron 0.6 mg / 100g, vitamin B 0.12 mg / 100 g, and vitamin C 17.5 mg / 100 g. The ratio of bananas, leaves, and stems based on the dry matter was 37%, 25%, and 39%, respectively. Based on these comparisons, 6.62 million tonnes of banana stems in the dry matter were obtained in the same year [17].

Animal feed originating from agricultural and plantation waste has low nutritional value, so it needs to be optimized for quality through fermentation technology and the manufacture of complete feed [18]. The fermentation process increases the digestibility and value of feed protein due to the utilization of inorganic nitrogen into microorganism cell protein [19]. Besides that, fermentation is also a method of preserving agricultural waste biologically by fermented products in organic acids [20]. A complete feed
is a feeding method by mixing forage and concentrate homogeneous, which aims to increase the nutritional value of feed, palatability and prevent livestock from selecting feed. Providing complete feed in the form of a complete feed can increase feed consumption and increase the daily body weight of beef cattle [21]. Banana peels fermented with probiotics can increase the crude protein content by 14.88% and crude fibre by 11.43%, which are suitable for the growth of broilers [22].

4.2. Coconut industry waste utilization technology innovation

4.2.1. Coconut cake. According to [23], coconut cake is a byproduct obtained from fresh/dry coconut flesh. The use of coconut cake as animal feed has been widely reported with different results. Coconut cake has been used extensively in ruminant feed [5,24] and pig [25,26]. Although coconut cake is commonly used as an ingredient in poultry rations, its utilization has not been optimal. Due to the high content of crude fibre in coconut cake, it causes low nutrient availability.

Zamora et al. (1989) reported that coconut cake generally contains about 20% crude protein and a reasonably high natural fibre content, around 23.5 - 25.5% consisting of 13% cellulose fraction and 61% galactomannan [27]. Meanwhile, Wahju (1988) stated that coconut cake contains crude protein that is relatively high, around 21%, almost the same as the protein content of commercial rations, namely 21-23%, while the metabolic energy content is 2120 kcal/kg [28].

According to the average use of coconut cake in poultry rations in Malaysia is only 4% [29]. Meanwhile, research in Indonesia shows that coconut cake in broiler rations should not exceed 15% (Creswell and Zainuddin, 1979). Thorne (1988) suggests that the limit for using coconut cake in chicken rations is 20% [25]. Panigrahi (1988) suggests that the use of coconut cake up to 40% in the broiler or laying chicken rations can be done by paying attention to the balance of amino acids in the ration [30].

The limiting factor for using coconut cake as an ingredient in poultry feed is the high fibre fraction because the compound will bind to protein, thereby reducing its digestibility. Rafindira 1997 stated that the factors that influence the limit of use of coconut cake in chicken rations are the low content of the amino acid lysine, the high crude fibre content, and the relatively high aflatoxin content (especially in wet tropical climates) [31].

One of the efforts to optimize the utilization of coconut cake is using fermentation. Fermentation is a process of changing the chemistry of organic substrates due to the action of biochemical catalysts, namely enzymes produced by certain microbes [32]. According to [33], agro-industrial waste is generally considered a suitable substrate for solid substrate fermentation. This process is widely used to produce enzymes, and fermented materials can also be directly used as a mixture of rations and a source enzyme. [19] stated that during the aerobic fermentation process, coconut cake was produced hydrolytic enzymes of mannanase and cellulase. [34] The fermentation process with tape yeast can cause changes to the chemical composition of materials such as amino acid content, fat, carbohydrates, vitamins, and minerals due to the activity and proliferation of microorganisms.

Mairizal (2003) reported the results of his research that fermentation of coconut cake using Aspergillus niger can increase protein content from 22.41% to 35.27% and reduce crude fibre from 15.15% to 10.24% so that its use in chicken rations meat can be increased [35]. Likewise, fermentation of coconut cake with tempeh yeast (Rhizopus sp) can be used up to a level of 15% in broiler rations. The fermentation results with tape yeast are dissolved organic compounds or materials that are easily absorbed, such as essential amino acids and disaccharides [36] and a source of vitamin B [37]. [36] state that the use of fermented coconut cake with Trichoderma harzianum in broiler rations can only be used up to a level of 15%.

Fermented coconut cake has a higher metabolic nutrient content and nutritional value (protein, energy, and phosphorus) than unfermented coconut cake. However, its use in ducklings up to 5 weeks of age can cause growth inhibition. Unfermented coconut cake can be used in duck rations up to 30% without cause growth disturbances, while fermented coconut cake can only be used up to 20% [38].
4.2.2. Coconut pulp. Coconut dregs are a byproduct obtained from the extraction of fresh or dry coconut flesh. Coconut dregs are generally used as a mixture of animal feed. The potential for coconut dregs can reach 34-42% of the total coconut fruit. Coconut pulp contains protein and fat [23].

Coconut dregs have problems being fed to livestock because of the low crude protein content and high crude fibre. Puri (2011) stated content of coconut dregs consists of 13.35% water, 5.09% crude protein, 19.44% crude fat, 3.92% ash, and 30.4% crude fiber [39]. Hidayati (2011) reported that coconut dregs had a crude protein content of 4.89% and a crude protein content of 28.72% [40]. To overcome these obstacles, it can be done through a fermentation technology approach, namely the use of enzyme and microbial services to increase the nutritional value of coconut dregs, especially an increase in protein and a decrease in crude fibre and fat content.

Fermentation using fungi allows the overhaul of difficult to digest ingredients, so it is expected to increase their nutrition [41]. Farizaldi. (2016) states that the fermentation process can reduce the fat content of coconut dregs by 11.39% [42]. The feed produced in this fermentation process is safe enough for consumption by livestock because it contains aflatoxin Bi, B2, and G2 feed <20ppb. The analysis conducted by [43] showed an increase in the protein content of coconut dregs after fermentation from 11.35% to 26.09% or 130% and a decrease in fat content by 11.39%. Digestibility of dry matter and organic matter increased from 78.99% and 98.19% to 95.1% and 98.82%, respectively.

4.2.3. Coconut Coir. Coconut coir is a fibrous material with a thickness of about 5 cm and is the outermost part of the coconut fruit. Coconut husk consists of the epidermis, fibre, and husk. Coconut fibre can not be directly given to livestock because the nutritional quality is low. According to Oladayo (2010), coconut fibre has a fibre content of coarse 30.34% and abu3,95% [44]. The protein content of the coarse coir, i.e., 3,13% [45]. The chemical composition of coconut water to 26.0%, pectin 14.25%, hemicellulose 8.50, cellulose 21. 07% and lignin 29.23% [46].

Coconut coir contains lignin and fibre. Causes low digestibility of coconut coir. High levels of crude fibre in the feed will result in low palatability, nutritional value, and digestibility of feed [47]. Low digestibility results in the nutrition of coconut coir not being utilized optimally, so efforts are needed to process the material so that it is easier for livestock to digest. Improving the quality of feed ingredients can be done in several ways, namely by fermentation and ammoniation processes.

To increase the nutrient content of young coconut coir, further processing can be carried out to be used as an alternative feed material for fibre sources. One of the usual processing methods is ammonia using urea. Ammoniation with urea is a chemical treatment that is classified as cheap and easy to do. Ammoniation treatment with urea in fibre feed can loosen lignocellulose bonds so that it is easier to digest by rumen bacteria. Still, it can also increase the crude protein content of the meal to meet nitrogen needs for the growth of rumen bacteria [48].

The ammonia treatment can be stored for one week [49]. According to [50], the dose of urea used in the ammonia process is 4-6% of the dry matter used. Urea at a dose of 1% is used as a source of nitrogen for microbes in the fermentation process, so that urea is not only an addition to feeding nutrition but can also be said to be a catalyst in the fermentation process.

The results of the research reported by [51] stated that the use of 3-6% urea dosage in young coconut husk ammonia could increase crude protein content and reduce natural fibre content in ammoniated young coconut coir, 4% urea dose is the best in increasing crude protein content by 7.41% and reducing genuine fibre content by 4.65% in ammoniated young coconut coir. [52] states that ammonia is one of the alkaline chemical treatments that can dissolve hemicellulose and break the lignin bonds with cellulose and hemicellulose. Ammonia can partially dissolve silica because silica is easily dissolved in alkalis, reducing cellulose crystallinity [53].

4.3. Technology innovation for utilizing food crop waste
4.3.1. Local tubers. One of the alternative feed ingredients used as feed ingredients is sourced from root crops such as cassava and sweet potato. According to Adrizal (2003), cassava tubers, in general, can be
used as a source of carbohydrate food (54.20%), tapioca flour industry (19.70%), animal feed industry (1.80%), non-industrial other food (8.50%) and exported around 15.80% [54].

The waste product obtained from the processing process is skin, which is generally disposed of or not yet utilized. [55][30] reported that each kilogram of cassava can produce 15-20% of the skin. [56] The crude protein of the leaves, stems, and bark of cassava tubers was 12.76%, 6.17%, and 4.90%. It was further explained that the TDN of the leaves, stems, and bark of cassava tubers was 63.10%, 64.79%, and 56.91%.

Several studies have reported that sweet potato skins are a potential and inexpensive source of animal feed. However, it has constraints due to its limitations, namely, low protein content and high cyanide acid content. Cassava shoots have problems because they contain high cyanide acid (HCN), young leaves range from 427-542 mg/kg, and old leaves are lower from 343-379 mg/kg [57].

Some of the pre-treating methods used for processing waste as feed include chemical/physical hydrolysis, fermentation, ammonia, or just drying and shading. One of the efforts that can be done to increase its nutritional value is fermentation [58]. Spontaneous fermentation or administration of certain cultures has shown better results in protein content, HCN levels, or direct application to livestock [59,60]. The increase in protein content after protein from the material before fermentation and after fermentation for the treatment of tape yeast, mixture, tempah, and control yeast were as follows: 78%, 58%, 64%, and 66%, respectively. This increase, when compared to a study by [60], is quite significant; where there is an increase in the protein of more than 10% for cassava peels fermented using Saccharomyces cerevisiae and Lactobacillus spp.

4.3.2. Corn cob. A byproduct of corn farming, one of them is in the form of a cob. Corn cob has not been widely utilized and generally just thrown away or burned. Corn cob can be developed as livestock feed but not yet optimally used as a livestock feed ingredient. Caused by the limiting factor is that the quality is relatively low corn Cobs have high levels of protein with low levels of lignin and cellulose that high. According to Pramono (2016), the nutrient content of corn cob based on the analysis covers water content (delivery 29.54%), dry ingredients (70.45%), crude protein (2.67%), and crude fibre (46.52%) in 100% of dry material (BK) [61]. While the results of the research Kadir (2014) reported a corn Cob has the protein content is low (2.94) with lignin content (5.2 per cent) and cellulose high (30%) and digestibility of ± 40% [62]. With the cellulose content relatively high, which is a component of the fibre that can be digested, then the cob of corn can provide enough energy for microbial growth in the rumen. However, the low protein content and high lignin levels make cellulose not available for fermentation in the rumen resulting in low digestibility (in vitro digestibility).

The palatability of corn cob low can still be used as animal feed processing. Fermentation is all sorts of metabolic processes with the help of enzymes from microbes (microorganisms) to perform oxidation, reduction, hydrolysis, and other chemical reactions. The fermentation process, in general, has several objectives, namely producing cells of the microbes or produce biomass; producing enzymes of microbial; produce the metabolite compounds, and for the process of transformation of certain substances that are added in the fermentation process [62]. Increase the quality of the nutrients in the corn cob through particle size reduction and fermentation can significantly increase the crude protein [63]. The results of the research Dwi (2015) stated that cob maize inoculated fungi 5% Trichoderma sp. can degrade organic material and increase crude protein content [64]. The cob of corn fermented with microbes Aspergillus niger produces a high natural protein of 4%, whereas the cob corn fermented with Trichoderma virede protein yield of 3.4% [65]. The protein composition of a corn cob that has been fermented with microbes, in general, has increased from 3% to 6.1% [66].

5. Conclusion
The border area is one of the strategic areas as the gateway to the Unitary State of the Republic of Indonesia (NKRI). To support the Nawacita program, especially in agricultural development, to realize food independence for people in the border areas, a touch of agricultural innovation support is needed, especially in the livestock sub-sector. By utilizing the potential of existing agricultural resources such
as plantation crops and food crops, crop production produces waste that can be used as alternative animal feed materials. Through the innovation of fermentation technology, ammonia and silage can increase the value of nutritional content, so it is expected to increase livestock productivity and welfare of farmers in the border region of North Sulawesi.

References
[1] Kemendagri [Ministry of Home Affairs Public Relations] 2015 Building Indonesia from the Periphery
[2] Sudaryanto and Syaharga N 2002 Kebijaksanaan Pembangunan Pertanian wilayah Dalam Analisis Kebijakan: Paradigma Pembangunan dan Kebijaksanaan Pengembangan Agro Industri. Monograph No. 22, ed A S and M A T. Sudaryanto, I.W Rusastro
[3] Arman Drakel 2008 Analisis Usaha Tani Terhadap Masyarakat Kehutanan di Dusun Gumi Cesa Akelamo Kota Tidore Kepulauan Sci. J. Agribus. Fish. 1 24–30
[4] BPS [Central Bureau of Statistics] 2017 Talaul Islands in Figures
[5] Chandrasekharaiah M, Sampath K T, Thulasi A and Anandan S 2001 In situ protein degradability of certain feedstuffs in the rumen of cattle Indian J. Anim. Sci. 71
[6] BPS [Central Bureau of Statistics] 2017 Badan Pusat Statistik Kabupaten Kepulauan Seribu
[7] Parera H and Jacob J M 2016 Peningkatan Manajemen Kesehatan Babi dan Pertanian Terpadu di Kelompok Mawar dan Kelompok Lorosae J. Pengabdi. Masy. Peternak. 1 19–31
[8] Sihombing D T H 1997 Ilmu beternak babi Univ. Gadjah Mada Press. Yogyakarta
[9] Kairupan A N 2019 Profil Pemeliharaan Ternak Babi di Wilayah Perbatasan Pulau Miangas Kepulauan Talaud Inovasi Teknologi Pertanian Unggulan Daerah Mendukung Pencapaian Target Produksi Nasional (Manado) p 559
[10] Higa T and Parr J F 1994 Beneficial and effective microorganisms for a sustainable agriculture and environment vol 1 (International Nature Farming Research Center Atami)
[11] Sapanca P L Y, Cipta I W and Suryana I M 2015 Peningkatan manajemen kelompok ternak babi di Kabupaten Bangli J. Agrimeta 15 1–69
[12] Sihombing D T H 1997 Ilmu ternak lebah madu (Gadjah Mada University Press)
[13] Aritonang E 2010 Revised Edition (Jakarta: Self-Help Spreader)
[14] Sihombing D T H 1997 Ilmu Ternak Babi. Cetakan ke-2
[15] Poyyamozhi V S and Kadirvel R 1986 The value of banana stalk as a feed for goats Anim. Feed Sci. Technol. 15 95–100
[16] Retno D T and Nuri W 2011 Pembuatan Bioetanol Dari Kult Pisang Prosiding Seminar Nasional Teknik Kimia Kejuangan Pengembangan Teknologi Kimia Untuk Pengolahan Sumber Daya Alam Indonesia
[17] Foulkes D, Espejo S, Marie D, Delpeche M and Preston T R 1977 The banana plant as cattle feed: composition and biomass production Trop. Anim. Prod. 3 45–50
[18] Wahyono D E and Hardianto R 2004 Pemanfaatan sumberdaya pakan lokal untuk pengembangan usaha sapi potong Lokakarya Nasional, Jakarta
[19] Purwadaria T, Haryati T, Darmal J and Munazat O I 1995 In vitro digestibility evaluation of fermented coconut meal using Aspergillus niger NRRL 337 International Seminar on Tropical Animal Production (ISTAP) pp 375–81
[20] Utama C S and Mulyanto A 2009 Potensi limbah pasar sayur menjadi starter fermentasi J. Kesehat. 2 6–13
[21] Nusin M and Utomo R 2011 Pengaruh Penggunaan Tongkol Jagung Dalam Complete Feed Dan Suplementasi Undegraded Protein Terhadap Pertambahan Bobot Badan Dan Kualitas Daging Pada Sapi Peranakan Ongole Bul. Peternak. 35 1–9
[22] Udijanto A, Rostianti E dan Purmana D R 2005 Pengaruh pemberian limbah kulit pisang fermentasi terhadap pertumbuhan ayam pedaging dan analisa usaha Pros. Tenu Tek. Nas. Tenaga Fungsional Pertanian, Bogor 2005 76–81
[23] Indonesian National Standar 1992 SNI for Coconut Cake. Revised SNI. 01-2904-1992
[24] Umunna N N, Magaji I Y, Adu I F, Njoku P C, Balogun T F, Alawa J P and Iji P A 1994 Utilization of palm kernel meal by sheep J. Appl. Anim. Res. 5 1–11
[25] Thorne P J, Wiseman J, Cole D J A and Machin D H 1989 The digestible and metabolizable energy value of copra meals and their prediction from chemical composition Anim. Sci. 49 459–66
[26] Agunbiade J A, Wiseman J and Cole D J A 1999 Energy and nutrient use of palm kernels, palm kernel meal and palm kernel oil in diets for growing pigs Anim. Feed Sci. Technol. 80 165–81
[27] Zamora A F, Calapardo M R, Rosano K P, Luis E S and Dalmacio I F 1989 Improvement of copra meal quality for use in animal feeds Proc. FAP/UNDP Workshop on Biotechnology in Animal Production and Health in Asia and Latin America pp 312–20
[28] Wahju J 1988 Poultry Nutrition (Yogyakarta: Gadjah Mada University Press)
[29] Hutagalung R I 1978 Non-traditional feedstuffs for livestock. In: Feedstuffs for Livestock in South-East Asia (United Nations University)
[30] Panigrahi S 1989 Effects on egg production of including high residual lipid copra meal in laying hen diets Br. Poult. Sci. 30 305–12
[31] Ravindran V and Blair R 1992 Feed resources for poultry production in Asia and the Pacific. II. Plant protein sources Worlds. Poult. Sci. J. 48 205–31
[32] Fardiaz S 1992. PT Gramedia Pustaka Utama: Jakarta Mikrobiol. Pangan 1
[33] Haryati T, Togatorop M H, Sinurat A P and Purwadaria T 2006 Utilization off fermented copra meal with A. niger in broiler diet J. Ilmu Ternak dan Vet. 11 182–90
[34] Pederson C S 1971 Microbiology of food fermentations. Microbiol. food Ferment.
[35] Mairizal 2003 Pengaruh penggunaan bungkil kelapa hasil fermentasi dalam ransum terhadap pertumbuhan ayam pedaging (Semarang)
[36] Hack G 2018 Useful and Effective Microorganisms for Sustainable Agriculture and Environment
[37] Sukaryani S 1997 Ragi, bahan makanan ternak alternatif berprotein tinggi Poult. Indones. 205 15–6
[38] Sinurat A P, Setiadi P, Purwadaria T, Setioko A R and Dharma J 1995 Nutritive value of fermented coconut meal and its inclusion in ration of male ducklings J. Ilmu Ternak dan Vet. 1 161–8
[39] Puri Elyana 2011 Pengaruh Penambahan Ampas Kelapa Hasil Fermentasi Aspergillus oryzae dalam Pakan Komersial terhadap Pertumbuhan Ikan Nila (Oreochromis niloticus Linn.) (Sebelas Maret University)
[40] Hidayati S G 2017 Pengolahan ampas kelapa dengan mikroba lokal sebagai bahan pakan ternak unggas alternatif di Sumatera Barat J. Embrio 4 26–36
[41] Supriyati T P, Hamid H and Sinurat A 1998 Fermentasi bungkil inti sawit secara substrat padat dengan menggunakan Aspergillus niger J. Ilmu Ternak dan Vet. 3 165–70
[42] Farizaldi 2017 Evaluasi kandungan nutrisi ampas kelapa terfermentasi dengan ragi lokal dan lama fermentasi yang berbeda Jambi Univ. Res. Sci. Ser. 18 49–55
[43] Miskiyah I M and Haliza W 2006 Pemanfaatan ampas kelapa limbah pengolahan minyak kelapa murni menjadi pakan Seminar Nasional Teknologi Peternakan dan Veteriner pp 880–4
[44] Adeyi O 2010 Proximate composition of some agricultural wastes in Nigeria and their potential use in activated carbon production J. Appl. Sci. Environ. Manag. 14
[45] Lorica R G and Uyenco F R 1982 Agricultural and food processing wastes as potential substrates Microb. Protein Prod. Chem. Anal. Sci. Diliman Publ. Philipp.
[46] Tyas S I S 2000 Studi netralisasi limbah serbuk sabut kelapa (Cocopeat) sebagai media tanam Skripsi. Fak. Peternakan. Inst. Pertan. Bogor, Bogor
[47] Winugroho M and Mariati S 1999 Kecernaan Daun Kelapa Sawit Sebagai Pakan Ternak Ruminansia Lap. penelitian. Balai Penelit. Ternak, Bogor
[48] Granzin B C and Dryden G M 2003 Effects of alkalis, oxidants and urea on the nutritive value of Rhodes grass (Chloris gayana cv. Callide) Anim. Feed Sci. Technol. 103 113–22
[49] Kartadisastra H R 1997 Ternak Kelinci (Yogyakarta: Kanisius)
[50] Setyono H, Kusrimingrum R S, Mustikoweni T N, Sidik R, Al-Arief A, Lamid M and Lokapirnasari W P 2009 Teknologi Pakan Hewan Dep. Peternakan. Fak. Kedokt. Hewan. Univ. Airlangga.
Surabaya

[51] Haryandi, Mulyani S and Fridarti 2016 Universitas Taman Siswa (Taman Siswa Padang University)

[52] Klopfenstein T 1978 Chemical treatment of crop residues J. Anim. Sci. 46 841–8

[53] Van Soest P J 1982 Nutritional Ecology of Ruminant and Feed Metabolic Chemistry and Plant Fiber (Oregon, United States of America: Cornell university press)

[54] Andrizal 2003 http://medpub.litbang.pertanian.go.id.

[55] Muhiddin N H, Juli N and Aryantha I N P 2001 Peningkatan kandungan protein kulit umbi ubi kayu melalui proses fermentasi JMS 6 1–12

[56] Antari R and Umiyash U 2009 Optimizing The Use of Cassava Plant and its Byproduct as Ruminant Feed War. Indones. Bull. Anim. Vet. Sci. 19 191–200

[57] Sofyan L A 2004 Pengaruh Penambahan Makanan Penguat dengan Taraf Onggok dan Tepung Hijauan Ubi Kayu yang berbeda untuk Domba yang mendapat Ransum Basal Jerami Padi (Bogor Agricultural University)

[58] Suyanto 2011 Physical Processing of Cassava Skin as Animal Feed

[59] Ofuya C O and Obilor S N 1993 The suitability of fermented cassava peel as a poultry feedstuff Bioreosour. Technol. 44 101–4

[60] Oboh G 2006 Nutrient enrichment of cassava peels using a mixed culture of Saccharomyces cerevisiae and Lactobacillus spp solid media fermentation techniques Electron. J. Biotechnol. 9

[61] Pramono E 2016 FTIR studies on the effect of concentration of polyethylene glycol on polymerization of Shellac

[62] Kadir J 2014 http://repositor.unhas.ac.id

[63] Hasrul 2016 The Use of Rotten Mushrooms To Increase The Nutritional Value Of Corn Cobs

[64] Dwi Y A 2015 http://repository.unhas.ac.id

[65] Yulistiani D 2012 Corn Cob Silage for Ruminant Animal Feed Tabloid Sinartani Agric. Res. Dev. Agency

[66] Warisman 2014 Biological Processing in Improving the Quality of Nutrition Corn Cobs Fermented as Lamb Feed (University of North Sumatra)