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RESEARCH PAPER

The comparative study of geographically and demographically of the animal protein consumption from livestock source

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ABSTRACT

Livestock is one of the essential sources for protein in Jambi Province. However, the information on the consumption behavior of animal protein by local people was not available. Hence, the study aimed to analyze the behavior of consumption of protein sources from livestock between geographically and demographically separate regions. The research survey conducted for six months using cross-section data with the unit of analysis is the household. The multistage cluster random sampling (CRS) technique was used to select three types sub-districts (urban, migrant, and native rural) in three districts representing the western, central, and eastern. The selected numbers of 150 households where are allocated equally with 50 elected for each district. Simultaneous equations model of AIDS (Almost Ideal Demand System) was used to analyze the difference in the proportion of consumer spending for food material sources of animal protein from livestock. The AIDS model estimated by Seemingly Unrelated Equation (SUR) technique using the SAS/ETS 9.12. The result showed that geographically, the household expenditure for eggs significant differences among the others and the highest occur in eastern regions; while demographically, the household expenditure for meat in rural areas was significantly higher than in the urban, but for dairy significantly higher than in urban areas. The household expenditure for eggs more responsive to the other prices, but the meat more responsive to own and dairy prices. It is concluded that demographic factors are more influential than geographic factors on the behavior of animal protein consumption from livestock.

Keywords: Geographically, Demographically, Livestock, Protein, AIDS

INTRODUCTION

Empirical evidence shows that the quality of human resources greatly determines the progress of a nation, and to produce high-quality human resources has to be supported by adequate nutrition, especially animal protein. Zollitsch *et al.* (2016) emphasized the necessity of including protein quality changes resulting from the transformation of plant proteins to animal proteins when evaluating the net contribution of livestock to the human food supply. Furthermore, these differences in protein quality might also need to be considered when choosing a functional unit for the assessment of environmental impacts of the production of different proteins. As income per capita of a country increases, its food consumption transitions. Key features of this food transition are increased caloric intake and increased consumption of animal protein (Zulauf, 2015). Although tied to rising per capita income over time, the food transition can be illustrated by comparing food consumption across regions at a point of time.

The per capita supply of vegetable protein is slightly higher in developing countries, while the supply of animal protein is three times higher in industrialized countries (FAO, 2003). There is a strong positive relationship between the level of income and the consumption of animal protein, with

the use of meat, milk, and eggs increasing at the expense of staple foods. Urbanization is a major driving force influencing global demand for livestock products. Compared with the less diversified diets of the rural communities, city dwellers have a varied diet rich in animal proteins and characterized by higher consumption of meat, poultry, milk, and other dairy products. Meat demand is associated with higher incomes and a shift due to urbanization to food consumption changes that favor increased proteins from animal sources in diets (OECD, 2018). Global meat consumption is predicted to double by 2050, not only will the corresponding increase in production represent a significant challenge in terms of negative impacts on soils, water, biodiversity, and animal welfare, but it will also have a range of adverse health impacts. The major sources of animal protein consumption in Indonesia, basically a fish-based consumption bundle, with poultry and dairy products gaining increasing importance and with beef and pork making a small contribution (Fabiosa, 2005).

Geographically, based on the sea level, the Jambi Province divided into three regions, namely; (a) the eastern region (lowland <100 asl) such as Western and Eastern Tanjung Jabung Regency, (b) the middle or center region (moderate land 100 - 500 asl) such as Jambi City, Muaro Jambi and Batanghari Regencies, and (c) the western region (highland > 500 asl) such as Sungai Penuh City, Kerinci, Merangin, Sarolangun, Bungo and Tebo Regencies. Demographically, the smaller scoping the settlement typology and cultural can be classified are homogeneous on the rural (native or traditional and migrant or transmigration) and heterogeneous on the urban areas. Consumer behavior in each region and areas varies and so influenced by internal (the consumer itself), and external factors (culture), for example; the number of household members, work and school, and several other economic factors such as income, level of expenditure for food, and prices of some animal protein-based food products (Muzayyanah *et al*., 2017). One external factor according to Utami (2018) is a culture which is a symbol and complicated fact created by humans, passed down from generation to generation as a determinant and regulator of human behavior in existing societies.

The consumption patterns can be analyzed using the Almost Ideal Demand System (AIDS) model that was first introduced by Deaton and Muellbauer (1980) using the dual formulation of consumption allocation problems. The advantage of AIDS was provided the first order approximation arbitrarily for any demand system, provides accurate estimations of axioms of choice, aggregates consumers perfectly, and has a functional form which is consistent with household budget data (Şahinli and Özçelik, 2015). According to Zhou (2015) uses both models of non-linear AIDS and LA-AIDS to examine the demand system analysis of beef, pork, chicken, ocean shrimp, and penaeid shrimp in the U.S. food market, mainly focusing on the own and cross relationship between the expenditure share and price, expenditure changes from the above five food commodities. Hence, the present study aimed to analyze the behavior consumption patterns on the protein sourced from livestock in three areas geographically and demographically in Jambi Province.

MATERIALS AND METHODS

Time and Site

The survey research was carried out for six months from April to September 2016 with the location of activities in three districts in Jambi Province, namely Merangin, Muaro Jambi, and Tanjung Jabung Timur Districts.

Data collection

Data collected in the study consisted of primary and secondary data. Primary data is obtained through direct field observation activities using a questionnaire. The unit of analysis in the study is that households with target respondents are housewives as managers of household consumption expenditure. The questionnaire consists of two parts, namely questionnaire identity and household characteristics, and a list of household expenditure records for 14 days (2 weeks). Furthermore, the secondary data obtained from various related institutions. The sampling technique uses multistage cluster random sampling, as presented in Figure 1.

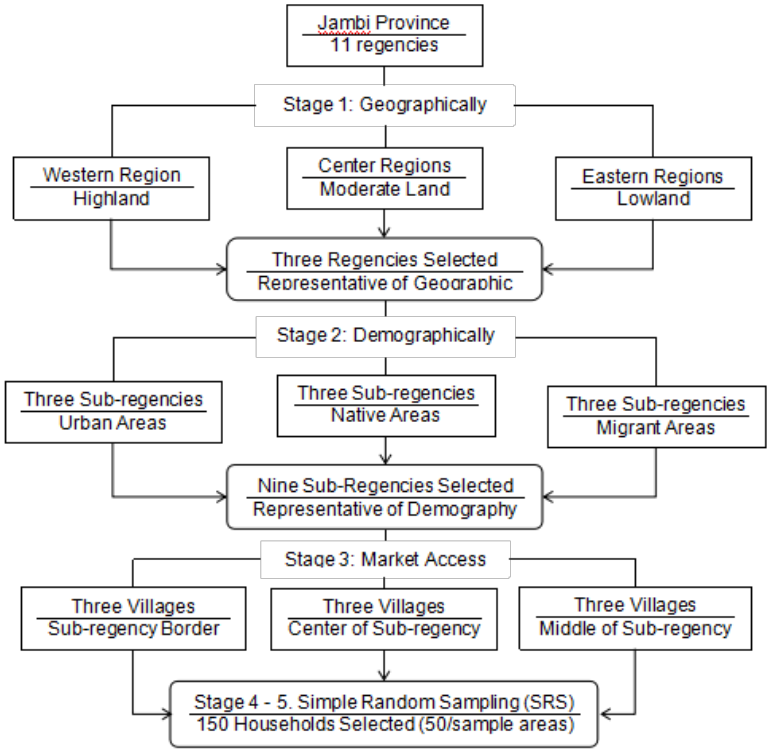

Figure 1.
Muti-stage cluster random sampling technique

In the first stage, there were three districts from 11 regencies in Jambi Province which represented three geographical regions namely Merangin (West), Muaro Jambi (center), and Tanjung Jabung Timur (east). The second stage is the selection of three sub-districts in each of three selected regencies, which represent three demographic characteristics, namely; urban, transmigrant, and indigenous (native). The third stage is the selection of three villages from nine selected sub-districts to illustrate the market access, namely the sub-district center, the sub-district border, and intermediate. Furthermore, for each chosen village household selection was carried out using simple random sampling.

Model and Estimation Method

AIDS model specification by approximate first differentiation of the linear demand of the livestock food material sourced protein, formulated as:

$sEXP_{1\text{-}3} = \alpha_{i,j} + \theta_1 DGEO_{1,j} + \theta_2 DGEO_{2,j} + \theta_3 DDEM_{1,j} + \theta_4 DDEM_{2,j} + \theta_5 DHWE_{1,j} + \theta_6 DHWE_{2,j} + \beta_1 LnP^* + \gamma_{1,j} LnPIEG + \gamma_{2,j} LnPIME + \gamma_{3,j} LnPIMI + \delta_{1,j} LnHINC + \delta_{2,j} LnHAGE + \delta_{3,j} LnTELP + \delta_{4,j} LnCPHM + \varepsilon_{i,j}$

$sOEx = 100 - sEXP_{1\text{-}3}$

Where"s:

$sEXP_{1\text{-}3}$ = Share of expenditure of animal protein sources of livestock food (%)
sOEX = Share of other food expenditure (%)
α = Constant or intercept
β = Coefficient estimate for stone price index's
γ = Coefficient estimate for price factors
δ = Coefficient estimate for non-price factors
θ = Coefficient estimate for dummy variable
$DGEO_1$ = First dummy of geography (1 for middle region and 0 the others)
$DGEO_2$ = Second dummy of geography (1 for western region and 0 the others)
$DDEM_1$ = First dummy of demography (1 for urban area and 0 the others)
$DEEM_2$ = Second dummy of demography (1 for migrant area and 0 the others)
$DHWE_1$ = First dummy of housewife education (1 for bachelor and 0 the others)
$DHWE_2$ = Second dummy of housewife education (1 for high school and 0 the others)
Ln P* = $\sum_j \omega_j \triangle \ln P_j$ = Stone's Price Index where's ω_j = lagged period and P_j = food prices.
PIEG = Price Index of Eggs (IDR)
PIME = Price Index of Meat (IDR)
PIMI = Price Index of Milk (IDR)
HINC = Household Incomes (IDR)
HAGE = Housewife Ages (years)
TELP = Total expenditure allocation of the animal protein source from livestock (IDR)
CPHM = Child Proportion of household members (%)
ε_{ij} = Error term

The AIDS model estimate is *a Seemingly Unrelated Regression (SUR)* technique using the SAS/ETS 9.12 program. Determine the response to household consumption expenditure changes due to the price (price's elasticity) of the AIDS model (Eales and Unnevehr, 1991), were:

1. Price and cross elasticity $\varepsilon_{ij} = -\theta_{ij} + \{\gamma_{ij} - \beta_i(\omega_j - \beta_j \ln(x/P)\} \omega_i$
2. Expenditure elasticity $\varepsilon_i = 1 - \beta_i/\omega_i$
3. Compensation price elasticity $\varepsilon_{ij}^* = \varepsilon_{ij} + \omega_j \varepsilon_i$

Where's

ε = Elasticity
γ = Price coefficient of the animal protein source
β = Stone's Price Index Coefficient
θ = Dummy variable coefficient .
ω = Quantitative proportion of household consumption
ϖ = Proportion of the household expenditure on the animal protein source

The foodstuff criteria based on elasticity were elastic if $\varepsilon > 1$ and in-elastic if $\varepsilon < 1$, and substitution goods if $\varepsilon < 0$ and complementary if $\varepsilon > 0$.

RESULTS

Characteristics of Consumer and Households Expenditure

Geographically, the administrative area of Jambi Province can be distinguished on the Western, Central, and Eastern regions which have different characteristics from one region to another showed in Table 1. Some variables that can be used to see a variety of the consumer character and potentially affect consumer behavior are the ratio of the husband to housewife ages, the children (< 15 years) proportion in the household, and the role of the wife in the household economy and the housewife educations. The age ratio indirectly affects the pattern of decision making of the housewife who is responsible for managing household consumption expenditure. In general, the smaller the ratio, the easier the communication will be in the household so that the process of division of tasks is clearer and decision making by her will be more independent. There is not much difference between regions, both from the average variable of ages of housewife and husband, and the ratio of both variables. The pattern of consumption related to the size and structure of the household. The difference in size explained by several household members will encourage an increase in needs, but in real terms, the structure of family members will be one of the considerations. The size of consumer households in the central region (4.70 people) is more significant than in the other areas and is followed by a higher proportion of child (33.29%). The consumer of an animal protein source is recognized as one to meet the needs of both health maintaining and growth accelerating. Allegedly a household with a higher proportion of child will spend more income earned on livestock food, especially dairy products.

Table 1. Characteristics of household consumers of food material source of animal protein from livestock in each region

Household Characteristics	Region			Average
	Easter	Western	Central	
Age (years)				
a. Housewife	36.72	37.78	37.94	37.48
b. Father of the head a household	40.24	47.98	46.60	44.94
Age Ratio (b/a)	*1.10*	*1.27*	*1.23*	*1.20*
Households member (person)	3.68	4.54	4.70	4.31
a. Adult	2.60	3.32	3.14	3.02
b. Children	1.08	1.22	1.57	1.29
Children Proportion (%)	*29.35*	*26.87*	*33.29*	*29.84*
Households Income (Million IDR/month)	4.15	2.86	2.84	3.28
a. Father of had a households	3.13	2.74	2.72	2.86
b. Housewife	1.02	0.12	0.12	0.42
Housewife Contribution (%)	*24.55*	*4.20*	*4.33*	*33.08*
Housewife Education				
High (Academy and Bachelor)	18.00	22.00	26.00	22.00
Middle (Senior or Junior High School)	74.00	66.00	74.00	71.33
Low (Elementary)	8.00	12.00	0.00	6.67

Sources: Primary data processing (2014)

Generally, in Indonesia, the most significant contribution to household income comes from husbands. The highest average household monthly income in the west region (IDR 4.15 million) with the housewife contributions reaching 24.55%. This means that in this region, the role of housewife to supporting the family economy is large relatively, while the average income of the husband between areas does not have much difference. Livestock products are known as common goods, so housewife income is usually directly proportional to household expenditures. On the other hand, the wife contribution to the household economy will influence the pattern of consumption through an easier to make a decision. The decision making of households expenditure is also related to the knowledge and awareness of the importance of animal protein. The level of housewife education can be used as an indicator. In general, the housewife education level is still dominated by middle level (junior and senior high school). The housewife proportion that has a higher education is that the diploma or university is relatively low with the largest proportion in the central region. This is related to education accessibility, wherein the middle region which is a center of the economic area relatively have better access. The difference in housewife education is expected to give a different impact on the knowledge and awareness of the importance of animal protein consumption. The meat consumption was more dominated by poultry meat (broiler and native chicken) than large and small ruminant meat. The egg consumption which is more dominated by chicken eggs such as chicken and ducks farming the household owned. The compare geographically and demographically of the households expenditure for three grouped of animal protein sources showed in Table 2.

The most significant total household expenditure for two weeks is in the middle region (IDR. 955,000) followed by spending on animal protein source foods from livestock. The proportion of household expenditure for animal protein source food from livestock is relatively low (20.02%) with contributed by meat (8.94%) and eggs and dairy respectively 5.73% and 5.35%. Geographically comparison shows that the most significant total expenditure is the middle region but not on their proportion to all spending; the largest is the central region (Figure 2).

Table 2. Household expenditure for animal protein sources from livestock

Region or area	Expenditure for two weeks				Other Exp.	Total Exp.
	Eggs	Meat	Dairy	Total		
Geographically (IDR)						
a. Eastern Region	51,910	53,980	47,140	153,030	571,838	724,868
b. Center Region	37,500	98,000	31,500	167,000	788,000	955,000
c. Western Region	38,000	53,000	54,000	145,000	808,500	953,500
Demographically (IDR)						
a. Urban	42,845	56,898	40,272	140,015	710,003	850,018
b. Migrant	47,624	81,144	57,833	186,602	633,129	819,730
c. Native	38,021	78,925	43,337	160,283	656,622	816,904
Animal Protein Expenditure						
a. Value (IDR)	42,709	63,600	43,527	677,893	149,835	827,728
b. Proportion (%)	5.73	8.94	5.35	20.02	79.98	100.00

Source: Primary data processing

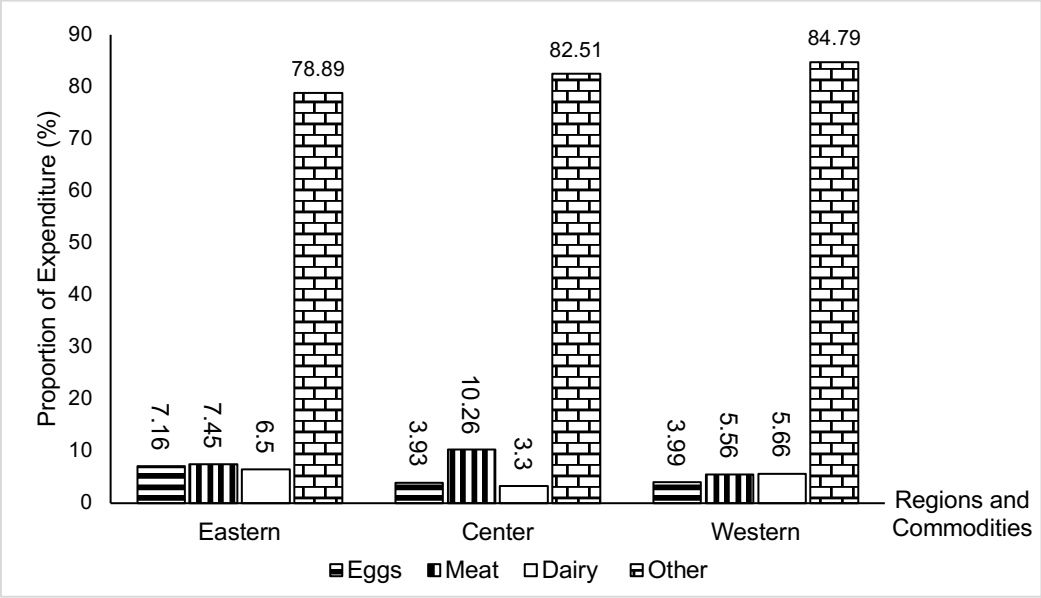

Figure 2. Geographically comparative the households expenditure proportion for food sources animal protein form livestock

Table 3. The SUR estimation result for household expenditure behavior for food material sources animal protein form livestock

Variables	Eggs		Meats		Dairy	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Intercept	0.1445	0.8550	4.0533	0.0004	-3.5275	0.0238
DGEO1	***-0.0644***	***0.0007***	0.0366	0.1657	0.0112	0.7589
DGEO2	***-0.0514***	***0.0026***	0.0074	0.7528	0.0339	0.3021
DDEM1	-0.0017	0.8852	***-0.0349***	***0.0376***	***0.0391***	***0.0919***
DDEM2	0.0117	0.3401	-0.0150	0.3863	0.0067	0.7789
LnP	***0.2030***	***0.0001***	***-0.3008***	***0.0001***	***0.0694***	***0.0118***
PIEG	0.0654	0.2840	-0.1046	0.2245	0.0371	0.7552
PIME	***0.1091***	***0.0441***	***-0.1821***	***0.0175***	0.0837	0.4267
PIMI	***0.0419***	***0.0376***	***-0.0505***	***0.0749***	-0.0095	0.8085
HINC	-0.0123	0.2502	-0.0058	0.6987	0.0170	0.4146
HAGE	-0.0268	0.2132	-0.0146	0.6297	0.0350	0.4043
TELP	***-0.1733***	***0.0001***	***0.1178***	***0.0001***	***0.1104***	***0.0004***
CPHM	***0.0047***	***0.0840***	0.0038	0.3221	0.0000	0.1218
DHWE1	***0.0376***	***0.0639***	-0.0013	0.9649	-0.0280	0.4776
DHWE2	0.0173	0,3514	-0.0307	0.2403	0.0212	0.5588

Note: Bold and Italic show that significant at 90% confidence level (P < 0.100).
Sources: Estimate Result of SUR Technique

In the eastern region, the food expenditure proportion for animal protein sources from livestock is almost evenly distributed for each commodity group with a total proportion of 21.11%, likely in the western region but with a smaller portion of 15.21%. Significant differences between

commodity groups occur in the expenditure for the consumption of animal protein in the central region where the proportion of 17.49% is mostly used for meat commodity expenditure (10.26%). Some things that are thought to be the cause are differences in the tastes of household consumers and the ease of obtaining these meat commodities. Household expenditure of the urban areas with a relatively heterogeneous population is totally greater than in other regions, but for food expenditures, it turns out to be lower especially when compared to the relatively more homogeneous on the native and migrant areas. This seems to indicate that the diversity of tribes, races, and religions in urban areas do not have an impact on increasing expenditure for animal protein source from livestock. Another factor that is suspected to be the cause is the cheaper prices of animal protein source food products in urban areas so that even though the volume is large but the total expenditure will be smaller. Demographically, comparative of the proportion of household expenditure for animal protein source from livestock (Figure 3).

Based on Figure 3, it can be seen that there is not much difference between commodities in each demographic except for native areas where the proportion of food expenditure is higher in meat than egg and milk commodities. The expenditures proportion for meat commodities reached 9.69% of all consumption of food sources of animal protein which reached 19.62%. Actually, likely happened in transmigration areas, so it can be stated that in the relatively homogeneous demographic area, the proportion of meat commodity expenditure is relatively higher. Some things that can be suspected as the causal factors are because of both rural characteristics areas, so the consumption of eggs can be fulfilled partly from the results of their livestock cultivation, and this is not found in urban areas. The more expensive factor in the price of meat commodities and the structure of households with a proportion of children is more likely to be another contributing factor that has increased the percentage of expenditure on livestock meat commodities.

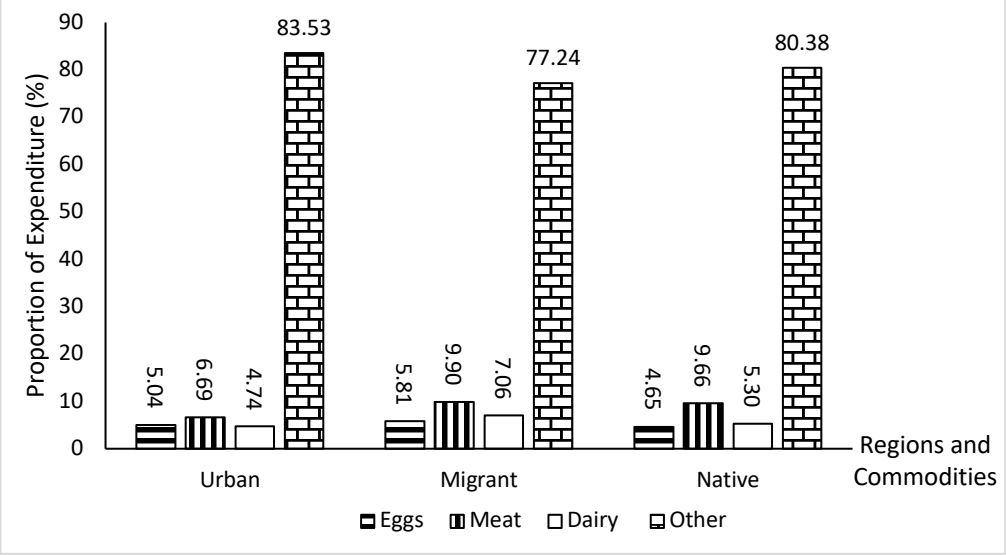

Figure 3. Demographically comparative the households expenditure proportion for food sources animal protein form livestock

Household Expenditure to Animal Protein Source Behaviors, Price and Expenditure Elasticities of Animal Protein Sources

The geographically and demographically comparative of the consumption patterns can use the indicators the household expenditure proportion for each commodity. The result estimation of the consumption expenditure pattern for food material sources of animal protein from livestock was presented in Table 3. Factors affecting household consumption expenditure are grouped on 3, namely geographic and demographic factors, price factors (themselves and other products) and non-price factors (household characteristics). The results of calculating the price elasticity both at their own price and the other livestock products (Table 4) show that all foodstuffs sources of animal protein from livestock are in-elastic (e <1).

Table 4. The Elasticity of Price and Cross-Price, Expenditures and Compensated

Elasticity	Geographically			Demographically		
	East	Center	West	Urban	Migrant	Native
Price Elasticity						
Own price elasticity						
a. Egg	-0.512	-0.166	-0.193	-0.350	-0.395	-0.277
b. Meat	0.763	0.931	0.565	0.612	0.874	0.854
c. Dairy	-0.399	-0.165	-0.358	-0.191	-0.404	-0.259
Cross price elasticity of egg						
a. to meat price	-0.909	-0.379	-0.399	-0.611	-0.693	-0.524
b. to dairy price	-0.737	-0.281	-0.308	-0.491	-0.564	-0.415
Cross price elasticity of meats						
a. to eggs price	0.362	0.390	0.286	0.306	0.424	0.400
b. to dairy price	0.645	0.759	0.483	0.515	0.744	0.718
Cross price elasticity of dairy						
a. to eggs price	-0.339	-0.137	-0.311	-0.156	-0.348	-0.216
b. to meat price	-0.431	-0.182	-0.383	-0.213	-0.433	-0.282
Expenditure elasticity						
a. Eggs	0.572	0.221	0.233	0.376	0.458	0.323
b. Meats	0.366	0.540	0.150	0.203	0.462	0.448
c. Dairy	0.517	0.049	0.446	0.268	0.508	0.345
Compensated price elasticity						
Own price elasticity						
a. Eggs	-0.241	-0.108	-0.131	-0.228	-0.223	-0.180
b. Meats	0.785	0.962	0.581	0.630	0.900	0.880
c. Dairy	-0.399	-0.165	-0.358	-0.191	-0.404	-0.259
Cross elasticity of eggs						
a. to meat price	-0.638	-0.322	-0.337	-0.489	-0.522	-0.427
b. to dairy price	-0.465	-0.223	-0.246	-0.369	-0.392	-0.318
Cross elasticity of meat						
a. to eggs prices	0.384	0.420	0.302	0.323	0.450	0.425
b. to dairy prices	0.667	0.789	0.500	0.533	0.770	0.743
Cross elasticity of dairy						
a. to eggs price	-0.339	-0.137	-0.311	-0.156	-0.348	-0.216
b. to meat price	-0.431	-0.182	-0.383	-0.213	-0.433	-0.282

Sources: Calculating by MS Excel based on SUR coefficient estimate

Another advantage of the SUR estimation method is that there is a relationship between food that shows changes in other food expenditure due to changes in expenditure on one of the other animal protein sources. The correlation between foodstuffs in the form of a correlation matrix estimation results as in Table 5. Every percent increase in egg expenditure both due to price and amount will encourage households to reduce 0.6446 percent dairy expenditure and compensate by increasing 0.3049 percent spending on meat. This indicates that there is a relationship of substitution between eggs and meat, while complementary between eggs and dairy. The relationship pattern of expenditure between egg and meat was strengthened by changes that occurred due to an increase meat consumption spending which encouraged households to increase the share of egg expenditure by 0.3049 percent and was followed by a decrease in the share of dairy expenditure by 0.9236 percent. On the other hand, if dairy food expenditure increases, it will be compensated by reducing egg expenditure by 0.6446 percent and meat by 0.9236 percent. The difference between compensated and uncompensated price elasticity in this research is shown in Table 6.

Table 5. Matrix of Inter-Correlation Between Animal Protein Sources from Livestock

Product	Share of Expenditure		
	Eggs	Meats	Dairy
Eggs	1.0000	0.3049	-0.6446
Meats	0.3049	1.0000	-0.9236
Dairy	-0.6446	-0.9236	1.0000

Sources: Estimate result of SUR technique

Table 6. The reduction result of compensated price elasticity with uncompensated price elasticity

Elasticity and product	Geographically			Demographically		
	East	Center	West	Urban	Migrant	Native
Own price elasticity						
a. Eggs	0.271	0.058	0.062	0.122	0.172	0.097
b. Meats	0.022	0.031	0.016	0.018	0.026	0.026
c. Dairy	0.000	0.000	0.000	0.000	0.000	0.000
Cross elasticity of eggs						
a. to meat price	0.271	0.057	0.062	0.122	0.171	0.097
b. to dairy price	0.272	0.058	0.062	0.122	0.172	0.097
Cross elasticity of meat						
a. to eggs prices	0.022	0.030	0.016	0.017	0.026	0.025
b. to dairy prices	0.022	0.030	0.017	0.018	0.026	0.025
Cross elasticity of dairy						
a. to eggs price	0.000	0.000	0,000	0.000	0.000	0.000
b. to meat price	0.000	0.000	0,000	0.000	0.000	0.000

Source: price elasticity data processing

DISCUSSIONS

Geographically, the significant difference in expenditure consumption of animal protein sources only in egg food material. The highest egg food expenditure was in eastern and was significantly higher at 5.14 percent compared to other regions, followed by western regions which were significantly 6.44 percent higher than the middle region. The expenditure proportion of meat and dairy expenditure does not have a significant difference among regions, with the highest order from the middle, west and east regions. This is thought to be the main cause which causes the egg expenditure to have the opposite rating and differences between regions become significant. Demographically, significant differences between urban and rural areas only occur in expenditure for meat and milk but have opposite directions. Whereas there were no significant differences among fellow rural areas between migrant and native areas. The proportion of milk expenditure is highest in urban areas with expenditure levels of 3.91 percent higher than in rural areas. Furthermore, migrants were followed which were only 0.67 percent higher than the native areas. In contrast, the meat expenditure in rural areas is higher by 3.49 percent compared to urban areas. Furthermore, among rural areas, although not significant, the native areas of meat consumption are 1.50 percent higher than the migrant areas. For egg expenditure there is no significant difference between the three regions but based on the highest order, the migrants are followed by the native and urban regions respectively.

A tentative conclusion can be drawn based on the above discussion both geographically and demographically factors as follows: a) geographical factors only cause significant differences in expenditure on egg consumption, where the highest expenditure occurs in eastern regions, b) demographic environment lead to significant differences in consumption between regions with the residents living in relatively heterogeneous and homogeneous populations, and c) the proportion of household expenditure for meat in the homogeneous demographic region is significantly higher than heterogeneous, but for dairy that is significantly higher in heterogeneous than homogeneous areas. The research finding by Nayga and Capps (1994), indicate that the following variables significantly affect the number of meals purchased namely region, race, ethnicity, sex, household size, age, income, and time of week of consumption. The determinants of functional food or supplement use depended on the type of product, so generalization of consumer characteristics over different foods is not legitimate. In addition to research on lifestyle factors, surveys about consumers' attitudes, norms, and knowledge regarding functional foods in relation to actual dietary patterns and health risk profiles are necessary (de Jong *et al*., 2003).

The amount of consumption of egg and meat commodity consumption is significantly affected by price factors both at their prices and other commodity prices. While for dairy commodities, changes in consumption expenditure are thought to be caused more by changes in quantity. Changes in egg commodity consumption expenditure are not significantly affected by changes in egg prices but will experience a significant increase if there is an increase in meat and milk commodity prices. This means that an increase in meat and milk prices will encourage households to divert the consumption expenditure allocation for meat and milk commodities to egg commodities. The significant increase in the proportion of egg commodity expenditure due to the rise in meat and milk prices shows that for commodity, household eggs are substitutes for commodities from animal sources from other livestock. The substitution effect is the component of a change in demand for a good as a result of a price change that can be attributed to substitution between different goods

(Chappelow, 2019). As prices rise, consumers will replace more expensive items with less costly alternatives.

Unlike egg commodities, changes in own prices (meat prices) will significantly reduce meat consumption expenditure, where each percent change in meat prices will cause a change of 1.75 percent his proportion. This is due to the relatively high market price of meat, so that price changes followed by changes in quantity will drive significant changes in household spending on these commodities. The increase in prices for other animal protein sources such as eggs does not significantly increase expenditure for meat, but an increase in dairy prices will significantly reduce expenditure for meat. The relationship between meat commodities and egg commodities is a substitution, while dairy commodities are complementary. This complementary relationship is explained by Fisher (1979) in Griffith *et al.* (2011) that the quantities of chicken product and meat fresh supplied are highly correlated. Each percent increase in dairy prices will be followed by a decrease of 5.05 percent for meat expenditure, and then will be allocated for expenditure on substitute the egg.

Non-price factors such as income and characteristics of housewives (age) do not have a significant effect on the expenditure for each food material source of animal protein from livestock. On the other hand, household expenditure allocation for animal protein from livestock significantly affects the proportion of expenditure for each commodity. Increasing the allocation of expenditure on animal protein source from livestock will encourage a significant reduction in expenditure for egg but a significant increase in expenditure for meat and dairy. This means that meat and dairy for households are seen as luxury goods rather than eggs and conversely the eggs tend as goods inferior to other commodities. With regards to the social factors influencing the purchasing decision of housewives, the family was found to mainly influence the purchases of the housewives followed by the social class the consumer supposedly belongs to (Obeidat *et al.*, 2018).

Although it does not have a significant effect, it will be interesting to also discuss the pattern of functional relations between expenditure and household structure. An increase in the proportion of family members belonging to children (<15 years) will encourage an increase in consumption of all food items. This increase in children proportion only significantly increases egg expenditure, but not for meat and dairy. Another characteristic factor of housewives education influences the consumption pattern of food of protein sources from livestock because it is related to the knowledge and awareness of the importance of animal protein. Household expenditure for eggs with high education of housewife is significantly higher than for middle and low housewife education. In other food items, although not significant, meat expenditure is higher in low-educated housewives, and milk is higher in middle-school. This composition is suspected because higher-educated housewives realize that basically egg can be used as a source of animal protein to meet the nutritional needs and the relatively cheap and so that more flexible to manage expenditure. A tentative conclusion can be drawn that egg food is still the main mainstay for households to fulfillment animal protein needs from livestock. In accordance with the opinion of Obeidat *et al.* (2018) that the purchase decisions of the housewives were motivated by the necessity to satisfy basic needs and the family appeared to be the main influencer affecting the housewife purchase decision.

The results of calculating the value of price elasticity in the geographically and demographically divided regions indicate that the demand for meat, eggs, and dairy is elastic (e <1). This means that the demand for these three types of livestock commodities is not responsive to changes in prices both at their own prices and other prices. Some of the allegations that are the causes of the low response of animal protein sources from livestock demand for price and the other prices

include: a) availability of other protein sources of food which are not livestock products such as fish and other fishery products, b) availability of livestock source of animal protein food sources that can be obtained without having to buy or produce their own cultivation, c) increasingly open market access so that the availability of food is easily obtained at prices that are not much different between regions or areas, and d) two weeks of research using cross-section data so that the symptoms of price changes are not very visible compared to time series data. The demand elasticity of own prices for eggs and dairy is negative and this is consistent with some of the results of previous studies. The research using the AIDS model showed that the commodities broiler and chicken eggs were negative (-0.905) and were necessities product (Suryanti and Reswita, 2016).

The demand elasticity of meat for own prices is generally more elastic than other commodities but has a different sign that is positive. Geographically, comparisons show that price elasticity in the central region is higher than others, while the highest elasticity value is obtained for migrant areas. For the commodities of eggs and dairy in the eastern region and migrant areas, they are more responsive to changes in their own prices. The elasticity of meat are positive and in-elastic is slightly different from some research results. The consumption of meat, chicken eggs, and dairy in Indonesia households has negative elasticity for own price according to the law of demand (Umaroh and Vinantia, 2018). Own price elasticity for beef is elastic, as well as analysis of consumption projections show that consumption of rice, soybeans, and beef is estimated to increase by 2.2%, 0.8%, and 4% per year respectively (Nur, et al. 2012). The response of the demand for beef/buffalo to changes in quantity is higher than the response due to price changes which are also seen in higher cross flexibility values in the AIDS model compared to cross-elasticity in the AIDS model (Novra, 2004). The price elasticity of the two other commodities, namely eggs and dairy, although also not elastic, but theoretically is in accordance with the theory.

Cross price elasticity varies among commodities, regions, and typology of the area, but in general meat, commodities are more responsive to changes in prices of two other commodities. Comparisons between regions and area typologies have the same pattern as the price elasticity itself, where the most responsive regions are the central region and the migrant area. The same pattern with its own price elasticity also applies to the other two commodities, namely the eastern region and the most responsive migrant area. The cross-price elasticity of meat commodities to the prices of eggs and dairy shows that in the household both commodities are substitutes for meat commodities. On the other hand, the elasticity of cross-egg prices for the prices of other animal protein source commodities shows that for households meat and dairy are complementary goods. The same thing applies to dairy commodities, where meat and eggs are complementary goods.

Positive expenditure elasticity for all sources of the animal protein shows that changes in demand for all three commodities are directly proportional to changes in income. Increased income will encourage an increasing proportion of household expenditure for the consumption of all three sources of animal protein. Response to changes in demand for eggs and dairy due to price changes is more responsive to the eastern region, and the same thing is found in migrant areas. Cross price elasticity varies with each other, expenditure elasticity is positive which indicates that all commodities are normal goods (Umaroh and Vinantia, 2018; Arthatiani *et al.*, 2018). Based on these criteria, eggs and milk can be called normal goods because they have positive expenditure elasticity and negative price elasticity. The estimated shows that all the food income elasticity are less than unity (e = 1), so the goods are necessities (Clements and Si, 2015). Especially to the meat that has positive expenditure and price elasticity, it is more closely referred to a luxury good that is not consumed regularly.

The compensated elasticity shows the quantity response of a good which a consumer would buy if he is income-compensated for a change in the price of that good. In other words, the compensated elasticity for a good is a response that shows how much quantity would be purchased at the changed price by the consumer if the income effect is eliminated (Paradisi, 2016). An important point to be noted is that the compensated demand curve, whether of Hicks or Slutsky, always slopes downward because it is so drawn that the substitution effect only is in operation and the income effect is altogether eliminated through compensating variation in income. The compensated price and cross elasticity of meat products are positive and conversely, of egg and dairy products are negative. An important factor observed in compensated price elasticity is the strength between the effect of price and income, by looking at the difference in the absolute value of each elasticity. Cornelsen *et al.* (2014) and Green *et al.* (2013) made a major contribution in reviewing a large number of recent studies of food demand and summarized the price elasticity for seven important food items. In this study showed how to covert these uncompensated elasticities into their compensated counterparts. The difference between the two elasticity depends on the relative importance of the good in consumers budgets and income elasticity. Zero difference of the compensated and uncompensated price elasticity of dairy shows that the effect of price and income to influence of this product demand is balances. Therefore, the demand for meat and eggs more dominated by price compared income effect cause the compensated price higher than uncompensated elasticity.

CONCLUSIONS

Geographically, the household expenditure for eggs was significant differences among the others, and the highest household expenditure for eggs occurred in eastern regions; while demographically, the household expenditure for meat in rural areas significantly more elevated than urban, but dairy in urban areas was substantially higher than other regions. In addition, the behavior of animal protein consumption from livestock was significantly affected by demographic factors.

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