

PIG PRODUCTION IN INDONESIA

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ABSTRACT

Indonesia consists of 34 provinces and more than 250 districts. The human population in 2013 was approximately 250 million, with about 60% living in Java, an island that accounts for only 7% of the country's surface area. About 60% of Indonesia's population lives in rural areas and 54% of the workforce are engaging in agricultural activities. Although about 80% of Indonesian population is predominantly Muslim, pigs are also considered important livestock species.

The majority of pig producers are smallholders (368.000 households). The pig industry is still dominated by small-scale-raisers, whose households raise about 2-5 pigs each. There are also semi-commercial farms (25-500 pigs) and commercial farms (>500 pigs) in the country and these pigs are raised primarily for breeding and fattening. Some [now, only one producer exporting pigs to Singapore: Indotirta Suaka, a subsidiary of Salim Group] of the large scale commercial production have also exported pigs to Singapore for many years, following the closing down of pig farming in that country in 1984.

Indonesia has a number of indigenous pig breeds (such as the Bali, Nias, Papua and the Sumba pigs) that are raised by smallholder farmers in their places of origin. The Government has shown its interest in developing R&D for indigenous pigs and gives priority to know more information concerning the characteristics of the native pig and its possible contribution to production within low – intensity system. There is also a need to know more about its origins and genetic purity.

Keywords: Smallholders, Native Pigs, Swine Production Technologies

INTRODUCTION

Overview of the Country

Indonesia is the largest archipelago in the world. Consisting of five main islands and 30 smaller archipelagos, it has a total of 16,670 islands, 600 of which are inhabited. The country stretches along a distance of 5,100 km from west to east and 1,880 km from north to south, and spans the equator from 6° north to 11° south. The climate varies from humid to semiarid tropical. Average annual rainfall ranges from 1000 to 3,200 mm. Indonesia consists of 34 provinces and more than 250 districts. The human population in 2013 was approximately 250 million, with about 58% living in Java, an island that accounts for only about 7% of the country's surface area. About 60% of the population lives in rural areas and 54% of the workforce is engaged in agriculture.

OVERVIEW OF PIG PRODUCTION IN INDONESIA

Role of Livestock in the National Economy

The agricultural, livestock, forestry and fishery sectors, when compared to other sectors, have contributed 15.29% to Gross Domestic Product (GDP) in 2009-2010. If viewed from the role of GDP of the agricultural, livestock, forestry and fishery sectors, in descending order, the sub-sector with the largest contribution from

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2008 to 2012 was food crops sub-sector which was around 48% - 49%; the fishery around 19% - 21%; plantation crops around 13% - 15%; livestock and its products around 12%; and forestry around 5% - 6%.

The agricultural GDP value in 2010 at constant price was USD 27,709,090,909, increasing by 3.01% from the year 2009 amounting to USD 26,900,000,000. On the other hand, the GDP value of the livestock sub-sector in 2010 amounted to USD 3,472,000,000 increasing by 4.27% from the year 2009 amounting to USD 3,236,000,000.

In 2010 the export volume of pigs was 27,045 tons amounting to USD. 10,341,569, compared to goats, 39.11 tons (USD. 155,856) and sheep 14.5 tons (USD. 57,025). PT. Indotirta Suaka, which has a modern pig farm in Bulan Island, exports live pigs to Singapore.

In 2013, pig producers in some part of Indonesia suffered from low price because of oversupply. This is particularly true in the provinces of Bali, Java and North Sumatera. One way to overcome the decline of the pig price is to communicate with farmers in production centers in order to control the population together, so that oversupply can be avoided. This is necessary because the pork market in Indonesia is very limited with feed cost up, many backyard producers who account for about 65% of the total industry, opted to stop raising pigs, at least temporarily (Asian Pork, 2014).

Livestock Population

Based on its type, livestock are grouped into large livestock (beef cows, dairy cows, buffalos, and horses), small livestock (goats, sheep, and pigs), poultries (free-range chickens, laying hens, broilers, and ducks) and various livestock (rabbits, quails, and pigeons). Table 1 shows a detailed account of the livestock population in Indonesia in 2009 – 2013.

Table 1. Livestock population in Indonesia, 2009 – 2013

Species	Year (000 head)				
	2009	2010	2011	2012	2013
1. Ruminants					
1.1 Beef Cattle	12,760	13,582	14,824	15,981	16,607
1.2 Dairy Cattle	475	488	597	612	636
1.3 Buffalo	1,933	2,000	1,305	1,438	1,484
1.4 Goat	15,815	16,620	16,946	17,906	18,576
1.5 Sheep	10,199	10,725	11,791	13,420	14,560
2. Non-ruminants					
2.1 Pig	6,975	7,477	7,525	7,900	8,246
2.2 Horse	399	419	409	437	454
2.3 Rabbit	887	834	760	1,075	1,090
3. Poultry					
3.1 Native chicken	249,963	257,544	204,340	274,564	290,455
3.2 Layer	111,418	105,210	124,636	138,718	147,279
3.3 Broiler	1,026,379	986,872	1,177,991	1,244,402	1,355,288
3.4 Duck	40,676	44,302	43,488	44,357	46,313
3.5 Quail	7,668	7,054	7,357	12,234	12,594
3.6 Pigeon	1,815	490	1,209	1,806	1,833
3.7 Manila duck	-	-	-	4,938	4,618

Source : Livestock and Animal Health Statistics, 2013

The agricultural sector plays an important role in Indonesian economy. As an integrated part of agriculture, livestock has contributed greatly to the general welfare of farmers.

Pig Industry

Pig population was in the top five of the 34 provinces in Indonesia from 2009 to 2013 (Table 2). Although about 80% of the Indonesian population are Muslims, pigs are also considered important species especially in East Nusa Tenggara, Bali, South Sulawesi, Papua provinces (Eastern part of Indonesia) and North Sumatera province.

Table 2. Pig population in the top five provinces of Indonesia (2009-2013)

Provinces	Year				
	2009	2010	2011	2012	2013
1. East Nusa Tenggara	1,583,052	1,724,591	1,669,705	1,697,252	1,729,650
2. Bali	925,290	922,947	922,739	890,598	900,662
3. North Sumatera	734,043	660,662	749,354	866,207	947,414
4. South Sulawesi	546,351	608,335	612,414	603,337	624,724
5. Papua	540,480	537,782	518,963	577,407	588,086

Source : Livestock and Animal Health Statistics, 2013

Further discussion will focus on smallholders that mostly raise local pigs using traditional, semi-intensive and intensive methods.

East Nusa Tenggara province

East Nusa Tenggara province has local pigs whose names take after the areas where they were raised. For example, Sumba pigs are called such because they came from Sumba Island. Pigs are tied in the gardens to find tubers and they are put in a very simple housing (Fig.1). Farmers usually raise a small number of pigs, about four pigs, in the housing located at the back of their houses. Sometimes the pigs are set free around their houses or are tied in the garden so that they can find their own food, such as tubers, besides carbohydrates such as sago (*Metroxylon sago Rottb*).

The characteristics of local pigs (Fig.2) that have been raised extensively are medium-sized bodies, small and rather long heads and non-sticking canines when they are old enough. Their ears are small and pointed, and their backbones are not so strong that sometimes their stomachs almost touch the ground, especially when the pigs are fat or pregnant. The color of their hair varies; black, black striped, or blackish, white and red-brown. Timor pigs have coarse hair, especially along the brisket, short legs, and pointed snouts. They are agile, and the females can have their first pregnancy at the age of more or less four months (Fuah *et al.* 2013).



Fig 1. Housing of Timor pigs



Fig 2. Timor local pig

These pigs provided a significant amount of pork meat found in eastern part of Indonesia, especially in the regions where the majority of the population is social-culturally pork consumers with rate of consumption 3.43

kg/year (DGL, 2009). In West Timor, they provided cash income for smallholder farmers, and were often closely integrated with other enterprises, where the animals were also given some supplementary feed in the form of feed scraps. Pigs search and scour for food around households and were sometimes given table or kitchen leftovers and crop residues. The approximate amount of feeds given to pigs comprised of maize, palm pith and rice bran of 1.7 kg/pig/day. Occasionally, farmers fed pigs with either raw or cooked mixed vegetables, such as “kangkung” (*Ipomoea aquatica* Forsk.), pumpkin leaves and cassava residue, particularly during harvesting. This management resulted in poor condition, because pigs were often affected by diseases, scabies, pneumonia and internal parasites of which heavy infestation caused their high death rate.

Pig population in the province of East Nusa Tenggara in 2009 was 1,531,166 heads, of which West Timor accounted for approximately 33% with rate of increase at 16%/year, over five years (2005-2009) (Statistics of Indonesia, 2009). Most pigs of indigenous genotypes are widely spread throughout rural areas. Since indigenous breeds make up a high proportion of the total number of pigs, it is not surprising that meat production in 2009 (220.1 tons) was considered low (DGL, 2009). The main constrain to pig population increase was the high death rate of young pigs associated with 1) low availability of suitable feeds; 2) low genetic potential of indigenous breed; 3) lack of skilled farmers and adequate facilities; and 4) poor management (Fuah and Priyanto, 2011).

Bali Province

Pig farming in Bali still has an important position in rural areas. Pigs are one of the livestock commodities that have long been raised by the people. Most farming business in Bali consists of traditional farming with raising a few pigs in each household. Nevertheless, there are quite many semi-intensive and even modern farming businesses that can raise as many as 100 pigs or more. The traditional pig farmers have the following characteristics, among others, 1) they raise 1-4 pigs; 2) pigs are tied or put in a simple housing; 3) pigs are not given factory-made concentrates; and 4) pigs are not given regular vaccination. Bali pigs have a very important socio-cultural status, namely 1) for ceremonial (religious) activities and offerings and 2) for social activities.

There are actually two types of Bali pigs. The first one is found in eastern part of Bali, which is assumed to be derived from China (*Sus vittatus*). Its characteristics are black and coarse hair, curved backs but their stomach does not touch the ground and their snouts are rather long. (Fig.3). The second type that lives in northern, western, southern and central part of Bali has the following characteristics: curved back (lordosis), big stomach, white stripes on its four legs, short snouts, pointed ears, 54 cm tall, 90 cm long and 20-25 cm of tail. The sow's stomach is lowering, and even touching the ground when it stands (Fig.4). Their nipples are between 12 and 14, and they can have 12 piglets per period (Budaarsa, 2012).



Fig. 3. Local bali pig in eastern part of Bali



Fig. 4. Local bali pig in other parts of Bali

Bali pigs genetically have slower growth compared to imported breeds. However, these pigs can stand hardness, being economical in terms of water consumption, and can survive in spite of improper feeding. Therefore, they are suitable for arid areas. Bali pigs are fed with various feeds from day to day. Probably they are fed more with green leaves, and sometimes they are given rice bran and domestic wastes, and they are seldom given concentrates.

Pigs for “*Babi Guling*” (*be guling*) is a traditional Bali food, made of a whole pig that has been slaughtered and cleaned, its internal parts have been removed, and then some ingredients and vegetables are put inside. In the

process of making it the pig is rolled above ember. The ready-to eat rolled pig is marked with the change in the skin color from white to red brown (Fig.5).

Although basically all types of pigs can be made into rolled pig, bali pigs are the best because they taste better and are more delicious. The problem with bali pigs is that they are difficult to get, and only available in villages. Rolled pigs are taken from starter phase until grower stage. Their price fluctuates between USD 1.5 – 2.0/kg.

The number of pigs needed in Bali province for making rolled pigs and for food stall/restaurants is 207 young pigs/day or 74,520 pigs/year. This number does not include the ones rolled by general public for offerings in a certain ceremony (Fig.6) in various villages in Bali province, which need about 91,880 pigs/year. It is such a big number, and it should be met by local farmers without bringing in any from other areas. (Budaarsa, 2012).

To provide bali pigs needed for rolled pigs that are assumed to be more preferable, the government, together with the regional government, local universities, the central government and foreign agencies that are interested in conservation of various germplasms existing in the world, should carry out a conservation program for bali pigs as the original Bali germplasm so that they will not be extinct (Budaarsa, 2012)



Fig.5. Babi guling



Fig.6. Babi guling is used for Bali's ceremonial

North Sumatera Province

In some regencies in North Sumatera there are still some indigenous pig breeds whose names takes after the place which they come from, among others nias pigs in the regency of Nias, Toba/Batak pigs in the regency of Toba Samosir and North Tapanuli and Samosir pigs in Samosir regency. Indigenous pig breeds in the four regencies have several characteristic in common although there are some differences. The hair in general is black grey, their backs are curved and relatively flat, their stomachs are big and low so that they almost touch the ground, the snouts are long and the ears are rather pointed and small. The results of measurement on the field carried out in April 2014 can be seen in Table 3.

Table 3. Results of observation and measurement of pig body in four regencies in North Sumatera, 2014.

Regency	Body size (cm)			Body weight (kg)
	Body length	Chest size	Body height	
1. Nias	70 – 90	62 – 94	45 – 65	20 – 50
2. Samosir	90 – 108	85 – 100	50 – 60	40 – 70
3. Tobasa and North Tapanuli	84 – 86	83 – 84	43 – 50	50 – 70

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Nias local pig breed and its housing are shown in Fig. 7. The simple housing is made from bamboo and its floor is cemented. The feeds are composed of sweet potato leaves that have been chopped and a little bit of bran and grated coconut.



Fig. 7. Simple housing and nias local pig

Besides consuming its meat, people also use Nias local pig breed as a part of custom when proposing to a Nias girl during the marriage process. Nias pig aged 6 months (12-15 kg) is sold for USD 50-60, and the one-year old (25-35 kg) is sold for USD 80-120.

Toba pig breed (Fig. 8.) is generally raised semi-intensively. The animal is set free during the day and at night put into housing which is usually under the house (Fig. 9). There are also some that are set free all day long and go back to the house yard whenever they are hungry. They are fed in the morning and in the afternoon. The feed is usually composed of sweet potato leaves that have been chopped finely. Some farmers add a little bit of bran and cassava that has been grated and cooked. Batakese people cannot be separated from pigs in any custom activities. Toba pig breed aged 4 months (7-10 kg) is sold for USD 35-40, and aged one-year (30-60 kg) for USD 3.4 – 4.5/kg.

Samosir pig breed (Fig. 10) in general is raised extensively. The animal roams freely around the house yard, and there are some tied with a rope as long as 10 meters in open areas with a mud hole (Fig. 11). The feeds given are sweet potato leaves that are finely chopped. Some farmers even add a little bit of bran and grated and cooked cassava and leftover of rice and vegetables. The price of Samosir pigs is almost similar to that of Toba pigs.



Fig. 8. Toba local pig



Fig. 9. Pig housing under the house



Fig. 10. Samosir local pig



Fig. 11. Samosir local pig with a mud hole

In general the sows farrow at the age of eight months since they are already in heat and they can be mated at the age of four months or less. They can produce 2 to 12 piglets per litter farrowing.

Breeding Station for Superior Breeds of Pigs, Buffaloes and Forages (BSSB-PBF)

BSSB-PBF is a technical service unit of breeding that has missions to be reported the Director of Animal Breeding and the Director of Animal Feeds, Directorate General of Animal Husbandry and Animal Health. It is located at Siborongborong, about 250 km from Medan (the Capital of North Sumatera Province); its altitude is 1200 m above sea level; and its temperature is 15°C.

BSSB-PBF Siborongborong has a duty to maintain production, breeding, development, dispersal and distribution of semen. Based on its mission, development of BSSB-PBF Siborongborong is carried out in four breeding locations, one of which is Siaro installation. It is specifically devoted to pigs; the area covers 17 hectares. Nowadays there are four types of pigs being developed in this area, namely Yorkshire, Landrace, Duroc and Berkshire, whose descendants have been distributed to smallholders.

In order to increase the population and productivity of breeding stocks, selection, performance test and breeding program are needed. BSSB-PBF also conducted technical training about breeding to the people, such as measuring, recording, good and correct selection, and helped them to understand the importance of pig breeding. It is realized that the role of BSSB-PBF is not yet optimal. It is far from standard; however, many breakthroughs have been carried out. In the future BSSB-PBF is expected to become an office/station that can provide certified superior breeding stocks.

In 2014 BSSB-PBF will start carrying out “Germ Plasm Conservation” program by searching and getting indigenous pig breeds from four regencies around BSSB-PBF, namely the regencies of Nias, Tobasa, Samosir and North Tapanuli. Each has 2-3 male pigs and 12 female pigs aged around four months. This indigenous pig breeds have been bred with imported pigs; however, there are still many that are close to their purity. Later on, their reproduction characteristics will be observed through an appropriate breeding program, and their production features will also be observed until they reach their proper weight.

In this project there will be many constraints that will be faced in terms of resources, especially funds. We humbly expect an assistance of cooperation with experts and institutions to conserve germ plasms especially for indigenous pig breeds that exist in Indonesia. Apart from BSSB-PBF Siborongborong that produce pig of breeding stocks, in some provinces in Indonesia there are four units of regional animal nurseries for pigs (Regional Animal Nursery Unit – RANU) and one regional artificial insemination office (Regional Artificial Insemination Office – RAIO). The RANUs for pigs are located in East Nusa Tenggara Province (Tarus Installation), West Kalimantan Province (Ngaruk Installation), North Sulawesi Province (Kalasey Installation), and Papua Province (Wanggar Installation), whereas the RAIO is located in Baturiti, Tabanan, and Bali Province. The pig RANU has a duty to produce qualified pig breeding stocks that will be distributed to the people in order to increase the local government’s income and as an internship place or training for beginners. On the other hand, the Bali Province RAIO specially produces pig liquid semen and also pig breeding stocks that will be sold to smallholders or others who need them.

South Sulawesi

Toraja pigs can be found in one of the regencies in South Sulawesi, namely North Toraja, which is a tourism destination due to its beautiful scenery and also its regional ritual custom “Rambu Solo” and “Rambu Tuka”,

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which have attracted many tourists. Animal slaughtering is one of the main ceremonies of the ritual custom such that the availability of animals, especially buffaloes and pigs, is compulsory.

With regard to that, the people of Toraja generally raise pigs. Pigs are raised in almost every house. The type of pigs that are raised by Toraja people is local pigs; however, in line with the development of science and technology local pigs have now been crossed with imported pigs. Pigs that are raised by the people are those that have been bred from one generation to the next, namely local pigs (babi kampong according to Toraja language). The number of pigs that are raised varies depending on the family's affordability, which is four to 20 pigs/family. The population of pigs in Toraja is 287,583 heads (Statistical data, December 2013). The characteristics of Toraja pigs are: black color, blackish, small heads, rather pointed ears, weak spines and medium-sized bodies (Fig. 12). The breeding system of pigs in Toraja has been carried out intensively, in which the pigs are housed and fed regularly. Sanitation is carried out by cleaning the housing, and the pigs' health is maintained, and the sick ones are cured. The feeds given to pigs vary depending on the availability of foodstuffs and the economical capability of the family when providing the food. Basically, in order to maintain local pigs with a simple maintenance pattern, green leaves are fed to them (vegetables, especially sweet potatoes), together with bran and tubers, as well as leftover foods from the kitchen. Generally the pigs' feed are cooked first before it is given to them. After the vegetables are cooked, bran is added according to their needs. Then it is cooled and put in the pigs' feeding containers.



Fig. 12. Boar and sow of local toraja pigs

Pig breeding in Toraja has been conducted intensively, in which the housing is well-kept. The floor is made of bamboo or cement, and the wall is also from bamboo and its roof is from zinc or coconut midrib (Fig. 13). Pigs play an important role in the social life of the Toraja people. They function as a family saving that can be used any time whenever needed. The price of a three-month-old piglet is USD 50-70, while an older pig fetches a price of USD 200 or even thousands (USD) depending on its size. According to the social status of the people, the more pigs they raise, the better economic condition they have. From the viewpoint of Toraja culture, pigs play a very important role; in fact, in every traditional, ceremony pigs need to be slaughtered. The number of pigs slaughtered in every ritual traditional ceremony depends on the economic condition of the family; the number of slaughtered pigs varies from dozens to hundreds. The more pigs slaughtered means the higher social status of the family (Rantetoding, 2014).



Fig. 13. Housing of toraja local pigs

Papua province

Papua in Indonesia is very unique in many aspects. This includes the biggest island amongst other islands, the less populated island (6 persons/km² compared to Jakarta: 12,459 persons/ km²), with the highest numbers of tribes/ethnics and languages/accents, the less cultivated island (some regions consume sweet potato as the staple food) with the 6th highest pig population in Indonesia, and the less developed island.

The method of pig raising in Papua is still traditional. Generally the pigs are left to roam around freely. The pigs are only put into the housing at night, while during the day they are left to freely roam around. The feed is given in the morning when the pigs will be let loose, and in the afternoon when the pigs return to their respective housing.

Socio-Economics of Pig Farming in Papua (Ketaren, 2014)

This section describes the uniqueness of Wamena district, in Jayawijaya regency, Papua province, particularly the area of socio-economics of pig farming. Wamena district lies approximately 2,300 m above sea level; its average temperature is 19.3⁰C, with range of rainfall between 1128 and 3252 mm/year, average humidity of 86%, and about two hours from Jayapura, the capital city. The indigenous and dominant tribe in Wamena is Dani's tribe, who relies on sweet potato as their staple food. This region has relatively very fertile land, where pigs are raised for various purposes. Relationship among human, sweet potato, and pigs can be described and depicted as a harmonious triangle, three sides where each side needs the other side's support to maintain the triangle in shape harmoniously.

Sweet potatoes (Fig.14) are generally planted on soil mounding using short cuttings of two famous cultivars of Halalekue and Musan. Halalekue is for human consumption as the cooked tuber is soft, non-fibrous, sweet, and attractive and having smooth skin. The same characteristics of tubers are used for baby food but normally they are yellow-purple in color. The farmers usually look after their sweet potato gardens carefully and very gently, just like caring for their babies. When they harvest the sweet potatoes by digging the ground and cutting off selected tubers, and get sufficient amount for the daily needs of their family, and leave other tubers in the ground. This practice helps the food security of the family and also helps the tubers to grow up to their ideal sizes. The unexpected tubers which are too small, too big or cracked or fibrous tubers are used pigs' feed. These unexpected tubers of Halaleuke and Musan cultivars are used as pigs' feed. Some tubers may be sold to local market and the money earned is used for buying other commodities to fulfill the family needs. One family may have several sweet potato gardens in different ages to make sure that the tubers are sufficient for their families all-year round. Dani's families also used the tender sweet potato leaves as staple vegetable in their menu.



Fig. 14. Sweet potatoes (Courtesy of ACIAR project)

Pigs are dominantly raised in traditional system. At night, they are kept in wooden pens (Fig. 15) in the same building called "Honai" (Fig. 16) which is also used as family kitchen with dried grass bedding. This keeps the pigs in warm and nice condition as it is very cold at night in Wamena. Early in the morning, the pigs are released from the Honai and are let loose to freely roam and find their own feeds in the bushes or in the virgin forest. In the afternoon, the pigs will return to the Honai spontaneously as the farmers always provide sweet potato tubers and vines for them. Thereafter, the pigs will enter their own pens, a nice and warm environment in the kitchen Honai to have a good rest and sleep. The next day, the farmers will keep the pigs in the same system and procedure. In this traditional system, they need to raise the pigs for about 2-3 years before being sold or slaughtered for various

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occasions. The new technologies in improved pig farming system will certainly improve the pigs' growth and will only need 6-8 months to reach the same pig sizes as those raised for 2-3 years in the traditional system.



Fig. 15. Pigs in wooden pen
(Courtesy of ACIAR project)



Fig. 16. "Honai"
(Courtesy of ACIAR project)

The more number of pigs owned and raised by a certain farmer, the more prestigious the farmer in the community becomes, which also means the more sweet potato gardens to be built and cultivated by that family. Pigs are of great importance in Dani's tribe either as customary valuables, served in festive seasons such as parties for newly born-babies, marriage parties, funeral, exchanges or cash money, and also used as family savings. The bigger the pigs, the more valuable they become. In comparison, the price of the pigs in Wamena can be three to-four times higher than that in Java island.

Above the unique harmonious relationship of humans, sweet potatoes, and pigs there is a significant role of pigs in the socio-economic development of pig farming in Papua, particularly in the communities of Wamena, the highland of Jayawijaya regency. In conclusion, the triangle relationship of humans, sweet potatoes, and pigs help maintain the importance of those agricultural commodities in Dani's community. The socio-economics of pigs in Papua particularly in Wamena district helps the food security all-year round and guarantee the safety and future development of the community. This also means that the new technologies will certainly speed up the pig's growth and efficiency and help improve the prosperity of the farmers and communities.

The project funded by the Australian government through the Australian Center for International Agricultural Research (ACIAR) has successfully modified a farming system that has been developed and adapted for 14 years (2000 – 2014) in Papua and West Papua plateau, although the focus of the project is on Baliem valley, Papua and Arfak Mountains, West Papua.

One of the important activities that have been carried out is repairing the traditional sweet potato system that has dominated the agricultural system in Papua for centuries. In this activity, local farmers and pig raisers have also played important roles, one of them is the so-called Pig Confinement System (PCS), which significantly improves production and prevents the spread of diseases within pigs and from pigs to human beings. Although the PCS needs a lot of labors, it has successfully improved pig productivity and raised families' incomes.

The PCS that has been designed by the ACIAR project is aimed at keeping the pigs' safety and health, and providing good nutrition in a safe and clean environment.

The PCS includes housing and playing ground (Laleken) that has been enclosed (Fig. 17). The housing consists of pens that have a dry place where dry grass/straw is spread for the pigs to lie down at night, and the wet place where the pigs to eat and drink.



Fig. 17. Laleken (Courtesy of ACIAR project)

Laleken, a place for the pigs to exercise, is made as close as possible to the housing to make it easy for pigs to move from the housing to *Laleken*. It would be better if there is a place for pigs to secrete their feces between the housing and the *laleken*. Meanwhile the *Laleken* fence should be planted with trees which can provide shade for pigs, and thus the leaves can become protein supplement source for the pigs. Furthermore, the *Laleken* itself is planted with grass of high protein, such as “*sunda leka*”. Pigs will spend their time during the day in the *Laleken* (playing, eating grass of high protein, and lying down under the shaded life fence). By making a bigger *Laleken* for smallholders, pigs can be regulated to gather grass rotationally. Put some pigs in one plot and leave them all day long to eat high protein grass. If half (50%) of the grass is completely eaten, move the pigs to another plot until half of the grass is eaten completely, and so on repeatedly, and this is called rotation of pigs’ foraging in the *Laleken*. (Fig. 18).

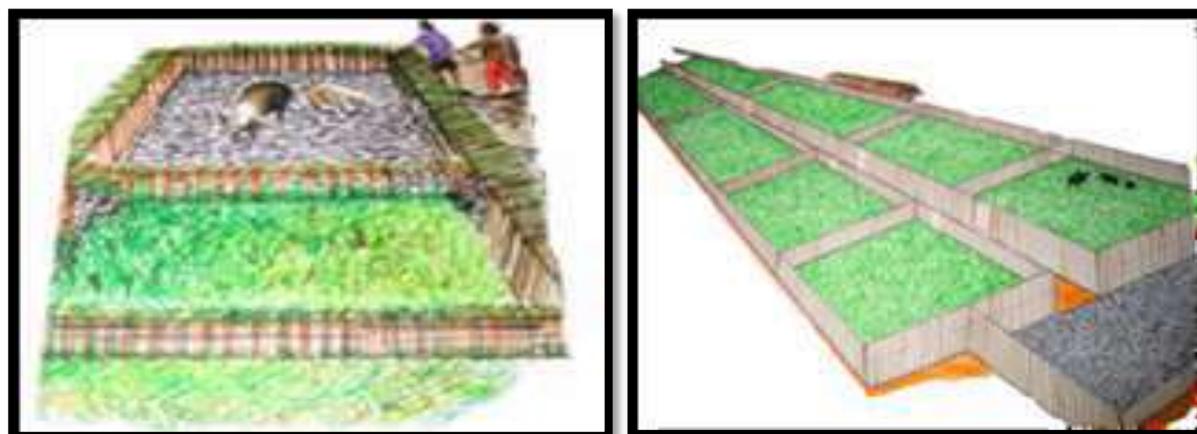


Fig. 18. Rotation of pigs foraging in the laleken (Courtesy of ACIAR project)

Feed Formulation of Pig

A series of field experiments to formulate the composition of the best feed ingredients for pigs have been carried out by the ACIAR-CIP-SARDI project in Baliem valley, Papua between 2002 and 2006. The results of the experiments can be seen in Table 4.

Table 4. Formula of feed, composition of feed ingredients and the growth from the results of the field experiment of ACIAR-CIP-SARDI project (2000-2006).

Feed Formula	Composition of Feed Ingredients	Potency (g/day)
Wamena #1	56% cooked sweet potatoes leaves + 33% cooked sweet potato tubers + 11% cooked banana leaves + 0.5 g salt	150 - 200
Wamena #2	33% cooked sweet potatoes leaves + 22% cooked sweet potato tubers + 34% sweet potato tubers and leaves silage + 11% cooked banana stems	150 – 200
Wamena #3	33% raw sweet potato leaves + 22% raw sweet potatoes + 34% sweet potato tubers and leaves silage + 11% raw banana stems	120 - 170
Wamena #6	50% cooked sweet potato tubers + 30% cooked sweet potato leaves + 20% organs inside cooked fish	250 – 300
Wamena #9	Wamena #2 or Wamena #1 + 5% boiled snails	200 – 260
Traditional feed (control)	Pieces of raw sweet potatoes and their leaves	30 – 50

CONCLUSION

In Indonesia, there are indigenous pig breeds that are suitable to be bred traditionally; however, they still give benefits to the farmers economically, socially and culturally. Therefore, these indigenous pig breeds need to be conserved as germplasm such that they will not be extinct, since there are many farmers who still want to breed them, and the consumers' demand is still high. The government should regulate the indigenous pig breeds in order to get better results and to increase the farmers/smallholders' income.

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