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**Interaction effects of pig farming systems with educational level on performances of pig production systems in Manokwari District, West Papua-Indonesia**

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**ABSTRAK**

Tujuan dari penelitian ini adalah untuk mengkarakterisasi kinerja sistem peternakan babi yang ditambatkan di berbagai zona agroekologi di Papua. Studi lapangan dilakukan di Kabupaten Manokwari dan melibatkan enam distrik, yaitu distrik Manokwari Utara, Distrik Manokari Timur, Distrik Manokwari Barat, Distrik Warmare, Distrik Prafi, dan Distrik Masni. Responden yang dipilih dipandu oleh penyuluh lokal, yang berasal dari 15 desa. Analisis situasi partisipatif (ASP) digunakan untuk mendekati petani babi dengan menggunakan kuesioner. Bobot tubuh babi dan peternak babi ditimbang kecuali untuk babi dewasa, panjang tubuh dan ketebalan perapian diukur menggunakan pita. Jumlah kawanan, jumlah anak babi, babi dewasa dicatat. Analisis varian satu arah digunakan. Semua data dimasukkan dalam Excel dan dianalisis menggunakan SPSS versi 10.0. Temuan menunjukkan bahwa interaksi antara pendidikan dan sistem pemeliharaan terjadi pada jam dan usia kerja. Pengaruh pendidikan signifikan pada pengalaman, lokasi, dan etnis. Dalam menjaga sistem, efeknya nyata pada pengalaman, jam kerja, lokasi, dan etnis. Interaksi tidak signifikan ada dalam jumlah babi termasuk melihat perantara, konsumen yang dikunjungi, ukuran sampah, jumlah pelarian dan sumber pendapatan.

*Kata Kunci: etnis, jumlah anak babi/kelahiran, jumlah kebuntingan induk/kelahiran, pendidikan, sistim produksi babi*

**ABSTRACT**

The aim of this research was to characterize pig farming system performances tethered under different agro-ecological zones in Papua. The field study was done in Manokwari regency and involved six districts, i.e. Nothern Manokwari district, Eastern Manokari District, Western Manokwari district, Warmare district, Prafi district and Masni district. Respondents chosen were guided by local extensionists, originated from 15 villages. Participatory situation analysis (PSA) was employed to approach pig farmers by using questionnaire. Pig body weights of piglets and growers were weighed except for mature pigs, body lengths and hearth girths were measured using tape. Herd number, number of piglets, adult pigs were recorded. A one-way analysis of variances was used. All data were entered in Excel and analyzed using SPSS version 10.0.. The findings shown that interaction between education and keeping systems occur on work hours and ages. Effect of education is significant on experience, location, and ethnic. In keeping systems, effect is real on experience, work hours, location, and ethnic. Interaction do not significant exist in number of pigs including see middle man, visited consumer, litter size, number of farrowing and income sources.

*Keywords: education, ethnic, farrowing rate, litter size, pig production systems*

## INTRODUCTION

Pig production systems on tropical agro-ecosystems of each country reared are varying. These pig production systems depend on resources, in particular feeds such as crops (D. Iyai 2015a), residues and other potential edible plants and climate elements (Kruska et al. 2003). Areas where available with crops can have certain animal production systems. Shapes and alternation of pig production systems tend to be determined by climates and other important relevant factors. Wet and dry seasons tend to shape livestock production systems. Many agro-ecological components have identified contributed in performing livestock production systems in Asia (Devendra 2007). Several classifications of animal agriculture and definitions can be referred in the articles of Kruska et al. (2003) and (Devendra and Thomas, 2002).

Other typical agro-ecological elements can be classified into island, coastal and lowland zones. Region such Indonesia has many agro-ecological zones. They are the recognised as typical agro-ecological components. Many livestock and crops production systems are severely and evidently depended on these components. However, many production systems shaped are rarely studied and lagged behind of information. Its effects on livestock production systems were studied quite often on ruminants, such as cattle, dairy cattle, goat and sheep. In one hand, another livestock commodity which has prospect is pigs (Iyai, 2008). Region where pigs are farmed in Indonesia are scarce and limited. North Sumatera, Borneo, Bali, North Sulawesi, Molucca, Flores and Papua are dependent on this animal agriculture (Liano and Siagian, 2002).

Papua has several recognized agro-ecological zones. Similar to other Indonesian regions, islands and mainland are clearly separated. Using different agro-ecological zones, its effects have been attached by the knowledge and experience of Papuan farmers. One of their main livelihoods is raising pigs (Peters, 2001). Iyai (2008b), Iyai and Yaku (2015) has classified pig keeping

systems into four systems. Other important Papuan livelihoods are farming, fishing, hunting and gathering and in few numbers are working as public state officers. Ethnic of Papuan live at coastal, islands (including big and small islands), lowland and highland. Their pig farming tethered and benefits the various agro-ecological zones have shaped the production of pigs. However, its typical and features of these zones are lagging behind. Therefore, the aim of this research was to characterize pig farming system performances tethered under different agro-ecological zones in Papua.

## MATERIALS AND METHODS

### Study Sites

The field study was done in Manokwari regency and involved six districts, i.e. Northern Manokwari district, Eastern Manokwari District, Western Manokwari district, Warmare district, Prafi district and Masni district (Figure 1). Manokwari regency, which has a total area of 14,445 km<sup>2</sup> and possesses a population of around 161,000 inhabitants with a density of 11,51 inhabitants km<sup>-1</sup>, is located at 132°30' – 134°45' East Meridian and 0°20' – 2°25' South latitude. Manokwari has relatively dense population of around 228 inhabitants per km<sup>2</sup>. The population in Manokwari is growing in both urban and rural areas, especially in transmigration areas, such as Prafi and Masni districts. Respondents chosen were guided by local extensionists, originated from 15 villages. In urban areas selected farmers originated from Anggrem, Borobudur, Fanindi, Wosi, Amban and Susweni villages, while in rural areas selected farmers originated at Tanah Merah, Nimbai, Waseki, Aimasi, Mokwan, Mimbawi, SP-8 Masni, Bremi and Warbefor villages.

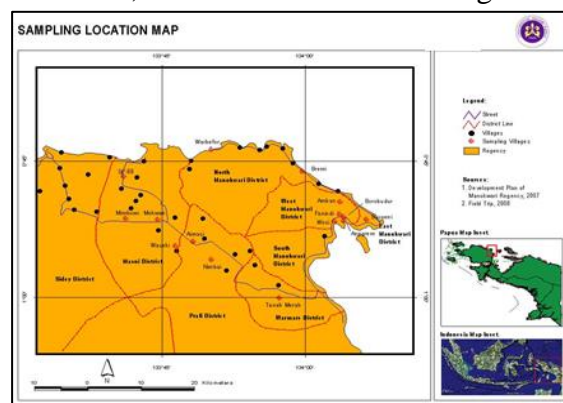


Figure 1. Research site location in Manokwari, West Papua

Three urban villages, Anggrem, Fanindi and Wosi, are situated on coastal areas of Manokwari as well as the two rural villages, i.e. Breimi and Warbefor, which are located in the Northern coastal line of Manokwari. Anggrem, Fanindi and Wosi are located at less than 5 m above sea level. Amban and Susweni are located at 110 m above sea level. The rural villages Breimi and Warbefor, are located less than 5 meter above sea level. While most villages in Prafi valley, such as Tanah Merah, Waseki, Nimbai, Aimasi, Mokwan, Mimbowi and SP-8 are located at about 20 to 25 meter above sea level.

### Research approach and parameters

Participatory situation analysis (PSA) was employed to approach pig farmers (Conroy, 2005). Interviews using questionnaire (Moleong, 1991) was done to gather information from all pig farmers. Pig body weights were weighed using 20 kg digital weighing except for mature pigs, body lengths and hearth girths were measured using tape. Herd number (in Topical Livestock Unit, TLU), number of piglets, adult pigs. Tropical livestock unit (TLU) of the pig is 0.25 from body weight.

### Statistical Analysis

General model of interaction proposed was as followed  $Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$  ;  $i=1,2,3; j=1,2; k=1, \dots, 5$ . Where  $Y_{ijk}$  is pig farming production parameters,  $\mu$  is intercept,  $\alpha_i$  = additive effect of farming systems (1=free range, 2=semi-pen, 3=pen),  $\beta_j$  is educational level (1=Papuan and 2=Non Papuan), and  $\gamma_{jk}$  = Interaction between farming system and educational level.  $\epsilon_{ijk}$  = effect of errors (Gaspersz 1991; Ott and Longnecker 2001). A one-way analysis of variances (Ott and Longnecker 2001) was used. Classification was based on pig keeping systems (Iyai, 2008). Mathematical formula was  $Y = \mu + \alpha_i + \beta_j + \gamma_{jk} + \epsilon_{ijk}$ , where  $Y$  is variable responses (Snedecor and Cochran, 1989), consisted of herd number (in Topical Livestock Unit, TLU), number of piglets,

adult pigs.  $\mu$  is overall mean,  $\alpha_i$  is effect of pig keeping systems, and  $\epsilon_{ijk}$  is errors with normal distribution,  $N(0, 1)$ . Qualitative and quantitative data were entered in Excel database (2003). Analysis of data using SPSS version 10.0., was used (Santoso, 2012; Asra and Sutomo, 2016).

## RESULTS AND DISCUSSION

The Levene's test of equality of error variances shown that variables such as household member, gender, ethnic and income sources were vary (Iyai, 2015b, 2020). However, variables such ages, experiences, no of pigs, no of Tropical Livestock Unit (TLU) of pigs, work hours, see middlemen, visiting consumers, litter size, number of farrowing, household size, location were homogeny (Iyai et al. 2013).1.

### Farmers characteristics

Farmers background of the recent study is presented consisted of household members (Hh\_mbr), experience, work hours, location of farming (urban and rural), gender, household size, ethnic and ages of farmers (Table 1.). The number of household member analyzed using GLM shown small numbers. No significant difference found at Hh\_mbr, gender, Hh\_size, and ages (Dione et al. 2014; Iyai et al. 2018; Iyai 2015).

Table 1. Description of pig farmers background

Variables (Unit)	Education Level		95% CI		pValue		Keeping systems		95% CI		pValue	
	$\bar{x} \pm SE$	LB	U	0.	Si	$\bar{x} \pm SE$	LB	U	0.	Si		
Hh_member (head/hh)	6.10±3.02	4.5	7.3	0.05	0.86	6.08±2.99	5.2	6.9	0.93	0.93		
Experience (yr/hh)	23.15±15.6	18.67	27.64	0.04	*	22.70±15	18.22	27.19	0.68	0.02		
Work_Hrs (hr/hh)	1.81±0.91	1.5	2.0	0.00	0.38	1.79±0.90	1.5	2.0	0.00	**		
Locations	1.59±0.49	1.4	1.7	0.00	**	1.59±0.49	1.4	1.7	0.80	0.00		
Gender	1.08±0.28	1.0	1.1	0.76	0.45	1.08±0.27	1.0	1.1	0.91	0.12		
Ethnic	1.29±0.46	1.1	1.4	0.00	**	1.29±0.45	1.1	1.4	0.03	*		
Age (yr/hh)	45.45±11.8	42.06	48.84	0.17	0.58	45.45±11.8	42.06	48.84	0.31	0.05		

Significant different based on education level found on indicators of experience

(23.15±15.61, pValue 0.045, location (1.59±0.49, pValue=0.001), and ethnic (1.29±0.46, pValue<0.05). However, according to pig keeping systems, significant difference reported on experience (22.70±1578, pValue), work hours (1.79±0.90, p<001), location (1.59±0.49, pValue=0.000) and ethnic. Widayati et al. (2018) found similar fact on their field visit in Manokwari, West Papua.

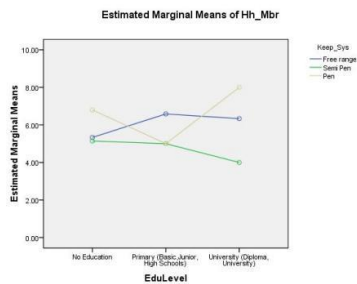


Fig.1. Interaction effect of educational level vs pig keeping systems on household member variable.

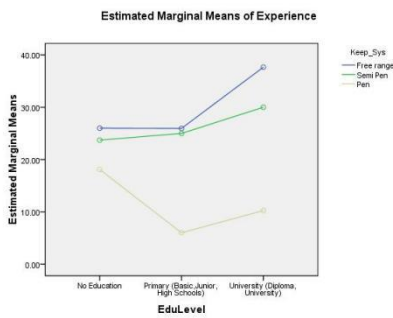


Fig.2. Interaction effect of educational level with pig keeping systems on farmers' experience

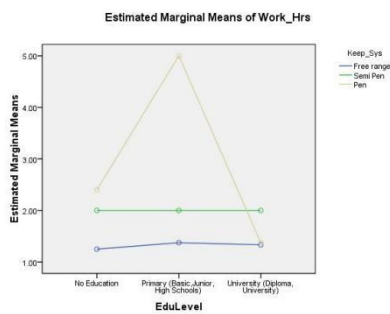


Fig. 3. Interaction effect of educational level vs pig keeping systems on work hours.

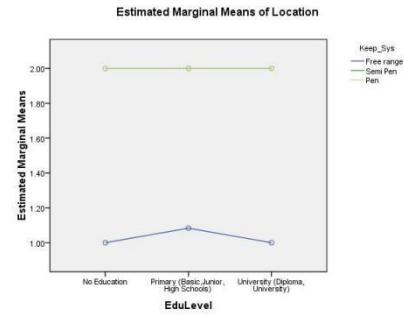


Fig. 4. Interaction effect of educational level vs pig keeping systems on urban and rural system.

### Pig production performances

Understanding pig production performances will enable decision making getting more easy and precise on selecting pig production traits and broad design on economic efficiency. Number of pigs (herding size) is an indicator explaining living asset that belongs and keeps a live by a farmer (Holt et al. 2019; Wabacha et al. 2004).

Table 2. Pig production performances in West Papua.

Variables (Unit)	Education Level	95% CI		pValue	Keep ing Systems	95% CI		p0.05	Si g.
		L	UP			L	UP		
No.Pigs (Tail/hh)	8±7.5	5.8	10.16	0.07	0.7	7.90±7.46	5.8	10.02	0.58
No.pigsT LU	2±1.87	1.4	2.54	0.07	0.7	1.98±1.87	1.4	2.54	0.58
See_Mid Man (Times/hh)	1.31±0.85	1.1	1.56	0.51	0.2	1.32±0.84	1.1	1.56	0.41
Visited_C onsumer (times/hh)	0.96±0.9	0.6	1.26	0.94	0.4	0.96±0.95	0.6	1.26	0.54
Litter_Siz e (tail/sow)	5.66±2.2	5.0	6.33	0.43	0.3	5.66±2.24	5.0	6.29	0.51
No_Farw ing (times/sow)	1.52±.61	1.3	1.69	0.97	0.9	1.52±0.61	1.3	1.69	0.92
Income_S ource	1.86±0.09	1.6	2.04	0.01	0.1	1.86±0.65	1.6	2.09	0.88

It seems that number of pigs kept by farmers was higher than that reported by Iyai (2009) in Manokwari, i.e. only 5 head/household. It seems that There is an effect and/or interaction of education level with keeping systems. Number of pigs based on

tropical livestock unit was then higher (>1 TLU).

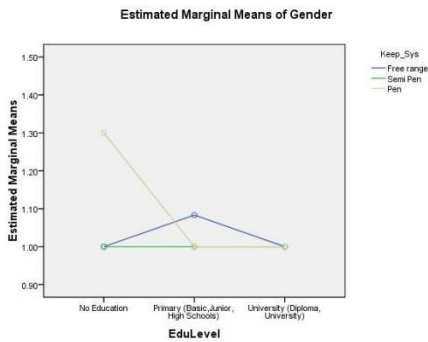


Fig. 5. Interaction effect of educational level vs pig keeping systems on gender.

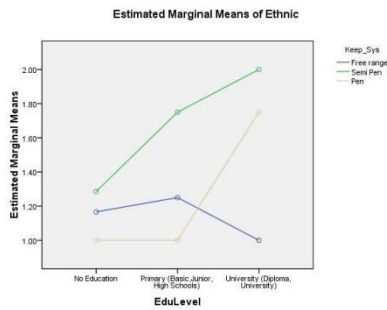


Fig.6. Interaction effect of educational level vs pig keeping systems on ethnic.

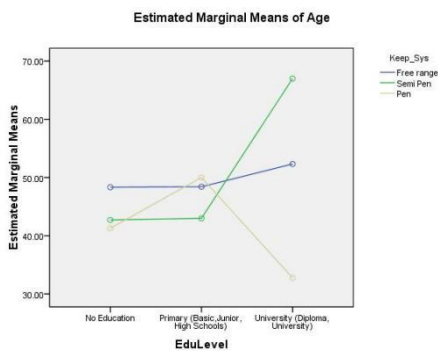


Fig. 7. Interaction effect of educational level vs pig keeping systems on farmers' ages.

### Interaction effect of farmers characteristic

Seeing interaction effect of education level and keeping systems will enable farmers to improve their pig productivities on scales and time. It seems that there is only two indicators that have significant effect on interaction, i.e. work hours and ages subsequently  $2.08 \pm 0.13$  and  $47.32 \pm 1.99$  (pValue < 0.05) (Iyai, 2010; Muhanguzi et al.

2012; Baxter and Edwards 2017; Olson et al. 2003). The rest were not significant proven.

Table 3. Interaction of education level and keeping system on pig farmers characteristic.

Variables (Unit)	EL* KS	95% CI		pValue (p0.05)
	$\bar{x} \pm \text{SEM}$	LB	UB	
Hh_member (head/hh)	$5.79 \pm 0.58$	4.62	6.98	0.838
Experience (Yr/hh)	$22.52 \pm 2.89$	16.67	28.37	0.677
Work_Hrs (Hr/hh)	$2.08 \pm 0.13$	1.82	2.34	0.005
Locations	$1.68 \pm 0.03$	1.62	1.73	0.956
Gender	$1.04 \pm 0.05$	0.94	1.15	0.598
Ethnic	$1.36 \pm 0.07$	1.21	1.50	0.092
Age (Yr/hh)	$47.32 \pm 1.99$	43.29	51.34	0.038

Household members leaving in farmer house as family and close relatives ( $5.79 \pm 0.58$  head in average and 95% confidence interval of lower bound 4.62-upper bound 6.98 heads) had no significant interaction (pValue > 0.05). It meant that the more education level obtained by farmers and escalation of keeping system from extensive till intensive farming systems had no effect on the dynamic number of household member living inside family of pig farmers. We found also an interesting trend on experience. Education levels and keeping systems of the pigs had not determined experience. It means that, changes in educations and keeping systems had no contribution on experiences. Experiences of a farmers will then be resulted from informal education and how farmers tethered their farming business (Fynbo and Jensen 2018; Boogaard et al. 2011; Kanis, Groen, and De Greef 2003; Lassen, Sandøe, and Forkman 2006; Correia-Gomes et al. 2017; de Greef et al. 2011). Another case found on work hours. The work hours between education level and keeping systems had strong interaction (pValue < 0.01). Location where farming business are established had no interaction effect on education level and keeping systems (pValue > 0.05). It meant that farmers with ranges of education and types of keeping systems could have similar chances in developing business of pig production. Gender in raising pigs based on education levels and keeping systems had no interaction effect (pValue > 0.05). Educating persons based on West Papuan circumstance are dominated by men. In running keeping systems,

men are engaging almost all process of pig production cycles.

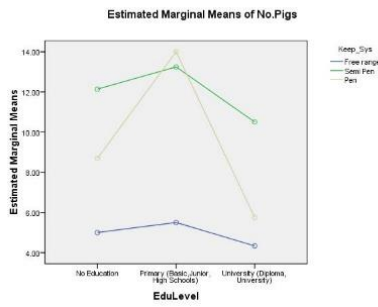


Fig. 8. Interaction effect of educational level vs pig keeping systems on pig herds size.

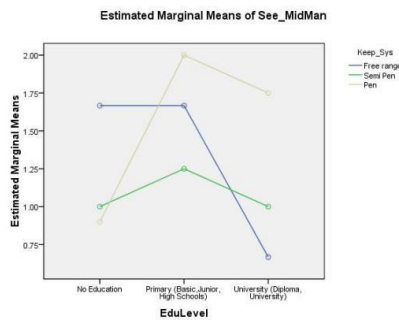


Fig. 9. Interaction effect of educational level vs pig keeping systems on see middle men interaction.

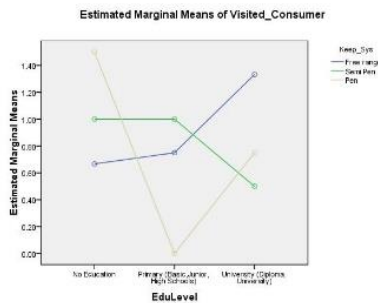


Fig. 10. Interaction effect of educational level vs pig keeping systems on visited consumers.

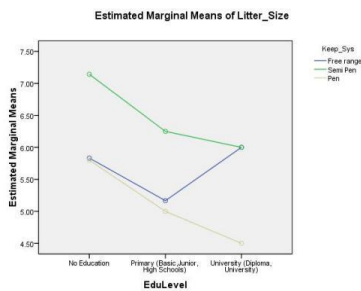


Fig. 11. Interaction effect of educational level vs pig keeping systems on Litter size.

We found no interaction between education level and keeping systems on ethnicity ( $pValue > 0.05$ ). It means that ethnic community that running pig business in Manokwari is still raising dominantly by local Papuan farmers. Ages of pig farmers had interaction effect on education level and keeping systems ( $pValue < 0.05$ ). Ages determined by education and keeping systems. The more educated a person will be, the more keeping systems will be shifted from extensive to intensive systems.

### Effect of interaction on pig production

Number of pigs (pig herds) as an indicator of pig production was observed. In average, number of pigs kept by farmers on each household was  $8.79 \pm 1.39$  by CI 95% of LB 5.97-UB 11.62 ( $pValue > 0.05$ ). This figure was higher found by previous study of Iyai (2008). If converted to TLU, in average the farmers kept  $2.19 \pm 0.35$  by CI 95% on 1.49 LB-2.90 UB ( $pValue > 0.05$ ).

Table 4. Interaction effect of pig production on educational level vs pig keeping systems.

Variables (Unit)	KS*EL	95% CI		pValue (p<0.05)
	$\bar{x} \pm \text{Std}$	LB	UB	
No.Pigs (tail/Hh)	$8.79 \pm 1.39$	5.97	11.62	0.968
No.pigs TLU	$2.19 \pm 0.35$	1.49	2.90	0.968
See_MidMan (Times/wk)	$1.32 \pm 0.15$	1.01	1.63	0.196
Visited_Consumer (Times/wk)	$0.83 \pm 0.18$	0.47	1.20	0.406
Litter_Size (tail/sow)	$5.72 \pm 0.40$	4.93	6.56	0.960
No_Farrowing (Times/sow)	$1.58 \pm 0.12$	1.36	1.79	0.090
Income_Source	$1.97 \pm 0.10$	1.76	2.18	0.155

See middle men (retailers) experienced by small-scale pig farmers in Manokwari. The figure shown no different of interaction between keeping systems with education level. It meant that middle men could have similar changes to approach farmers for transaction of selling-buying process. Litter size of the pigs kept by farmers was expected different due to interaction. However, the fact was different. No interaction ( $pValue > 0.05$ ) was found in litter size number. In average farmers could produce  $5.72 \pm 0.40$  head/sow/household. This figure has an effect as well on farrowing number per

sow/household. Farrowing rate which could achieved by local pig farmers was  $1.58 \pm 0.12$  times/year/sow/household (CI 95% on 1.36 LB-1.79 UB). It meant that farrowing rate of each gilt and/or sow was lower than that expected by the farmers.

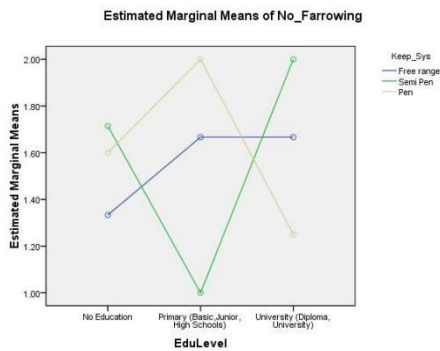


Fig. 12 Interaction effect of educational level vs pig keeping systems on number of farrowing.

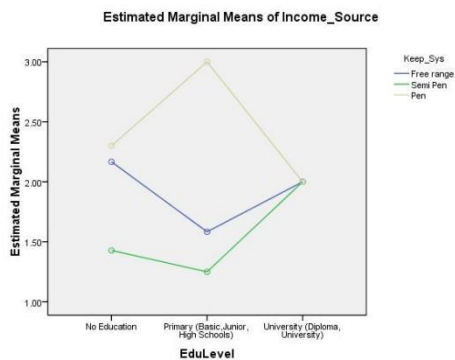


Fig. 13 Interaction effect of educational level vs pig keeping systems on income sources.

Income source found no difference of interaction between educational level with pig keeping systems. It is apparently seen that development of pig keeping systems in West Papua established without linearity with level of education. The effect is too small and depended on other factors.

## KESIMPULAN

We conclude that interaction between education and keeping systems occur on work hours and ages. In separate analysis effect of education is real on experience, location, and ethnic. In keeping systems, effect is real on experience, work hours, location, and ethnic. Interaction do not real occur in number of pigs including see

middle man, visited consumer, litter size, number of farrowing and income sources.

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