

Understanding the Objectives of Pigs Farming Development in Arfak Tribe Farmers, West Papua

Deny A. Iyai (Corresponding author)

Department of Animal Sciences. Faculty of Animal Husbandry. Papua University, Manokwari, West Papua, 98314, Indonesia.

Tel: +62-986-211455 Fax: +62-986-211455 E-mail: da.iyai@yahoo.com

Bernadin Gobay

Department of Animal Sciences. Faculty of Animal Husbandry. Papua University, Manokwari, West Papua, 98314, Indonesia.

Tel: +62-986-211455 Fax: +62-986-211455 E-mail: b.gobayunipa@yahoo.com

Alexander Yaku

Department of Animal Sciences. Faculty of Agriculture. Papua University, Manokwari, West Papua, 98314, Indonesia.

Tel: +62-986-211455 Fax: +62-986-211455 E-mail: axyaku@yahoo.com

(Received: June 09, 2015; Reviewed: July 20, 2015; Accepted Oct 20, 2015)

Abstract: *The multifunction of pigs for the Papuan are divergences and interrelated. This study was aimed to seek the objectives of keeping pigs by Arfak tribe and to find the trend relationships of economical and socio-cultural components determining the development of pig farming systems in Manokwari. A one-month field research was done at Manokwari Barat district. Quiztionaire was the tool used to record and collect the data. Snowball method was applied to chose the pig farmer participants and 60 respondents were participated. Several variables were quantified to measure the percentages of socio-cultural and economical objectives. The finding shown that income generation, savings barter were the subsequent components shaping the economic objectives and while organic fertilizer and biofertilizer resulted from manure were not applied yet. Although dung was frequently produced and spreaded at the pig house and around backyard. Socio-culture was done in the means of merrital prices, peaceness, gift and parties, respectively. The other findings were that the alternation of pig development indicated by herd size had positive relationship with the two motives. Similar relationship was shown by number of aided farmers. Hence, the changes of pig farming systems, e.g. extensive to semi-intensive and/or intensive to semi-intensive had shown weak relationship.*

Keywords: *Economical Motive, Social-Culture Motive, Arfak Pig Farmers*

1. Introduction

Pigs are highly valued and have a top priority of animal agriculture farmed in Papua and West Papua. Most livelihoods of native Papuan tribes are crops and livestock-based farmers. The majority of pig farmers in Papua live at Sorong, Birdhead (Basna,

2010, Basna, 2011), and Manokwari (Iyai, 2008). They are relied their livelihood and other rituals and important ceremonial on the pigs. Both conventional (Batam, crossed large white and saddle back) and the wild (*Sus scrofa*), pigs have determined the shapes and dynamic of income generation of

many native Papuan tribes. Several studies were done to experience the contribution of pigs in the livelihood income generation reported by Warastuti (2001), and Iyai (2008).

In one hand, texts of social values of the pigs have been explored by several authors such as Salabay (2009) and Sayori (2013). Inclining population of pigs is due to demands of open access local markets. The majority of Christian followers in Manokwari has benefits for pig farmers. Therefore Warastuti (2001) stated that pig agribusiness has been potential economical values. Demand of pig cuts in Manokwari has been increasing. Level of preferency of pig meat tend to increase as well due to socio-cultural activities. In socio-cultural values, pigs are frequently used as cultural ritual including merrital prices, barter, peaceness such as conflict, war, murder and death and other socio clashes. Pigs also determine social status in community, examples are given in Arfak tribe (Salabay, 2009). The more the pigs farmers have the more socio-rank the farmers have in Papua. The pig farms are therefore not only have socio-cultural values but also economical values. Examples in Asia depicted from Northern Thailand (Nakai, 2008), North Vietnam (Lemke *et al.*, 2006; Lekule and Kyvsgaard, 2003) and Zimbabwe (Chiduwa *et al.*, 2008) and Central Kenya (Wabacha *et al.*, 2004).

Iyai (2011) mentioned several areas where Arfak people can be met are district of West Manokwari, Southern Manokwari, Southern east and/or Southern coastal areas (Oransbari and Ransiki), Warmare, Northern Manokwari, Prafi and Masni. The Arfak tribe actually occupy highland mountain of Arfak such as Minyambouw, Anggi, Catubouw and

Tanah Rubuh.

However, detail contribution of pigs resulted from two objectives, i.e. economic and socio-culture were not mentioned yet. By identifying detailed components of social and economic components, impressions can be made and improved. The orientation of raising pigs are not identified yet. Whether the Arfak farmers have already been keeping their pigs in the economical means or for them socio-cultural demands are more important and priority. This thought plays a paramount role of development indicators for animal husbandry development in Papua, particularly in Manokwari.

It was argued that social and economical orientation of Arfak tribe farmers with respect to objectives will further interchangeable and unstable. It was argued as well that social aspects had no association with pig farming development in Manokwari, and likewise economical aspects have association.

2. Materials and Method

A one month of explorative method was done in administrative region of Manokwari Barat District, Manokwari regency. Three sub-districts were selected where Arfak tribe pig farmers dominantly settled, i.e. Wosi, Sanggeng and Amban. As much as 60 households selected was based on Snowball sampling method using semi-structure interviews. Triangulation of data was made by interviewing cultural board representative in Manokwari (Dewan Adat-Suku Arfak). Parameters used were economical, socio-cultural motivation and development of pig farming systems. In operational concepts, it was defined that income as a fresh money

earned as a result of selling pig products. Net income is therefore calculated as total farm generated income minus fixed cost of production. Saving is defined as sum of pig herds kept and calculated in money (pigs/hh). Barter is defined as sum of pigs used as exchange tools with other things (pigs/hh). Organic fertilizer is defined as wastes produced from pigs applied to fertilize the farming land (kg/ha/hh) calculated based on sum of manure used compare to sum of manure marketed (kg/Rp/hh).

Socio-cultural motives comprise of merrital prices. Peacefullness objective is defined as sum of pigs used to compensate a clash such as tribe and/or family war, conflicts vertical with government and horizontal with other community. Pig aid is defined as sum of pigs used as gift to other closed relatives. Cultural party defines sum of pigs used to celebrate parties (pigs/hh). Motive of farmers is defined as the reasons or stimulants come out from the farmers to keep the pigs. The value of motive is used as percentages (%) calculated by summing total each motivation components devided by 1000 multiplied by 100%. Mathematical formula is then $M = \frac{\sum Nm}{1000} \times 100\% \frac{\sum Nm}{1000} \times 100\%$ (Gobay, 2011).

Indicator of pig development consists of number of pigs based on physiological ages raised by pig farmers, i.e. piglet, grower, sows, and boars (pigs/hh). Number of relatives and/or family either Arfak pepole or Papuan were included (pigs/hh). Changes of pig farming systems were made by using parameter and identification made by Iyai (2008), which consisted of free-range (scavenging) pig systems, restrained pig systems, semi-penned systems and penned systems.

The changes of pig farming systems and its scales were made according to Gobay (2011). Following is the indicators used in chategorizing pig farming systems development, e.g. technology used, scale, labours involves, capital investment, and management. Every change of pig farming systems has its converted values. It was used indices of -2 for changes of pig farming systems from penned to free-range pig farming system and indeed used 3 for changes of free-range to penned systems and the values given were -10 and 15, respectively.

In statistical analysis, qualitative and quantitative data were recorded and stored in Microsoft Excel 2003. A multivariate analysis (MVA), i.e. principal component analysis (Ho, 2006) was performed to understand correlation between factors. Agglomerative hierarchical clustering (AHC) was used in classifying constraints in similarity classes. Data were run using Xlstat version 2009 (Xlstat, 2009).

3. Results and Discussion

3.1 Profile of Pig Farmers Related to Sub-districts

Subdistricts where pig farmers live is under administration of Western District consist of Wosi, sanggeng and Amban. The majority of Arfak community (30 hh or 50%) live in Wosi, Sanggeng (15 hh or 25%) and Amban (15 hh or 25%). Interviewed results of the reasons were due to land right of farmers' anchestor. Besides, other important economical reasons "being close to the available access of local markets". This is in line with the common livelihood systems as farmers (Iyai, 2008; Iyai and Randa, 2011). Market for their images has

played an important role for providing free feeding materials for animal, which are using crops and its residues for feeding the pigs (Iyai *et al.*, 2013). Thought for being efficient in reducing variable cost is exist and appreciateable. This reason was also in line with other findings of Marani (2007) and Awom (2010).

3.2 Characteristics of the Pig Farmers

The finding shown that the ages in average consisted of 33.1 ± 10.7 (y), which is stated that the range is in productive ages according to Mubyarto (1989). In the productive ages, individual will have more an ease to adopt and stand for the risks of new innovation and introduced things in raising pigs compare to oldest ages. This finding was confirmed by Marani (2004), Awom (2010) dan Iyai (2008).

The majority pig keepers of Arfak tribe was dominated by man, i.e. 51 hh (85%). This finding is commonly found in Papua, where a man has responsibility to provide basic needs for families. For Arfak tribe cases, few women (9 persons, 15%) were involved in keeping pigs. Cultural fact comparison amongst coastal and highland tribes is vary for some aspects. Similar finding also confirmed by Iyai (2008), and Iyai *et al.* (2010). The role of women in this aspect is as the household leader and/or responsible for farming the pigs. One fact is that job description of man and women in Arfak and some other tribes in Papuan is being promoted. Although supporting data/study to find the effect of women rising and man raising pigs is not available yet.

Education tend to change recently. It was found that education level of the Arfak

tribe was altered from dominantly non-educated to junior and senior high school, 28.33% farmers were in senior high school and 21% was in elementary. While 20% respondents were not educated and only few farmers had graduated from university. Education provides ability to creatively think to improve pig farming. However, experience as well as gives contribution in productivities. Experiences are not gaining in formal education however it is found at practices.

The principal finding of experience was that 26 hh (43%) had 6-10 years in raising pigs. Experience ≤ 5 years was 35% , and > 11 years was 21%. The more experience is gained the more local knowledge/wisdom is collected. Experience would allow farmers to select and provide better genetic pigs. Traits of the pigs should prefer and suitable for the farmers (Kanis *et al.*, 2008). This is in line with Kasmiatum (2003), where knowledge obtained is derived from long term experience.

It has been known that number of household members plays a significant role for household labours. The majority number of household member was in the range of 5-8 persons and followed by 1-4 persons and 11% has 9 household members. Types of family members in Papua are bounded with their relatives, such as nepew and parents in law. Based on Sagrim (2002), a merried Arfak man should live at his parent and his relatives consisted of wife and husband and nuclues family, i.e. 3 to 5 children. The larger number of family household, the larger number of household family labour is available for doing farming works.

3.3 Economical Objectives

Economical objectives comprised of number of sold pigs, income generation, organic fertilizer, savings, and barter. The findings of this study were that the majority of farmers (41,67%) were sold their piglets (baby pigs), followed by farmers sold growers (29,76%) and adults (28,57%). The percentages of sold piglets were due to economical reasons and technical reasons. In economical reasons, raising piglets or weaned piglets need additional costs for milk and electricity and providing well bedding. While, not many farmers during rearing pigs seldom provide such things. In technical consideration, it needs skillfull labour. Most of the farmers do have low qualify in rasing pigs. Iyai (2008) mentioned that mortality was found during early life of pigs. Pig farmers do not have certain places for slaughtering pigs. Close relatives and neighbours are invited at certain day for offering the cuts. One piece of cuts price is at least Rp. 100.000,00.

The lower income of raising pigs was 10 million rupiahs (78.33%). In small number of farmers earned income in range of 10 millions to 20 millions rupiahs every year. And only in few number of farmers obtained cash more than that of 21 million rupiahs per year. The fluctuative income of selling pigs depends on the number of pigs that are reared and sold. Due to socio-cultural in Arfak tribes, number of pigs reared will not assure the income created.

The objective of savings, i.e. rearing the pigs a life in the pig houses, was done by 50 % of pig farmers. The pigs will be sold if farmers have quick basic needs, such as education, conflict and cultural needs. Sav-

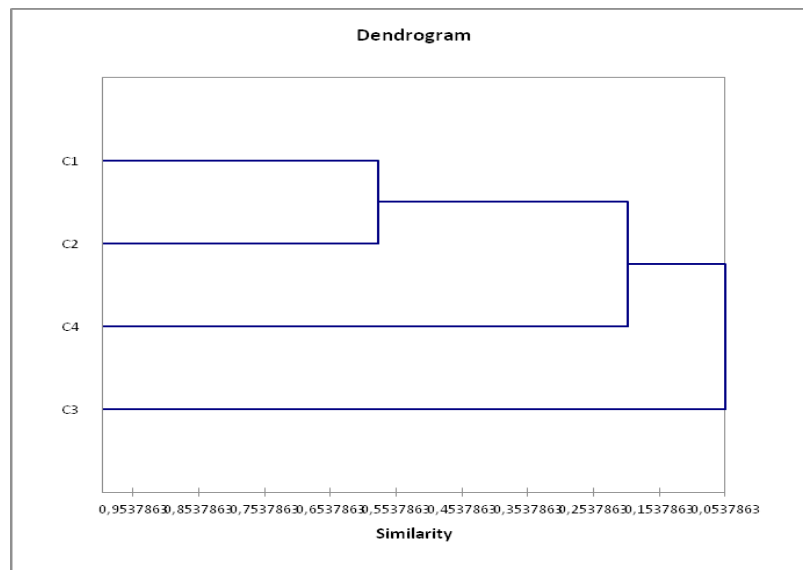
ing pigs done were the number of pig herds reared and shown the richness status of farmers. Pigs used as barter activity was 16.66% of respondents. The rests did not use pigs as barter. The ways how barter practised were exchange pigs with feeds of crops and its residues. The ages of pigs bartered were at piglet or weaned piglets. The prices of piglets and weaned piglets (ages of 1-3 months) were in a range of IDR 600.000,00-to IDR 1 million. This barter is oftenly done by farmers who do not have lands. Therefore, the objectives of economical function were as sources of income, savings, barter and bio-fertilizer. Similar works also reported by Peters *et al.*, (2005) in Vietnam.

3.4 Socio-Cultural Objectives

Socio-cultural objectives comprise of merrital prices, peacefullness, gift and parties. Of the evaluation done, average number of pigs used was subsequently for merrital prices, gift, peaceness and parties, i.e. 2.6 ± 3.5 heads/hh/y, 1.8 ± 2.1 head/hh/y, 1.4 ± 1.8 head/hh/y, 0.8 ± 1.7 head/hh/y.

Similar to that of economical objectives, allocation of pig percentage counting used to compute socio-cultural objectives is determined by the number of pigs allocated to socio-cultural objectives. It was evaluated that the way it is computed should be based on the number of pigs used to each socio-cultural activity divided by the whole pigs reared by farmers. It was depicted that the majority of ethnic Arfak for allocating their pigs were > 4 heads/hh/y for 43 hh, 4 to 8 heads/hh/y for 13 hh, and < 9 heads/hh/y for 4 hh, respectively. The cultural event of merrital price payment is oftenly arranged by the women family. The price of merrital

Figure 2. Summary of a binary tree diagram clustering of objectives of developing pig keeping systems in Manokwari.



The dotted-line, in the Figure 1, shown that more than 60% of all observations shaping these three classes had high similarity. The progressing of similarity decreases simultaneously up to 0.27 or 27%. Secondly, the more complex of components compiling the characteristics, the more homogeneity are the types of pig farming systems. It was apparently seen that the fourth class had the most number observations grouped there.

3.5 Distribution of Socio-Economical Components in PCA

The principal component is useful data reduction technique which works by reducing inter-correlation amongst components. The principles of PCA (Jolliffe, 2002) are that components pointed in opposite directions are strongly negatively correlated with one another. The advantages of PCA are twofold, i.e. PCA is able to reduce multicollinearity (Soemartini, 2008) and able to present data with simple structure without losing the essence in it. The PCA produced a new variable that have new combination

of components. Eigen value/lambda (λ) is used to measure of the fraction of variation explained in the data set. The Eigen value (λ) and percentage variance (variability) of the F1 axis was 3.281 and 46.87%, respectively. The proportion of the variance is merely the Eigen value for that axis divided by the total variance, i.e. the sum of the diagonal of the cross-product matrix.

The values of Eigenvectors (x) are containing a set of scores that shows the weight of each variable, i.e. components on each axis of PCA (Hurnik *et al.*, 1994; Jolliffe, 2002). The eigenvectors vary between -1 to +1 and if the value of the Eigenvector for a specific variable is close to absolute of 1, it is more important to weight on the axes (Medasghi, 2001). Variables of factors drawn from pig farmers are shown in Table 1. Values of Eigenvectors in particular F1 had shown severe positive weighting.

All components of objectives in Axis one (F1), i.e. income, saving, barter, bio-fertilizer (economic objective) were shown positive weighing. The higher positive mark

Table 1. Eigenvalue and Eigenvectors in Principal Component Analysis.

Eigenvalues:	F1	F2	F3	F4	F5	F6	F7
Eigen-value	3.281	1.102	0.950	0.533	0.504	0.358	0.272
Variability (%)	46.873	15.743	13.576	7.615	7.200	5.111	3.881
Cumulative %	46.873	62.616	76.193	83.808	91.008	96.119	100.000
Eigenvectors:							
Income	0.365	-0.238	-0.540	0.291	0.452	-0.401	0.262
Saving	0.418	-0.335	0.163	-0.418	0.433	0.193	-0.536
Barter	0.211	0.725	0.357	0.245	0.490	0.034	0.036
Bio-fertilizer	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marital prices	0.430	-0.094	0.168	0.621	-0.439	-0.109	-0.434
Peacefulness	0.370	-0.280	0.594	-0.159	-0.130	-0.167	0.602
Gift	0.440	0.119	-0.336	-0.002	-0.192	0.750	0.283
Party	0.366	0.452	-0.246	-0.520	-0.349	-0.445	-0.109

Table 2. Pearson correlation of Components.

	F1	F2	F3	F4	F5	F6	F7
Income	0.660	-0.249	-0.527	0.212	0.321	-0.240	0.137
Saving	0.756	-0.351	0.159	-0.305	0.307	0.116	-0.279
Barter	0.381	0.762	0.348	0.179	0.348	0.020	0.019
Bio-fertilizer	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Marital prices	0.778	-0.098	0.163	0.453	-0.312	-0.065	-0.226
Peacefulness	0.669	-0.294	0.579	-0.116	-0.092	-0.100	0.314
Gift	0.797	0.125	-0.328	-0.001	-0.136	0.448	0.148
Party	0.662	0.474	-0.239	-0.379	-0.248	-0.266	-0.057

was Savings, followed by income and barter. Socio components having higher to lower marks were Gift, Prices, Peacefulness, and party. In Axis two (F2) negative weighing were presented, i.e. Income, Saving, Marital prices and Peacefulness. In economic objective component, barter was severely shown high weighing. Party was the component of weighing determining social objective.

Table 2 shown that the coefficient of correlation r (Pearson's r) reveals the relationship between the PCA scores and individual variable used to construct the axes (Goldberg and Rachel; Hurnik *et al.*, 1994). The correlation coefficient table can be quite helpful in providing a quick interpretation of the ordination. Axis of F1 has higher coef-

ficient correlation (Pearson (n)). Pearson (n) correlation (Figure 2) shown that components of income, savings, barter, except bio-fertilizer, had severely positive economic objective values. Marital prices, peacefulness, gift and party were component of social objectives having positive relationship.

3.6 Development of Future Pig Farming

It was used indicators of alternation in pig farming systems chategorised based on Udo (1997) and adapted by Iyai (2008). The finding of this research was that no alternation development, i.e. extensive to extensive pig farming systems was faced by 26 hh (43.33%). Alternation of intensive to extensive pig farming systems (declining rank)

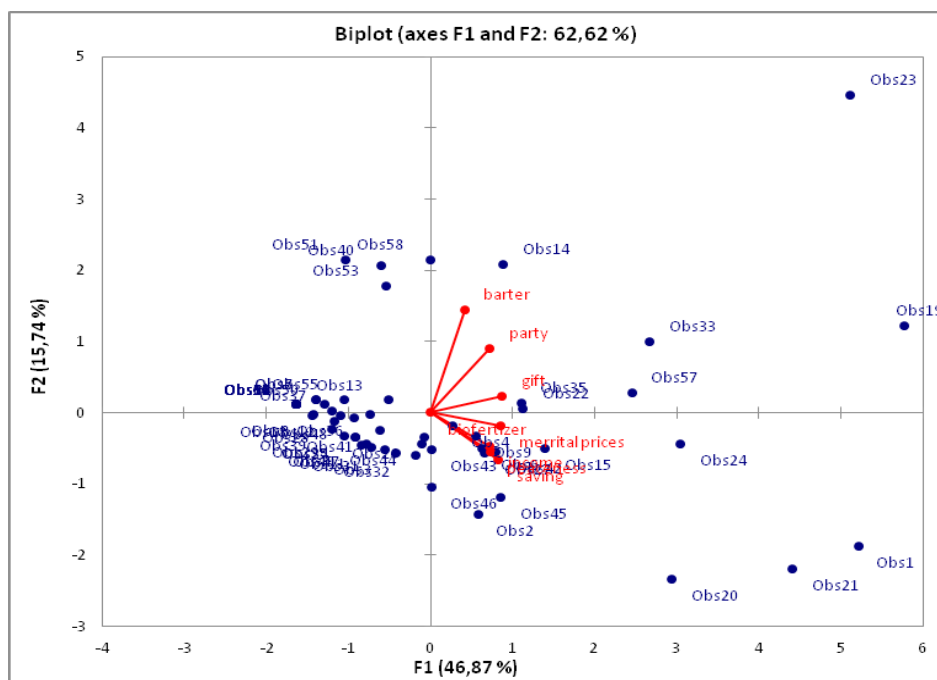
was faced by 13 hh (21.67%). Several pig farmers had semi-intensive (semi-penned) pig farming systems, i.e. 12 hh (20%). The rest was altered from extensive to semi-intensive, i.e. 9 hh (15%).

Components at the right angles are independent of one another. Observations dispersed close to those components had nearest relationship. This means that those observations had association with each other with related to technical and non technical components. Figure 3. i.e. Biplot graph is used to plot components /or ordination and observation /or species ordination in one ordination diagram.

The finding of unchangeable development of pig farming systems particularly extensive pig farming system was due to the costs for building the pig houses. Fixed and variable costs were the two reasons why pig farmers in Papua are facing constraints (Iyai, 2008; Iyai, 2011a,b). That situation induces pigs are frequently scavenging around the

backyard and other communal land. The alternation of intensive to extensive was due to housing damages. No cost and/or low investment practised by local Papuan particularly the Arfak induce social conflicts where the pigs are injured by accidents. The changes of pig farming systems from extensive to semi-intensive was due to the technical considerations. Similar experience described by Lemke and Zaratte (2008) in North Vietnam. Pigs need shelter for production and reproduction, which in line with Kunavongkrit and Heard (2000). Pigs should be maintained well in an appropriate way so that production will be maintained at the optimal production, example explains in North Vietnam (Lemke *et al.*, 2006) and Western Kenya (Kagira *et al.*, 2010). The changes of pig farming systems in Manokwari and might be in Papua has multiple implication. First of all and importantly is the farmers. The commitment and motivation, consciousness and efforts of investment are needed and should be guided

Figure 3. Distribution of observations and components in the Biplot, two-first Principal Component Analysis axes.



by other relevant and related parties as stakeholders and shareholders. In Manokwari the local regulation of shelter animal was issued by local government of Manokwari (Wona-torei, 2008).

Figure 3. i.e. biplot graph is used to plot components /or ordination and observation /or species ordination in one ordination diagram. In plots are the nearest observations placed. Besides, in Biplot inter-component distances and inter-observation distances could be seen. The findings were that in quadrant I components were independent with quadrant II. In another word, they are negatively correlated. In quadrant I, many observations were dispersed far from three components of socio-cultural objectives, i.e. barter, party, and gift. Quadrant I is dependent with quadrant III. Observations in quadrant III were dependent with quadrant I. Quadrant I is negatively correlated with quadrant IV. This in fact is logic in developing pig farming systems. Severe values of socio-cultural objectives, will not bring changes in pig farming development. Gift and barter and other socio-cultural objectives will decrease population and alternation of pig farming systems. Many pigs will be slaughtered including productive one. Iyai (2008) found that the average born piglets in Manokwari is 6 heads/cycle. Quadrant II is dependent with quadrant IV, while quadrant II is negatively correlated with quadrant III. No components existed in quadrant II. Quadrant III is negatively correlated with quadrant IV. There were no components exist in quadrant III. In quadrant IV, components of objectives of pig development are bio-fertilizer, income, saving and marital status. Components in quadrant IV have many ob-

servations that are interlinked, although few observations had no correlation. In quadrant I, several socio-cultural components existed are barter, party, and gift.

4. Conclusion

The objectives of raising pigs is dominated by socio-cultural objectives, i.e. marital prices, peacefulness, gift and parties, followed by economical objectives consist of income, savings, and barter. So far the use of manure as bio-fuel and bio-fertilizer is not applied yet. Barter, party and gift are independent and negatively correlated with economic objective. The pig development using indicator of pig farming system alternation is slowly changeable from extensive farming systems to intensive pig farming system.

References

- Awom, M. (2010). Prospek Usaha Ternak Babi Di Kota Manokwari. Laporan Penelitian. Fakultas Peternakan Perikanan dan Ilmu Kelautan. Universitas Negeri Papua Manokwari. Tidak dipublikasikan. (*in Indonesian*).
- Basna, A. (2010). Karakteristik Morfometri Ternak Babi Lokal (*Sus sp*) Pada Sistem Pemeliharaan Di umbar Dibawah Naungan Kelapa Sawit dan Dikandangkan di Lembah Prafi Kabupaten Manokwari. Laporan penelitian. Fakultas Peternakan Perikanan dan Ilmu Kelautan Universitas Negeri Papua Manokwari. Tidak dipublikasikan. (*in Indonesian*).
- Basna, Y. (2011). Sistem Pemeliharaan Ternak Babi oleh Suku Maybrat di Sorong Selatan, Papua Barat. Laporan penelitian. Fakultas Peternakan Perikanan

- dan Ilmu Kelautan. Universitas Negeri Papua Manokwari. Tidak dipublikasikan. (*in Indonesian*)
- Chiduwa, G., M. Chimonyo and T.E. Halimani. (2008). Herd Dynamic and Contribution of Indigenous Pigs to the Livelihood of Rural Farmers in A Semi Arid Area of Zimbabwe. *Tropical Animal Health Production* 40: 125-136.
- Gobay, B. (2011). Hubungan antara Motif Ekonomi dan Motif Sosial terhadap Perkembangan Ternak Babi Pada Masyarakat Suku Arfak di Manokwari. Laporan Penelitian. Fakultas Peternakan Perikanan dan Ilmu Kelautan. Universitas Negeri Papua Manokwari. Tidak dipublikasikan. (*in Indonesian*).
- Goldberg and Rachel. (1994). Proc Factor: How to Interpret the Output of a Real-World Example.
- Ho, R. (2006). Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS. Chapman and Hall/CRC. Taylor and Francis Group. Australia.
- Hurnik, D. I.R. Dohoo, A.Donald, and N.P. Robinson. (1994). Factor Analysis of Swine Farm Management Practice on Prince Edward Island. *Journal of Preventive Veterinary Medicine*. 20 (1994). 135-146.
- Iyai, D. A. (2008). Innovation of Pig Keeping System In Pig Farmers At Manokwari, West Papua Province, Indonesia. Tesis Wegeningen University. The Netherlands.
- Iyai, D.A. (2011a). Valuing and Defining Socio-Economical Factors of Pig Farming Systems in Manokwari, West Papua. *Jurnal Ilmu Peternakan*. Vol. 5. No. 1. Fakultas Peternakan Perikanan dan Ilmu Kelautan. Universitas Negeri Papua. (*in Indonesian*).
- Iyai, D.A. (2011b). Analyses of Technical and Non-Technical Components of Pig Keeping Systems in Manokwari, West Papua. *Jurnal Agrinimal*. Vol.1 No. 2. Hal. 42-51. Faperta-Unpatti, Ambon. Maluku.
- Iyai, D.A., D. Saragih, and M. Kayadoe. (2013). Quantifying Feeding Regimes on Weaned Sows Under Tropical Papua Pig Keeping Systems. *Animal Production* 15 (2): 106-118.
- Jolliffe, I.T. (2002). Principal Component Analysis. Second Edition. Springer.
- Kagira, J. M., P. W. N. Kanyari, I. Maingi, S. M. Githigia, J. T. Ng'ang'a, and J. W. Karuga. (2010). Characteristics of Smallholder Free Range Production System in Western Kenya. *Trop Anim Health Prod* (2010) 42: 865-873.
- Kanis, E., K.H. De Greef, A. Hiemstra and J.A. M. van Arendonk. (2008). Breeding for Societal Important Traits In Pigs. *J. Anim Sci* 2005. 83: 948-957
- Kumaresan, A., K.M. Bujarbaruah, K.A. Pathak, Bijoy Chhetri, S.K. Das, Anubrata Das and S.K. Ahmed. (2007). Performance of Pigs Reared Under Traditional Tribal Low Input Production System and Chemical Composition of Non-Conventional Tropical Plants Used As Pig Feed. *Livestock Science*, 107:294-298.
- Kasmiatum, (2003). Perbandingan Pola Pengembangan Peternakan Daerah Transmigrasi Atau Lokal Distrik Wanggar Kabupaten Nabire. Fakultas Peternakan Perikanan dan Ilmu Kelau-

- tan. Tidak dipublikasikan. (*in Indonesian*).
- Kunavongkrit, A. and T.W. Heard. (2000). Pig Reproduction in South East Asia. *Animal Reproduction Science*.60(61):527-533.
- Lekule, F. P. and Niels. C. Kyvsgaard. (2003). Improving Pig Husbandry in Tropical Resource-Poor Communities and Its Potential to Reduce Risk of Porcine Cysticercosis. Review article. *Acta Tropica* 87: 111-117.
- Lemke U., B. Kaufmann, L.T. Thuy, K. Emrich, A. Valle Zarate. (2006). Evaluation of Smallholder Pig Production Systems in North Vietnam: Pig Production Management and Pig Performances. *Livestock science*. 105:229-243.
- Lemke U. and A. V. Zarate. (2008). Dynamics and Developmental Trends of Smallholder Pig Production Systems in North Vietnam. *Agricultural Systems*. 96:207-223.
- Marani, O.Y. (2004). Pemeliharaan Ternak Babi Oleh Masyarakat Suku Arfak Di Kampung Gaya Baru Kelurahan Wosi Distrik Manokwari. Laporan penelitian. Fakultas Peternakan Perikanan Dan Ilmu Kelautan Universitas Negeri Papua Manokwari. (*in Indonesian*).
- Mesdaghi, (2001). Vegetation description and analysis; a practical approach
- Mubyarto, (1989). Pengantar ekonomi pertanian. Lembaga penelitian, Pendidikan Dan Penerangan Ekonomi Dan Sosial (LP3ES). Jakarta. (*in Indonesian*).
- Nakai, S. (2008). Reproductive Performance Analysis of Native Pig Smallholders in the Hillside of Northern Thailand. *Trop Anim Helath Prod*.
- Peters, D., N. T. Tinh, M. T. Hoan, and N. T. Yen. (2005). Rural Income Generation through Improving Crop-Based Pig Production Systems in Vietnam: Diagnostics, Interventions, and Dissemination. *Agriculture and Human Value*, 22:78-85.
- Randa, S.Y. (1994). Performance of Indigenous Pigs of Upland And Lowland Irian Jaya. MSc Thesis. Department of Animal Science. Los Baños, The Philippines.
- Ropa, M. (2001). Sistem Pemberian Pakan Pada Usaha Peternakan Babi Rakyat Di Kecamatan Manokwari. Laporan penelitian. Fakultas Pertanian. Universitas Cenderawasih. (*in Indonesian*).
- Sagrim, M. (2002). Respon Petani Terhadap Program Pembangunan Berbasis Agraria (Kasus Petani Suku Arfak di Manokwari Irian Jaya). (*in Indonesian*).
- Salabai, B. (2009). Babi Perdamaian Penginjilan Kontekstual Suku Arfak. Penerbit Theresia Yogyakarta. (*in Indonesian*).
- Sayori, A. (2013). Persepsi Beternak Babi pada Masyarakat Etnis Arfak, Manokwari. Tesis. Universitas Negeri Papua. Tidak diterbitkan. (*in Indonesian*).
- Soemartini, (2008). Principal Component Analysis sebagai Salah Satu Metode untuk Mengatasi Masalah Multikolinearitas. Skripsi. Jurusan Statistika. FMIPA UNPAD. Jatinangor, Jawa Barat. (*in Indonesian*).
- Sustrisno, A. I. N. (1997). Pertumbuhan Anak Babi Pra Sapih dan Lepas Sapih

- Pada Peternakan Babi Rakyat Di Kecamatan Manokwari. Skripsi Sarjana Peternakan Fakultas Pertanian Universitas Cenderawasih. (*in Indonesian*).
- Ter Braak, J.F. Cajo, P. Smilauer. (2003). Introduction to Canoco. Centre for Biometry, Wageningen University.
- Wabacha, J.K., J.M. Maribei, C.M. Mulei, N. Kyule, K.H. Zessin, and W. Oluoch-Kosura. (2004). Characterisation of Smallholder Pig Production in Kikuyu Division, Central Kenya. *Preventive Veterinary Medicine*. 63:197-210.
- Warastuti, D. F. (2001). Sistem Pemeliharaan Ternak Babi Di Pesisir Teluk Doreri Kabupaten Manokwari Skripsi Sarjana Peternakan. Fakultas Peternakan Perikanan dan Ilmu Kelautan Universitas Negeri Papua Manokwari. (*in Indonesian*).
- Wonatorei, M. (2009). Persepsi Peternak Babi terhadap Penertiban Hewan/Ternak Peliharaan (Studi kasus SK Bupati Manokwari No. 357 Tahun 2004). Laporan penelitian. Fakultas Peternakan Perikanan dan Ilmu Kelautan. Universitas Negeri Papua. (*in Indonesian*).
- XLstat. (2009). XLstat version 2009.1.02. Microsoft Excel®. Copyright Addisonsoft 1995-2009.
