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Sustainability Assessment of the Philippine Native Pig (*Sus philippensis*) Production in Bataan, Philippines

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Abstract: We conducted this study to determine the present status, prospects, economic potential, and sustainability of Philippine native pig production in Bataan. We randomly selected and assessed a total of 100 pig farmers using survey questionnaires. The results showed that backyard producers dominated production (99.07%). The respondents' native pigs were non-descript because of a lack of proper characterization. Local needs dominated supply and demand, with 76.89% of the pigs sold on a wholesale basis without considering the actual pig weight, and 76.15% of the pigs picked up by buyers. The operating system was farrow-to-finish (78.15%), and there was no breeder operation. There was little concern for the provision of a proper housing system and equipment. Pigs were raised in a group or communal system (84.92%), which encouraged premature breeding because the smaller and weaker animals always lacked a chance during competition for food and better space. The feed types provided lack the necessary nutrition, resulting in slower growth and failure to reach maximum potential. The very low percentage of feeding commercial feeds (13.85%) was due to the high cost of the feeds. A lack of awareness about its negative effects led to the practice of inbreeding (68.52%). There was a very low percentage of people practicing proper animal health management. The lack of record-keeping prevents us from analyzing the economic potential of raising native pigs. These findings suggest the need to introduce science and technology interventions to sustain the Philippine native pig production in Bataan.
Keywords: breeding system, economic potential, non-descript, Philippine native pig, prospects

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INTRODUCTION

Native animals are considered an important factor in the agricultural production system in the Philippine countryside. They augment the food supply, provide high-quality protein food, and provide a source of livelihood. One of these animals is the Philippine native pig. The country's native pig is the result of indiscriminate crossbreeding between domesticated wild pigs and introduced pig breeds. After a long process of natural selection, it has evolved into a group that is able to survive and reproduce in natural environments even with minimal human intervention. Through a process of natural selection, the native pig has developed unique patterns of

behaviour that enhance its fitness for local conditions and resilience to extreme climatic occurrences. Other important characteristics of a native pig are its adaptability to local environmental conditions, apparent resistance to diseases, and the unique texture and taste of its meat. These are enough reasons to invest in research and development initiatives to improve the native pig in the Philippines (Yap Jr., 2017).

There is a notion that raising native pigs is not sustainable because of the belief that this breed's growth is slow, resulting in a slower rate of return on investment. Others believe that the country's native pig industry will continue to be an insignificant factor in the local swine sector. Press Reader (2016) asserts that the native pig industry holds significant potential for generating business prospects and employment opportunities, especially for small players. Native pig meat is the best alternative to commercially sold pork meat on the market. We anticipate native pig meat to emerge as a formidable alternative in the pork market, given the growing demand for organic products. Raising and breeding native pigs has the following advantages: they are highly sought after in the lechon industry, are high-value meat, adapted to native conditions, have economic advantages, are relatively healthy (their cholesterol content is lower than that of commercial breeds), and are "organic" in nature. The target market includes the lechon (roasted pig) industry, breeders, and medical researchers. Longganisa (sausages), bagnet (deep-fried pork), tapa (bacon), etag (cured and aged slabs of pork in salt), organic, and pork meat are among the meat products it produces (The Mail Man, 2015).

The aforementioned circumstances prompted the researchers to conduct a descriptive survey study to assess the sustainability of Philippine native pig production in the province of Bataan. The result may help Philippine native pig producers become more competitive with commercial (imported) pig growers in terms of profit and technology. This research primarily aimed to assess the current state, future prospects, economic potential, and sustainability of Philippine native pig production in Bataan, serving as a foundation for devising scientific and technological interventions to enhance its production efficiency. Specifically, the research aimed to determine the current native pig population on a commercial and backyard scale, as well as the supply and demand, pricing, and delivery systems. It also examined production and management practices, including the system of operation, housing conditions, feeds and feeding systems, breeding practices, health management, and an economic analysis of raising native pigs.

MATERIALS AND METHODS

The researcher cannot secure Institutional Animal Care and Use Committee (IACUC) approval because the university, including in the province of Bataan, Philippines, still lacks an established IACUC. Instead, the researcher secured a Certification of Ethical Approval from the BPSU-Peninsula Research Ethics Committee (REDO.PROJ.AC.2018.01) prior to conducting this study. We conducted this study in the province of Bataan, Philippines, collaborating with the Local Government Unit-Municipal Agriculture Offices (LGU-MAO), Office of the Provincial Agriculturist (OPA), and Provincial Veterinary Office (PVO) to pinpoint the precise locations of native pig raisers from the municipalities of Dinalupihan, Hermosa, Orani, Samal, Abucay, Pilar, Orion, Limay, Mariveles, Bagac, Morong, and City of Balanga. Using Slovin's formula, the researchers selected and assessed 100 (N = 100) farmers who are raising Philippine native pigs from among the 131 participants. The researchers conducted face-to-face interviews with the respondents using a prepared questionnaire. The questionnaire outlines the current native pig population inventory on both commercial and backyard scales, marketing systems such as the current supply, demand, pricing, and delivery system, production systems such as the systems of operation, housing, and housing conditions, the types of feeds given to the native pigs, management practices such as feeding, breeding, and health management, and an economic analysis to determine the current production cost and income derived by the participants in raising Philippine native pigs
We analyzed all the collected data using basic descriptive statistics like frequency distribution, percentage, mean, and ranking.

RESULTS AND DISCUSSION.

This chapter presents all the information gathered during the study, which includes analysis, interpretation, and discussion of the current status of Philippine native pig production, system of operation, housing system, feeds and feeding practices, breeding, health management, current production cost, and income.

Current status of production.

Table I presents the current status of Philippine native pig production among the selected respondents.

Table I. Current status of Philippine native pig production in Bataan

Item	*Mean*	*Rank*
Gender of native pig raisers (respondents):		
Female	*40.83%*	*2*
Male	*59.17%*	*1*
Number of native pig per farmer (head)	*12.87*	
Scale of production:		
Commercial	*0.93%*	*2*
Backyard	*99.07%*	*1*
Supply:		
Local/Regional/National Market	*84.71%*	*1*
Personal/Family use	*15.29%*	*2*
Demand:		
Local/Regional/National Market	*84.52%*	*1*
Personal/Family use	*23.17%*	*2*
Method of selling:		
Wholesale (per head)	*76.89%*	*1*
Wholesale (per batch)	*3.98%*	*3*
Retail	*2.56%*	*4*
Personal/Family use	*18.05%*	*2*
Pricing (PhP):		
Grower/Finisher(price/hd)	*3, 286.81*	
Piglet/Starter (price/hd)	*1, 495.07*	
Culled (price/hd)	*6, 825.00*	
Retail (price/kg)	*150.00*	
Delivery system:		
Picked up by buyers	*78.15%*	*1*
Delivered to buyers	*3.69%*	*2*

The native pigs they raised were considered non-descript due to a lack of proper characterization. The scale of production depends on the extent, whether commercial (>20 sow-level) or backyard (<20 sow-level). The supply and demand considerations were for local, regional, national, or personal use. The market entails buying, selling, and pricing finishers, growers, starters, piglets, culled sows, boars, and dressed weights on a wholesale (per head or per batch) and retail basis, as well as those for personal or family useBuyers may pick up delivery or hauling systems, or the raiser may deliver them on a live-weight or dress-weight basis.s.

The respondents' gender during the survey was 59.17% male and 40.83% female. They raised an average of 12.87 heads, for a total of 1,081, composed of 87 boars, 254 sows, 95 gilts, 186 piglets, 181 starters, 265 growers, and 13 finishers. The highest number of Philippine native pigs was in the municipality of Orani, with a total of 245 heads composed of 8 boars, 42 sows, 7 gilts, 13 piglets, 118 starters, and 57 growers, while the least number was in the municipality of Pilar, with 30 heads comprising 7 boars, 9 sows, 2 gilts, 5 piglets, and 7 growers.

Backyard producers dominated production, with a mean of 99.07%, while only 0.93% were involved on a commercial scale. The municipality of Orani, Bataan, established a commercial Philippine native pig production, operating at a level of 20 sows. This finding confirms the preference of Bondoc et al. (1998) for raising native pigs due to their low input requirements and disease resistance. Many local special food preparations or dishes commonly incorporate native pigs. Manipol et al. (2014) also found out that the value chain of the Philippine native swine comprised small-scale holders. Local needs clearly dominated the supply (84.71%) and demand (85.52%), with the respondents using the remaining 15.29% of the supply and 23.17% of the demand for personal or family use. The highest supply, with an average mean of 100%, was in the municipalities of Abucay, Morong, Orion, and Bagac. The highest mean for personal use was in the municipality of Hermosa, with 45.45%. This absolutely indicates that the Philippine native pigs raised by the respondents are for local demand and personal use. The Food and Fertiliser Technology Centre for the Asian and Pacific Region has expressed that native animals have significantly

enhanced the cultural, social, and economic standing of rural farming communities. The growing population around the world prompted a demand for more produce, which led to intensive farming and the use of exotic commercial breeds and hybrids. But as people become more conscious of their health, natural products show potential for choosing native chickens and pigs when it comes to animal production (Santiago, 2018). Observations showed that 76.89% were selling their products on a wholesale (per head) basis, 3.98% on a per-batch basis, and 3.98% on a retail basis. There were 18.05% that answered for their own use. The average price was PhP 3,286.61 for grower or finisher, PhP 1,495.07 for piglet or starter, PhP 6,825.00 for culled sow or boar, and PhP 150.00 per kilogram for dress weight. Buyers picked up 78.15% on a live-weight basis, and delivered 3.69%. There were 8.88% that processed lechon, 1.88% into tapa or bacon, and 0.83% into tocino and sausage.

Production system.

The respondents' production systems for Philippine native pigs (Table II) include the system of operation, housing, and housing conditions, as well as the type or kind of feed provided to the animals. The system of operation involves: farrow to finish, which means they raise sows to produce piglets and take care of the piglets until the finishing stage; farrow to wean, which means raising ewes to produce the piglets and selling the piglets as weanlings; fattening operation, which means buying weanlings and raising them until the growing or finishing stage; and breeder operation, which means they produce breeding gilts or boars as replacement stocks.

Table II. Production system for Philippine native pigs in Bataan

Production system	*Mean, %*	*Rank*
System of operation		
Farrow to finish	*78.85*	*1*
Farrow to wean	*8.12*	*3*
Fattening	*14.65*	*2*
Breeder	*0.00*	*4*
Housing system		
With housing	*63.89*	*2*
On pasture	*29.54*	*3*
Tethered	*15.89*	*4.5*
Individual pen	*15.08*	*4.5*
Group/ Communal	*84.92*	*1*
Housing condition:		
Indigenous/local materials	*51.46*	*1*
Concrete flooring	*11.95*	*3*
Concrete flooring and walls	*9.52*	*4*
Concrete flooring, walls and G.I. roofings	*16.76*	*2*
Feeding trough	*30.41*	*2*
Waterer	*39.64*	*1*
Properly ventilated	*28.58*	*3*
Properly illuminated	*0.93*	*4*
Feeds		
Commercial	*13.85*	*3*
Self- formulated	*27.31*	*2*
Others (rice bran and kitchen left- overs)	*48.01*	*1*

The housing system encompasses the type of housing, such as raised on pasture, tethered, in individual pens, or in a group or communal system. The condition of housiThe condition of the housing, whether it was made of indigenous or local materials, with concrete flooring, concrete walls, or a combination of concrete flooring, walls, and galvanized iron roofing, also playeThis study also evaluated the types of feeds given to the animals, including commercially available hog feeds, self-formulated feeds, and a combination of rice bran and kitchen leftovers. Observations showed that 78.85% of the respondents practiced the farrow to finish operation, 14.65% the fattening operation, and 8.14% the farrow to wean operation. None of the respondents practiced the breeder operation. 63.89% of the respondents housed their native Philippine pigs, 29.54% raised them on pasture, 15.89% tethered them, 84.92% raised them in a group or communal manner, and 15.08% raised them in

individual pens. Raising pigs in a group or communal system encourages early or premature breeding. Bigger and stronger animals always have a chance during competition, either for food or for a better space. This scenario suggests conducting a training seminar on the importance of proper animal housing to assist Philippine native raisers in improving their production practices. Individual pen or confinement is important to separate the boar from the herd to discourage premature breeding, to separate pregnant sows to prevent abortion, lactating sewesto improve their piglets' survival, and the smaller pigs to increase growth performance. It was noted that an average percentage of 51.46% of housing was made from indigenous or local materials, while 16.76% was made from concrete flooring, walls, and galvanised iron roofing, 11.95% was made of concrete flooring, and 9.52% was made of concrete flooring and walls. Those that provide a feeding trough, waterer, proper ventilation, and illumination have 30.41%, 39.64%, 28.58%, and 0.93%, respectively. Proper housing conditions and equipment provision are critical to protecting the pigs from extreme weather conditions and predators. This would likewise prevent further competition for food and space. We observed that 48.01% fed with rice bran and kitchen leftovers, 27.31% fed self-formulated feeds, and 13.85% fed commercially available feeds. Manipol et al. (2014) mentioned that the production of native pigs can be a viable source of income for swine producers who cannot cope with the high price of commercial swine feeds and for those who have limited capital. The highest average mean of 100% that were feeding rice bran and kitchen left over were from Balanga City, while the highest average mean for those feeding a self-formulated diet were from Abucay, and those that were feeding commercially available feeds for hogs were from Orani with 33.33%. According to 48.01% of the respondents, feeding rice bran and kitchen leftovers lacks the necessary nutrition for the animals. This practice may not encourage the Philippine native pigs to grow to their maximum potential. The very low percentage of feeding their animals with commercial feeds (13.85%) was due to the very expensive cost. This implies the creation and testing of feed formulations tailored for Philippine native pigs to enhance the nutritional value of the feeds provided to the animals.

Management practice

Management practices for raising Philippine native pigs include restricted, ad libitum, dry, wet, individual, or communal feeding practices. Breed management included natural breeding, artificial insemination, inbreeding, and crossbreeding. The health management practices included vaccination against common swine diseases, disinfection of pens and surroundings, deworming of pigs, quarantine for newly purchased animals, and supplementation to improve the nutritive value of feeds.

Table III. Management practice for Philippine native pigs in Bataan

Management practice	*Mean, %*	*Rank*
Feeding		
Restricted	*90.65*	*1*
Ad libitum	*9.35*	*2*
Dry	*16.70*	*2*
Wet	*83.30*	*1*
Individual	*14.70*	*2*
Communal	*84.33*	*1*
Breeding		
Natural	*98.81*	*1*
Artificial Insemination	*1.19*	*2*
Inbreeding	*68.52*	*1*
Crossbreeding	*31.48*	*2*
Health management		
Vaccination	*6.55*	*4*
Disinfection	*8.22*	*3*
Deworming	*12.79*	*1*
Quarantine	*0.00*	*5*
Supplements	*11.43*	*2*

The feeding practices, as shown in Table III, were 90.65% restricted feeding and 9.35% ad libitum. Wet83.30% of individuals practiced wet feeding, while 16.70% practiced dry feeding. 84.38% and 14.70% of

individuals practiced group or communal feeding. s means that most of the respondents were practicing restricted, wet, and group feeding for Philippine native pigs. Smaller pigs would always have a lesser chance to eat enough when feeding in groups. The respondents' Philippine native pig breeds were indistinct due to a lack of proper characterization. It was noted from thThe data revealed that 98.81% of the respondents practiced natural breeding, while 1.19% employed artificial insemination. of 68.52% practiced inbreeding, while 31.48% practiced crossbreeding. The practice of inbreeding by 68.52% of the respondents would result in a decline in growth and reproductive performance as well as in the disease resistance of the animals, while crossbreeding encourages hybrid vigour or heterosis and an improvement in the animals' performance. We suggest conducting training seminars on the importance of breeding and reproduction to encourage Philippine native pig raisers to practice crossbreeding and breed improvement. only 6.55% practicing vaccination to immunise their animals against common swine diseases, while 8.22% were disinfecting the pens, 12.79% were practicing deworming to eliminate parasites, none of the respondents practice quarantine for newly purchased animals, and an average mean of 11.43% were giving feed supplements to improve the nutritive value of feeds given to their Philippine native pigs.

Economic Analysis.

Respondents' economic analysis of raising Philippine native pigs includes their current production costs, such as their expenditures on stocks, housing, feeds, labor, biologics, and other expenses. The earned income from the sales of piglets or weanlings, starters, growers, finishers, breeders, and culled sows and boars exceeds the production costs. The respondents lack proper financial and production records, making an economic analysis impossible. This demonstrates that the surveyed Filipino native pig raisers in the province did not prioritize record-keeping. Hence, it is an opportunity for the university to conduct trainings and seminars on production and financial record-keeping.

CONCLUSION

The study's findings led researchers to draw the following conclusions: Backyard producers dominated the production of Philippine native pigs in Bataan, compared to commercial scale production. Local needs and personal use were the primary drivers of supply and demand. Selling on a wholesale basis rather than on a liveweight basis would be very disadvantageous if the native pigs are heavier. The farrow-to-finish system dominated the operation. We observed that none of the respondents participated in the breeder operation. The respondents showed minimal concern for the provision of a proper housing system and equipment. The respondents raised pigs in a communal or group system that encouraged early or premature breeding. The types of feed provided lack the necessary nutrition for the animals. The very low percentage of feeding their animals with commercial feeds was due to the very expensive cost of the feeds. Formulation of feeds suited for Philippine native pigs should be made and tested to help improve the nutritive value of feeds given to the animals. The practice of inbreeding may result in a decline in growth and reproductive performance as well as in the disease resistance of the animals. Most were not aware that crossbreeding encourages hybrid vigour, or heterosis, and an improvement in the animals' performance. To encourage Philippine native pig raisers to practice crossbreeding and breed improvement, we suggest conducting training seminars on the importance of breeding and reproduction. The low percentage of respondents who practiced vaccination, disinfection, deworming, quarantine, and supplementation indicated their ignorance of the importance of these health management practices or their belief that the Philippine native pigs' resistance to pests and diseases rendered them unnecessary. The respondents did not practice record-keeping, resulting in a lack of documentary evidence on their expenses and income from raising native pigs. Therefore, the lack of financial and production records precludes conducting an economic analysis.

Backyard raisers that dominate Philippine native pig production in the province should be provided with technical and financial assistance, while those with financial capability could engage in commercial production to fill the gap between supply and demand. Government interventions, policies, and guidelines can also enhance the selling process and pricing system. A standard pricing system should be in place specifically for native pigs. We should encourage value-adding to boost the farmers' income. To determine the most appropriate and economical housing and facilities for the animals, the province must study the development of the most suitable housing and facilities for Philippine native pigs. Trainings and seminars on the importance of proper animal housing can also be helpful to improve production practices. We also encourage feed formulation and feeding trials using locally available feedstuffs to identify the most suitable feeds for Philippine native pigs. Native pigs can be grown with better feed efficiency and lower feed costs per kilogramme of weight gain using indigenous feedstuffs to replace certain amounts of commercial rations, as recommended by Callo-Etis (2015). We must discourage group feeding, as it only benefits the largest and strongest animals. Separating smaller animals from the larger ones would increase their chances of survival. To have a reliable source of breeder stocks, Bataan should establish a breeding station for Philippine native pigs. It is crucial to

conduct a thorough characterization of the native pigs raised in Bataan to ensure accurate identification. In order to preserve the true "native" pigs, we must first set and certify minimum standards (Bondoc and Ramos, 1998). These findings suggest that science and technology interventions such as breed characterization to identify the ideal Philippine native breeds, the development of a marketing system, housing design and facilities, feeds, a health programme, valuedding, a and record-keeping must be introduced to help improve the Philippine native pig production in Bataan. Training the respondents in keeping financial and production records would enable economic analysis.

Conflict of Interest

There is no conflict of interest on the author's part in any financial, personal, or other relationship with other people or organisations related to the material discussed in the manuscript.

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