Research Article

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The lacked access to beef in the low-income region: An evidence from the eastern part of Indonesia

Abstract: Indonesia generally has better food security performance, but the extent of food access at the commodity and regional level still needs to be questioned. The present study examines the causes of purchasing frequency and dietary habits of beef (access to beef) in eastern Indonesia, a low-income region. The variables under study are related to Turner's and colleagues' model, so the other aim of the present study is to prove the workability of the model. This research used a survey by randomly distributing an online questionnaire from July to October 2023 to 408 meat consumers/buyers in Indonesia's western part (high-income region) and eastern part (low-income region). Data collected from the survey were analysed mainly using the structural equation modelling technique using RStudio. This study discovered that people in eastern Indonesia purchase beef less frequently, which is caused by low incomes and high prices. People in east Indonesia also have irregular beef consumption habits contributed by infrequent purchasing, low incomes, and high prices. Moreover, the extended model proposed by Turner and colleagues is workable under a moderation test with limited variables (e.g., price, income, geographical factor, and food purchase). Besides the findings, this study has made scientific contributions to food accessibility and consumer behaviour, developed an extended model by Turner and colleagues, and conducted a comparative study on beef consumption (between marginal and non-marginal regions and between coastal and non-coastal regions). The efforts to improve accessibility to food will contribute to achieving zero goals under the Sustainable Development Goals.

1 Introduction

In general, Indonesians habitually consume meat. A comparative study on protein consumption between Malaysia and Indonesia found that meat consumption in Indonesia was higher than in Malaysia [1], even if meat intake in Indonesia was lower than other countries' intakes worldwide [2]. From a domestic point of view, meat places the second position of animal-source protein following seafood in Indonesia [3]. According to national statistical data [4], total meat (beef and buffalo meat) consumption among Indonesian households was 138,000 tons in 2019, increasing from 70,000 tons in 2014. In addition, meat (beef and buffalo meat) consumption per capita among Indonesian households was 0.52 kg in 2019, increasing from 0.28 kg in 2014 [4]. The increasing trend of meat consumption in Indonesia is perceived to be persistent in the future. Thus, this article focuses on the beef commodity.

Even if the aggregate index of food security in Indonesia is relatively good [5], Indonesia's food security performance for each commodity varies. According to the concept of food security [6], Indonesian households encounter a problem of food insecurity in beef because the consumption per capita

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of the commodity is lower than the needs of beef consumption per capita, as reported by the Government of Indonesia [7]. The regional disparity of beef consumption in Indonesia also raises questions regarding regional beef accessibility. Data show that the highest beef consumption is found, respectively, in West Java, East Java, and Jakarta; in contrast, the lowest beef consumption is found primarily in the eastern part of Indonesia (i.e. in Sulawesi, Maluku, and Papua Island) [4]. The lower consumption of beef in the eastern part of Indonesia potentially causes a low nutrition intake from beef. As some scholars argue [8–10], beef contains macro- and micronutrients.

The poor accessibility to beef in Indonesia attracts attention to income and price factors as the determinants of accessibility, as suggested by some scholars [5,11–13]. A study found that less affordability hindered the consumption of nutritious foods among children in South Asia [14]. Low-income households living in "urbanised disadvantaged areas" in Brisbane City were significantly vulnerable to food insecurity [15]. During coronavirus disease 2019, the unaffordability of foods affects the quantity and choice of food consumed by farmers in rural regions in Indonesia [16]. A study in Brazil found that purchasing power has a positive relationship with the meat diet among income groups [17].

The current study will focus on the factors affecting beef accessibility in eastern Indonesia, compared to western Indonesia. This study is attractive for some reasons. First, food consumption (including beef consumption) is complicated. The acquisition and consumption of food (as part of the food system) are affected by some factors within the food environment, such as affordability, culture, food price, and many other variables [13]. However, the existing model proposed by Turner et al. [13] works for general foods.

It is necessary to prove the model in the context of a specific commodity like beef. Second, low beef consumption in the eastern part of Indonesia [4] is probably related to economic access because the poverty rate in the eastern part of the country is relatively higher than in Java Island [18]. It is assumed that low-income regions cannot afford beef, as found in previous studies [14,16,17].

Third, the eastern part of Indonesia has a high risk of harmful effects of poor protein consumption. As reported by the Government of Indonesia [19,20], the number of districts in the eastern part of Indonesia vulnerable to food insecurity is higher than that in the western part of Indonesia due to the high poverty rate. Fourth, comparative studies on the food security of the beef sector between the western and eastern parts of Indonesia need much attention. Some studies discussed beef consumption more specifically, but they cover single locations [21–26]. Studies in West Java [21] and Kendari City [26] found that prices hinder beef purchasing in different regions. However, the studies used descriptive analysis only [21,26]. The other study only discussed determinants of beef consumption and did not associate beef consumption with habit [25].

The previous comparative studies in Indonesia cover food diet and security, but they cover the consumption of several types of meat and several groups of foods [16,27], not specifically beef. From the above standpoint, the present study proposed the following research question: To what extent are beef purchasing frequency and consuming habits in eastern Indonesia different from those in western Indonesia? What shapes the consumption habits and purchasing frequency of beef in the eastern part of Indonesia? This study aims to discover the causes of purchasing frequency and dietary habits of beef in eastern parts of
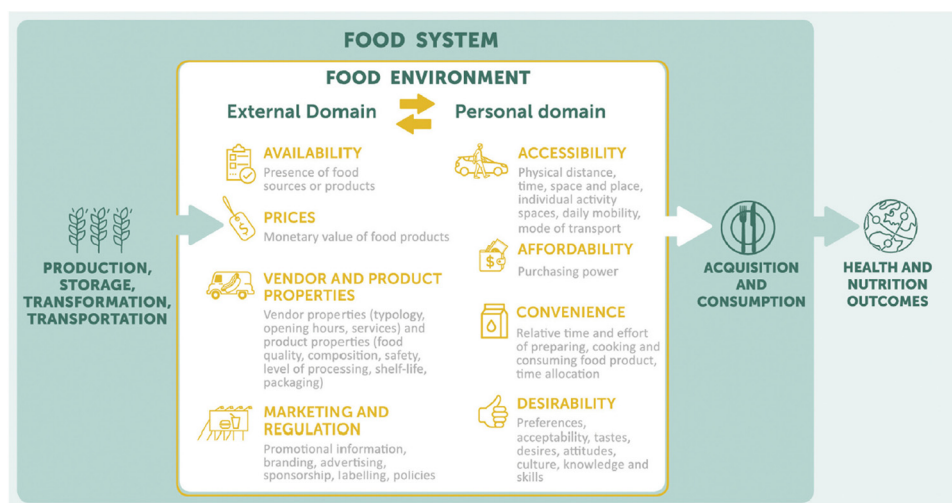

Figure 1: The interface between food environment and food system: the impacts of food price and affordability on food acquisition and consumption [13].

Indonesia. In other words, the present study examined factors affecting the accessibility to beef in eastern Indonesia, as a low-income region. Because the present study investigates beef purchasing (acquisition) and consumption as two independent variables, the present study extends the model proposed by Turner et al. [13], as presented in Figures 1 and 2, and aims to uncover the workability of the newly proposed model.

Some previous studies were then reviewed to provide the basis for hypothesis formulation. Based on a previous study [13], the present study split one of the indicators of the food system into two indicators: food acquisition (food purchasing) and food consumption (consumption habit or food use), as presented in Figure 2. In addition, the present study adopted only three variables (beef price, income, and geographic factor) among many variables of food environment according to Turner et al. [13]. Three adopted variables were used as predictors of food acquisition.

Three variables predicting food acquisition in Figure 2 gain different categorisation views among scholars [11–13,28]. For example, price and income are categorised into affordability variable, and geographic factor or location is categorised into the accessibility variable [12]. Turner et al. [13] categorise location into the accessibility variable. FAO [11,28] categorises incomes, price, and geographic factor or location into the accessibility dimension of food security. Thus, the three variables predicting food acquisition in Figure 2 (price, income/expenditure, and geographic factor) refer to FAO's categorisation: the accessibility-related food environment.

A study in Shenzhen, China, found that geographical distance/location and travelling time/methods (as the proxy of socioeconomic indicators) are used to explain factors affecting the accessibility to healthy foods [29]. The study in China also found that meat purchasing (including beef) increases with income, while the increase in meat prices causes a decline in meat purchasing [30]. The findings from rural inland China demonstrate that rural households consume more meat (over-consumption of meat and underconsumption of aquatic products) because of the affordable price of meat, high incomes,

and storage convenience of meat [31]. A study among marginal communities (lesbian, gay, bisexual, transgender, queer, questioning, intersex, agender, asex, and two-spirit or LGBTQIA2S and university students) in the United States found that food access among those communities is hindered by lack of employment (related to incomes), financial factors (i.e., food price and inflation), and other relevant factors [32]. A study among marginal communities in Baltimore, USA, found that low access to healthy food is affected by food prices, the amount of money spent on healthy foods, and the amount of taxes spent to purchase healthy foods [33]. The food expenditure is certainly related to the incomes of food buyers. A study in Kenya [34] found that childhood development is affected by fish consumption and fishing incomes, improving access to other foods.

Because there is an association between food acquisition and consumption, price, and income [13,29,30,32–37], the present study proposed purchasing frequency as an antecedent of consumption and then analyses the impact of price and income on purchasing frequency. Turner et al. [13] suggest that food price and affordability (purchasing power) affect food acquisition and consumption. Nevertheless, this study does not consider purchasing power because of the absence of data to calculate it. Data on incomes and prices for two periods are needed to calculate purchasing power, as argued by Ueta et al. [17]. Instead, incomes are used to predict food purchasing and consumption [12,30,37] without empirical data on purchasing power. Moreover, the present study analyses the impact of purchasing frequency, price, and income on consuming habits. Thus, the present study proposed the following hypotheses:

H_1: The purchasing frequency of beef is affected by price (a) and income (b).

H_2: The consumption habits of beef are affected by the purchasing frequency of beef (a), price (b), and income (c).

The other factor affecting food access is geographical situation/location [13,29,38]. Consuming and non-consuming habits of certain groups of foods are affected by geographical situations that indicate a culture and physical accessibility to foods, as summarised from previous
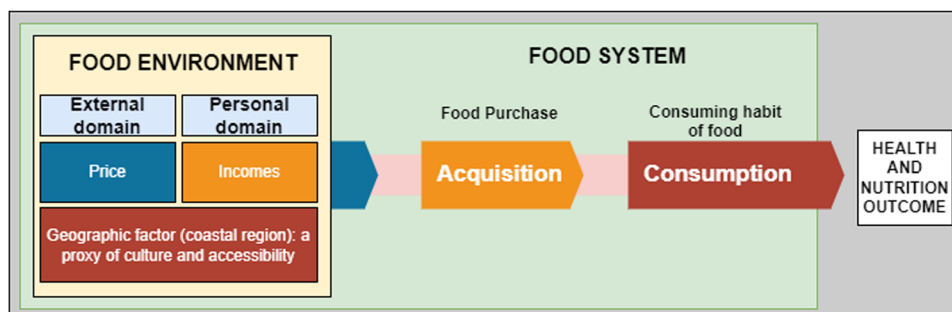

Figure 2: Turner's and colleagues' partially extended model. Source: Authors, adapted from a previous study [13].

studies [2,13,28,29,29,39–43]. Beef is favourable in some countries (e.g., Eastern Europe and Central Asia) but unfavourable in other countries (e.g., Southeast and East Asian Countries) [2]. People in mainland and land-locked regions prefer consuming meat, while those in coastal regions do not [2,39,41,43]. People living in mainland and land-locked areas probably find bovine meat easily, and those living in coastal areas find seafood easier than meat, as implied by previous studies [40,42]. In addition, a study in Inner Mongolia's three banners (i.e., West Ujimqin, Zhenglan, and Taibus) demonstrates that West Ujimqin and Zhengland residents consume more animal-source foods because they are mostly Mongolian ethnic groups growing animals and while Taibus residents consume less meat and more plant-based foods because they are mostly Han ethnic group cultivating crop production [38].

As the eastern part of Indonesia is situated in archipelagic and coastal areas [43], some people culturally consume seafood and consume less meat [40,43]. Irregular habits of beef consumption and regular habits of seafood consumption [40,42] are related to culture [13] or socio-cultural factors [44]. Moreover, the high poverty rate in eastern Indonesia [18] affects the low beef consumption rate [4,16]. Smil [42] found that people with high incomes consume more beef, while those with low incomes consume limited beef. Inner Mongolia's West Ujimqin and Zhenglan residents consume more meat than Taibus residents because they also have high disposable incomes [38]. Turner et al. also argue that some variables (e.g., culture, price, purchasing power, and accessibility) affect food acquisition and consumption [13]. A global study among 135 countries [45] found that incomes play the key role in food accessibility. The scholars [45] put an emphasis that between-country food access inequality declined while within-country food access inequality (including nutrient-dense foods, such as eggs, dairy foods, meat, and seafood) increased for more than five decades mainly in developing countries. Thus, the geographical factor, like eastern Indonesia in this study, can be the proxy of culture and accessibility, as depicted in Figure 2. The present study then proposed the following hypothesis as the extension of the previous hypotheses:

H_3: People in eastern Indonesia have lower incomes than those in western Indonesia.

H_4: People in eastern Indonesia purchase beef less frequently than those in western Indonesia.

H_5: People living in eastern Indonesia have irregular beef consumption habits compared to western Indonesia.

H_6: People living in eastern Indonesia purchase beef less frequently when moderated by incomes (a) and by beef price (b).

H_7: People living in eastern Indonesia have irregular habits of beef consumption when moderated by purchasing frequency of beef (a), incomes (b), and price (c).

The conceptual model was proposed based on the hypotheses above, as presented in Figure 3.

2 Materials and methods

2.1 Data collection

The present study adopted quantitative methods (questionnaire survey) using an explanatory study [46]. An online questionnaire (google form) was distributed randomly in some provinces in the western part of Indonesia (provinces in Java Islands only as the region with the highest beef consumption and relatively low poverty rate) and the eastern part of Indonesia (as the region with the lowest beef consumption and relatively high poverty rate) [4,18] from July to October 2023.

The total samples obtained were 408 observations. In the western part, respondents came from the provinces in Java Islands only, as follows: West Java (34.56%), Jakarta (9.07%), Banten (6.62%), Central Java (4.41%), East Java (3.68%), and Yogyakarta (2.21%). In contrast, eastern Indonesia's respondents came from the following provinces: Southeast Sulawesi (30.64%), South Sulawesi (2.94%), Maluku (2.70%), Central Sulawesi (0.98%), Papua (0.74%), and the rest of the provinces (consisting of Bali, West, and East Nusa Tenggara, respectively, about 0.49%). A more detailed sample description is presented in Table 1.

The respondents were asked some questions with nominal, ordinal, and ratio measurement levels, as suggested by some scholars [47]. The nominal scale measured the questions in Table 1; the ratio scale measured the income and beef price (Table 2); and the ordinal scale
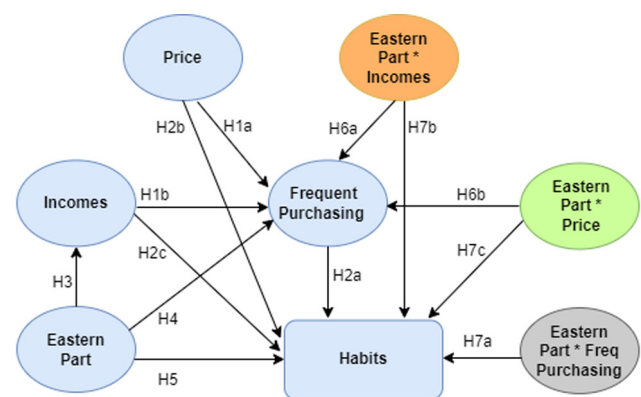

Figure 3: Conceptual model of the present study (Source: Authors, Original).

Table 1: Respondents' characteristics (*N*: 408)

No	Socio-demographic characteristics		Proportion (%)	Sample measurement
1	Gender	Male	54.66	Gender = 1 for female and = 0 for male
		Female	45.34	
2	Incomes	≤IDR 5 million (≤USD 305.14)	28.19	Transformed from continues to categorical data: ≤IDR 5 million (1),
		>IDR 5–≤IDR 10 million (>USD 305.14 – ≤USD 610.23)	29.17	IDR 5–≤10 million (2),
		>IDR 10–≤IDR 15 million (>USD 610.23 – ≤USD 915.34)	17.89	IDR 10–≤15 million (3),
		>IDR 15–≤IDR 20 million (>USD 915.34 – ≤USD 1.220.41)	12.01	IDR 15–≤20 million (4), and
		>IDR 20 million (>USD 1,220.41)	12.75	>IDR 20 million (5)
3	Residence 1	Western part of Indonesia	60.54	The eastern part of Indonesia = 1 for residents in Bali,
		Eastern part of Indonesia	39.46	Sulawesi, Nusa Tenggara, Maluku, and Papua regions, and the eastern part of Indonesia = 0 for residents in the Java region
4	Residence 2	Coastal area	31.13	Coastal areas = 1 and non-coastal areas = 0
		Non-coastal area	68.87	
5	Age	<30 years old	10.78	<30 years old (1), 30–50 years old (2), and >50 years
		30–50 years old	79.17	old (3)
		>50 years old	10.05	

Exchange rate USD 1 = IDR 16,386.9.
Source: authors (original).

measured the questions about monthly purchasing frequency and consuming habits (Table 2). A 5-scale likert [46] was used to measure questions about monthly purchasing frequency and consumption habits.

Ethics approval and consent to participate: There is no ethical clearance from authors' institutions. The study used data from an online questionnaire that participants used on their smartphones when they filled out the questionnaire. All participants consented to completing the questionnaire and agreed to share their information. The participants agreed to share the data only for academic purposes. Data that they gave are reported in the aggregate.

2.2 Data analysis

Based on the survey results and the hypotheses, the data were processed mainly in the structural equation model (SEM) using Rstudio [48,49]. In addition, data regarding

Table 2: Research inquiries for main variables

No	Variable	Questions and Answers
1	Consuming habit (ConsumHabit)	Consuming beef is my habit: **Answer:** Strongly disagreed (SD) = 1, disagree (D) = 2, neutral (N) = 3, agree (A) = 4, and strongly agree (SA) = 5
2	Monthly purchasing frequency (FreqPurchasing)	I purchase beef frequently in a month: **Answer:** Strongly disagreed (SD) = 1, disagree (D) = 2, neutral (N) = 3, agree (A) = 4, and strongly agree (SA) = 5
3	Monthly incomes (Incomes)	What is your monthly income? **Answer:** Continuous
4	Beef price (BeefPrice)	What is your residential area's estimated/average price of one-kilo beef? **Answer:** Continuous
5	Residence in the eastern part of Indonesia (EasternPart)	I live in one of the following regions: **Answer:** Eastern part of Indonesia = 1 and western part of Indonesia = 0

Source: authors (original).

residence in coastal areas were performed using crosstab analysis with Rstudio [50] to support the findings from the SEM. Some required statistical tests were then performed, such as descriptive statistics, normality tests, measurement model evaluation (goodness-of-fit test), and structural model evaluation [49].

The descriptive statistics performed were mean, standard deviation (small value is better), skewness (value should be zero for normal distribution), and kurtosis (value should be zero as well) [50]. The normality test was performed using a univariate normality test (Shapiro–Wilk's W test) and a multivariate normality test (Mardia's test) [51]. The results of normality tests were assessed using P-value criteria that the P-values are significant if it is lower than $\alpha = 0.05$ (meaning the distribution is not normal). In contrast, P-values are non-significant if higher than $\alpha = 0.05$ (meaning the distribution is normal) [50]. Under SEM, the measurement (goodness-of-fit test) and structural model evaluation were performed using the criteria in Table 3.

Based on Figure 3, the present study adopted path analysis as "a more general model where all variables are still manifest but endogenous variables are allowed to explain other endogenous variables" [52], expressed with the following model:

$$y = \alpha + \gamma x + \beta y + \zeta, \qquad (1)$$

where $y = (y_1, ..., y_p)$ denotes vector of p endogenous variables, $x = (x_1, ..., x_p)$ denotes vector of p exogenous variables, α (alpha) denotes vector of p intercepts, γ (gamma) denotes matrix of regression coefficients ($p \times q$) of exogenous to endogenous variables whose ith row indicates the endogenous variable and jth column indicates the exogenous variables,

β (beta) denotes matrix of regression coefficients ($p \times p$) of endogenous to endogenous variables whose ith row indicates the source of variable and jth column indicates the target variable, ζ (zeta) = $(\zeta_1 ..., \zeta_p)$ denotes the vector of residuals.

Based on Figure 3, equation (1) was extended into broader equations. As SEM requires more than one model for comparison [49], the present study analysed three models. Model 1 is presented as follows:

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix} + \begin{pmatrix} \gamma_{11} & 0 & 0 \\ 0 & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & 0 & \gamma_{33} \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 0 \\ \beta_{21} & 0 & 0 \\ 0 & \beta_{32} & 0 \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} + \begin{pmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \end{pmatrix}, (2)$$

where y_1 denotes Incomes, γ_{11} denotes dummy variable of EasternPart (residence in Eastern Part = 1, and otherwise = 0), y_2 denotes FreqPurchasing, β_{21} denotes Incomes, γ_{22} denotes BeefPrice, γ_{23} denotes moderation between EasternPart and BeefPrice, y_3 denotes ConsumHabit, γ_{31} denotes BeefPrice, β_{32} denotes FreqPurchasing, and γ_{33} denotes moderation between EasternPart and BeefPrice.

Model 2 is presented as follows:

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix} + \begin{pmatrix} \gamma_{11} & 0 & 0 \\ 0 & \gamma_{22} & \gamma_{23} \\ 0 & 0 & \gamma_{33} \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 0 \\ \beta_{21} & 0 & 0 \\ \beta_{31} & \beta_{32} & 0 \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} + \begin{pmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \end{pmatrix}, (3)$$

where y_1 denotes Incomes, γ_{11} denotes dummy variable of EasternPart, y_2 denotes FreqPurchasing, β_{21} denotes Incomes, γ_{22} denotes BeefPrice, γ_{23} denotes moderation between EasternPart and Incomes, y_3 denotes ConsumHabit, β_{31} denotes Incomes, β_{32} denotes FreqPurchasing, and γ_{33} denotes moderation between EasternPart and Incomes.

Table 3: Evaluation criteria of goodness-of-fit indices and structural model evaluation

Nr	Fit index	Criteria
I	**Measurement model (goodness-of-fit indices)**	
1	Chi-square (χ^2)	A small degree of freedom is accepted, and the P-value is less than the 0.01, 0.05, or 0.10 significance level under a two-tailed test
2	Root mean square error of approximation (RMSEA)	≤0.05 = better fit
3	Standardised root mean square residual (SRMR)	≤0.08 = good fit ≤0.06 = better fit
4	Comparative fit index (CFI)	≥0.95 = better fit
5	Tucker–Lewis index (TLI)	≥0.95 = better fit
6	Akaike information criterion (AIC)	Smaller is better
7	Bayesian information criterion (BIC)	Smaller is better
II	**Structural model evaluation**	
1	The strength of the relationship and its significance	Regression results cover path coefficient estimate, standard error, z-value, P-value, covariances, and variances. P-values are significant if it is less than the 0.01, 0.05, or 0.10 significance level under a two-tailed test
2	Explanatory power (R^2)	Analysis based on the size of R^2

Source: Authors from many sources [49,61,62].

Table 4: Descriptive statistics (N = 408)

Parameter	EasternPart	Incomes	BeefPrice	FreqPurchasing	ConsumHabit
Mean	0.39	12.83	0.13	2.59	3.22
Std. dev	0.49	11.36	0.03	1.26	1.01
Skewness	0.43	2.61	0.02	0.37	−0.19
Kurtosis	−1.82	10.30	2.59	−0.86	−0.51
Normality test's W	0.62	0.76	0.95	0.89	0.91

Source: authors (original).

Equation (3) was also adopted for Model 3. Under equation (3), γ_{23} denotes moderation between EasternPart and BeefPrice, and γ_{33} denotes moderation between Eastern-Part and FreqPurchasing in Model 3.

3 Results

This section reports the results of SEM. Before that the results of descriptive statistics and normality tests were reported. The first is the outputs of descriptive statistics (Table 4). Standard deviation values for all variables are close to mean values. All the skewness values are close to zero except the skewness value of Incomes. Kurtosis values approach zero only for FreqPurchasing and ConsumHabit. The results of the normality test's W were presented. However, these outputs are inadequate to claim the normality of data. Thus, statistical tests of normality should be reviewed.

The second is the outputs of univariate and multivariate normality tests. Under the univariate normality test, all outputs of Shapiro–Wilk's W test are significant under α = 0.05 (P-values are lower than the 0.05 significant level), meaning that the data are not normally distributed (Table 5). The results of the univariate normality test in Table 5 are consistent with the normality test's values under descriptive statistics in Table 4. Under the multivariate normality test, the skewness and kurtosis values are significant under α = 0.05, meaning that the data are not normally distributed. The multivariate normality value demonstrates that the data are generally not normally distributed (Table 5). The state of non-normally distributed data does not end the analysis because there are some goodness-of-fit tests to uncover the quality of data and models that are discussed in later paragraphs.

After performing many simulations, the SEM outputs were now reported. The outputs of the measurement model (the goodness-of-fit test) are presented in Table 6. Outputs of all indices (chi-square, [standardised root mean square residual (SRMR), root mean square error of

Table 5: Normality test (N = 408)

Nr	Variable	Statistics	P-value	Remarks
A	**Univariate normality test (Shapiro–Wilk's W test):**			
1	EasternPart	0.6202***	0.000	Not normal
2	Incomes	0.7638***	0.000	Not normal
3	BeefPrice	0.9458***	0.000	Not normal
4	FreqPurchasing	0.8929***	0.000	Not normal
5	ConsumHabit	0.9077***	0.000	Not normal
B	**Multivariate normality test for five variables (Mardia's Multivariate tests):**			
1	Skewness	612.3633***	0.000	Not normal
2	Kurtosis	13.3976***	0.000	Not normal
3	Multivariate normality	—	—	Not normal

Note: ***significant under α = 0.01.
Source: authors (original).

Table 6: Outputs of the goodness-of-fit indices (N = 408)

Hypothetical model	User model		Baseline model		SRMR	RMSEA	AIC	BIC	CFI	TLI
	χ^2	df	χ^2	df						
Model 1	3.002	2	227.923***	10	0.016	0.035	4,309.901	4,382.104	0.995	0.977
Model 2	1.729	3	227.923***	10	0.012	0.000	**4,306.627**	**4,374.819**	1.000	1.019
Model 3	0.586	1	227.923***	10	0.008	0.000	4,309.484	4,385.698	1.000	1.019

Note: ***significant under α = 0.01.
Source: authors (original).

approximation (RMSEA), Akaike information criterion (AIC), Bayesian information criterion (BIC), comparative fit index (CFI), and Tucker–Lewis index (TLI)]) of Model 1, Model 2, and Model 3 are as follows: first, chi-square values for all models are same under baseline model (227.923), that is significant under α = 0.01 (fulfilling fit requirements); second, values of RMSEA for Model 1, Model 2, and Model 3 are, respectively, 0.035, 0.000, and 0.000 (lower than the 0.05 threshold), fulfilling better fit requirements; third, value of SRMR for Model 1, Model 2, and Model 3 are, respectively, 0.016, 0.012, and 0.008 (lower than the 0.06 threshold), fulfilling better fit criteria; fourth, values of CFI for Model 1, Model 2, and Model 3 are, respectively, 0.995, 1.000, and 1.000 (higher than 0.95 threshold, fulfilling better fit requirements); fifth, values of TLI for Model 1, Model 2, and Model 3 are, respectively, 0.977, 1.019, and 1.019 (higher than 0.95 threshold, fulfilling better fit requirements); sixth, the value of AIC for Model 2 = 4306.627 is smaller than those for Models 1 and 3, meaning that Model 2 has better fit than others; seventh, the value of BIC for Model 2 = 4374.819 is smaller than those for Models 1 and 3, meaning that Model 2 has better fit than others, as well. In summary, Model 2 is better than Model 1 and Model 3. Models 1 and 3 are equal regarding the goodness-of-fit indicators because they only differ in AIC and BIC values. The value of AIC for Model 3 = 4309.484 is smaller than that for Model 1 = 4309.901. The value of BIC for Model 1 = 4382.104 is smaller than that for Model 3 = 4385.698.

Under the structural model, the outputs of SEM for Models 1, 2, and 3 are presented as follows (Table 7). First, the path coefficients from Incomes to FreqPurchasing for all Models 1–3 are, respectively, 0.016 (*P*-value = 0.005), 0.017 (*P*-value = 0.003), and 0.019 (*P*-value = 0.001). This means that the coefficients are significant under α = 0.01. Thus, the hypothesis stating that the purchasing frequency of beef is affected by income (H_{1b}) is accepted.

Second, two path coefficients to ConsumHabit (i.e. from FreqPurchasing and Incomes to ConsumHabit) demonstrate the significance. The coefficient path from FreqPurchasing to ConsumHabit for Models 1–3 is, respectively, 0.399 (*P*-value = 0.000), 0.397 (*P*-value = 0.000), and 0.397 (*P*-value = 0.000), which is significant under α = 0.01. The coefficient path from Incomes to ConsumHabit for Models 2 and 3 are, respectively, 0.009 (*P*-value = 0.024) and 0.008 (*P*-value = 0.049), which is significant under α = 0.05. Thus, the hypotheses stating that the consuming habits of beef are affected by the purchasing frequency of beef (H_{2a}) and income (H_{2c}) are accepted.

Third, path coefficients from EasternPart to Incomes for all models are, respectively, −9.238, −9.322, and −9.322 (all

P-values = 0.000). It means significant under α = 0.01. The hypothesis stating that people living in eastern Indonesia have lower incomes than those living in the western part of Indonesia (H_3) is accepted.

Fourth, some path coefficients from moderating variables (EasternPart × Incomes and EasternPart × BeefPrice) to FreqPurchasing demonstrate the significance. The path coefficient from EasternPart × Incomes to FreqPurchasing (Model 2) is −0.154 (*P*-value = 0.047), significant under α = 0.05. The path coefficient from EasternPart × BeefPrice to FreqPurchasing (Model 1) is −0.214 (*P*-value = 0.004), significant under α = 0.01. Thus, the hypotheses stating that people living in eastern Indonesia less frequently purchase beef when moderated by incomes (H_{6a}) and beef price (H_{6b}) are accepted.

Fifth, the path coefficients from some moderating variables (EasternPart × FreqPurchasing, EasternPart × Incomes, and EasternPart × BeefPrice) to ConsumHabit demonstrate the significance, as well. The path coefficient from EasternPart × FreqPurchasing to ConsumHabit is −0.211 (*P*-value = 0.025), significant under α = 0.05. The path coefficient from EasternPart × Incomes to ConsumHabit is −0.154 (*P*-value = 0.047), significant under α = 0.05. The path coefficient from EasternPart × BeefPrice to ConsumHabit is −0.214 (*P*-value = 0.004), significant under α = 0.01. Thus, the hypotheses stating that people living in eastern Indonesia have irregular habits of beef consumption when moderated by purchasing frequency of beef (H_{7a}), incomes (H_{7b}), and beef price (H_{7c}) are accepted. Based on Models 1–3, the summary of accepted and rejected hypotheses is presented in Table 8.

In addition, the coefficient determination or R^2 for all models (Table 7) is as follows. First, the R^2 values for Incomes under Models 1–3 are, respectively, 0.159, 0.161, and 0.161, meaning that the variation of Incomes is explained by dummy EasternPart variable by 15.9, 16.1, and 16.1%, respectively, under Models 1–3. Second, the values of R^2 for FreqPurchasing under Models 1–3 are, respectively, 0.036, 0.034, and 0.031. It means that variation of FreqPurchasing is explained by Model 1 (i.e., Incomes, BeefPrice, and EasternPart × BeefPrice) around 3.6%, Model 2 (i.e., Incomes, BeefPrice, and EasternPart × Incomes) around 3.4%, and Model 3 (i.e., Incomes, BeefPrice, and EasternPart × BeefPrice) around 3.1%. Third, values of R^2 for ConsumHabit under Models 1–3 are, respectively, 0.287, 0.295, and 0.296. It means that variation of ConsumHabit is explained by Model 1 (i.e., BeefPrice, FreqPurchasing, and EasternPart × BeefPrice) about 28.7%, Model 2 (i.e., Incomes, FreqPurchasing, and EasternPart × Incomes) about 29.5%, and Model 3 (i.e., Incomes, FreqPurchasing, and EasternPart × FreqPurchasing) about 29.6%. In sum, the values of R^2 for Incomes, FreqPurchasing, and ConsumHabit under the three models do not deviate much.

Table 7: Outputs of structural model (N = 408)

Nr	Analysis	Model 1 Coeff est.	Std. error	z-value	P-value	Nr	Analysis	Model 2 Coeff est.	Std. error	z-value	P-value	Nr	Analysis	Model 3 Coeff est.	Std. error	z-value	P-value
A	**Regression model**																
1	EasternPart → Incomes	-9.238***	1.052	-8.784	0.000	1	EasternPart → Incomes	-9.322***	1.053	-8.853	0.000	1	EasternPart → Incomes	-9.322***	1.053	-8.853	0.000
2	Incomes → FreqPurchasing	0.016***	0.006	2.814	0.005	2	Incomes → FreqPurchasing	0.017***	0.006	2.997	0.003	2	Incomes → FreqPurchasing	0.019***	0.006	3.185	0.001
3	BeefPrice → FreqPurchasing	-0.749	2.125	-0.352	0.725	3	BeefPrice → FreqPurchasing	-0.756	2.122	-0.356	0.722	3	BeefPrice → FreqPurchasing	-0.771	2.120	-0.364	0.716
4	**EasternPart*BfPr → FreqPurchasing**	-0.214***	0.074	-2.905	0.004	4	**EasternPart × Incm → FreqPurchasing**	-0.154**	0.078	-1.989	0.047	4	**EasternPart × BfPr → FreqPurchasing**	-0.033	0.138	-0.239	0.811
5	BeefPrice → ConsumHabit	-0.047	1.447	-0.032	0.974	5	Incomes → ConsumHabit	0.009**	0.004	2.263	0.024	5	Incomes → ConsumHabit	0.008**	0.004	1.967	0.049
6	**EasternPart*BfPr → ConsumHabit**	-0.214***	0.074	-2.905	0.004	6	**EasternPart × Incm → ConsumHabit**	-0.154**	0.078	-1.989	0.047	6	**EasternPart × FrqP → ConsumHabit**	-0.211**	0.094	-2.247	0.025
7	FreqPurchasing → ConsumHabit	0.399***	0.034	11.861	0.000	7	FreqPurchasing → ConsumHabit	0.397***	0.034	11.768	0.000	7	FreqPurchasing → ConsumHabit	0.397***	0.034	11.746	0.000
B	**Intercepts**																
1	Incomes	16.473***	0.661	24.915	0.000	1	Incomes	16.506 ***	0.662	24.953	0.000	1	Incomes	16.506***	0.662	24.953	0.000
2	FreqPurchasing	2.564***	0.289	8.872	0.000	2	FreqPurchasing	2.528***	0.289	8.746	0.000	2	FreqPurchasing	2.455***	0.297	8.252	0.000
3	ConsumHabit	2.282***	0.213	10.733	0.000	3	ConsumHabit	2.142***	0.113	18.886	0.000	3	ConsumHabit	2.177***	0.117	18.608	0.000
4	EasternPart	0.395***	0.024	16.308	0.000	4	EasternPart	0.395***	0.024	16.308	0.000	4	EasternPart	0.395***	0.024	16.308	0.000
5	BeefPrice	0.127***	0.001	88.316	0.000	5	BeefPrice	0.127***	0.001	88.316	0.000	5	BeefPrice	0.127***	0.001	88.316	0.000
C	**Explanatory power (R²)**																
1	Incomes	0.159	—	—	—	1	Incomes	0.161	—	—	—	1	Incomes	0.161	—	—	—
2	FreqPurchasing	0.036	—	—	—	2	FreqPurchasing	0.034	—	—	—	2	FreqPurchasing	0.031	—	—	—
3	ConsumHabit	0.287	—	—	—	3	ConsumHabit	0.295	—	—	—	3	ConsumHabit	0.296	—	—	—
D	**Covariances**																
1	EasternPart ↔ BeefPrice	-0.000	0.001	-0.158	0.875	1	EasternPart ↔ BeefPrice	-0.000	0.001	-0.158	0.875	1	EasternPart ↔ BeefPrice	-0.000	0.001	-0.158	0.875
2	Incomes ↔ ConsumHabit	0.866*	0.445	1.947	0.052	2	—	—	—	—	—	2	BeefPrice ↔ ConsumHabit	-0.000	0.001	-0.040	0.968
E	**Variances**																
1	Incomes	108.085***	7.567	14.283	0.000	1	Incomes	108.083***	7.567	14.283	0.000	1	Incomes	108.083***	7.567	14.283	0.000
2	BeefPrice	0.001***	0.000	14.283	0.000	2	BeefPrice	0.001***	0.000	14.283	0.000	2	BeefPrice	0.001***	0.000	14.283	0.000
3	EasternPart	0.239***	0.017	14.283	0.000	3	EasternPart	0.239***	0.017	14.283	0.000	3	EasternPart	0.239***	0.017	14.283	0.000
4	FreqPurchasing	1.553***	0.109	14.283	0.000	4	FreqPurchasing	1.550***	0.108	14.283	0.000	4	FreqPurchasing	1.547***	0.108	14.283	0.000

(Continued)

Table 7: *Continued*

Nr		Model 1				Nr		Model 2				Nr		Model 3			
	Analysis	Coeff est.	Std. error	z-value	P-value		Analysis	Coeff est.	Std. error	z-value	P-value		Analysis	Coeff est.	Std. error	z-value	P-value
5	ConsumHabit	0.728***	0.051	14.281	0.000	5	ConsumHabit	0.720***	0.050	14.283	0.000	5	ConsumHabit	0.720***	0.050	14.283	0.000

Note: ***significant under $\alpha = 0.01$, **significant under $\alpha = 0.05$, and *significant under $\alpha = 0.10$.
Source: authors (original).

The structural model also produces values of covariances (Table 7). All of the values of covariances are higher than $\alpha = 0.05$. Thus, the covariances among variables in Table 7 do not exist.

4 Discussion

The results of the statistical analysis found in the present study uncovered some insights about beef consumption habits in eastern Indonesia and proved the extended model of Turner et al. [13] in Figure 2, as follows. First, the purchasing frequency of beef is affected by the extent of income (confirmed by the acceptance of H_{1b}). Then, high purchasing frequency and incomes drive high consumption habits of beef (confirmed by the acceptance of H_{2a} and H_{2c}). The present study fails to confirm H_{1a} (price affects purchasing frequency of beef) and H_{2b} (price affects consumption habit of beef). Thus, it is inadequate proof to confirm the extended model of Turner et al. in Figure 2 at this stage (non-moderation test). The proof of some other hypotheses in later paragraphs is then essential.

The findings from the non-moderation test above (total sample) align with the findings from some other countries. For example, some Mongolian people with high disposable incomes consume more animal-source food [38]. Moreover, in Western countries, high meat consumption in Europe and America (due to rising disposable incomes, industrialisation, and rapid urbanisation) transformed Western society from traditional to modern [42]. High-income society certainly demands more diversified foods and tastes. A literature review describes that consumers demand beef because of sensory factors such as visual appearance, texture, flavour, and odour [44]. Thus, the findings from the non-moderation test above mean that, in general, Indonesians frequently purchase meat and have meat-consuming habits.

Second, people living in eastern Indonesia have more infrequent purchasing of beef than those living in western Indonesia. Figure 4 demonstrates that people in eastern Indonesia purchase beef in a month less frequently than those in western Indonesia. The infrequent purchasing of beef is attributed to the high price of the commodity and the lower incomes of people in eastern Indonesia, as confirmed by the acceptance of H_3, H_{6a}, and H_{6b}. The lower incomes among people in eastern Indonesia are depicted in Figure 5 (left-hand side). On average, the people living in eastern Indonesia (in this study) have incomes below IDR 10 million. At the same time, people living in the western part have incomes between IDR 10 and 20 million. Low-income people in eastern Indonesia cannot afford beef at

Table 8: Summary of accepted and rejected hypotheses

Nr	Hypothesis	Remarks
1	H_{1a}: The purchasing frequency of beef is affected by the price	Rejected
2	H_{1b}: The purchasing frequency of beef is affected by incomes	Accepted
3	H_2: The consumption habits of beef are affected by the purchasing frequency of beef (a) and income (c)	Accepted
4	H_{2b}: The consuming habits of beef are affected by the price	Rejected
5	H_3: People in eastern Indonesia have lower incomes than those in western Indonesia	Accepted
6	H_4: People in eastern Indonesia purchase beef less frequently than those in western Indonesia	Omitted by the software
7	H_5: People living in eastern Indonesia have irregular beef consumption habits compared to western Indonesia	Omitted by the software
8	H6: People living in eastern Indonesia less frequently purchase beef when moderated by incomes (a) and by beef price (b)	Accepted
9	H_7: People living in eastern Indonesia have irregular habits of beef consumption when moderated by purchasing frequency of beef (a), incomes (b), and price (c)	Accepted

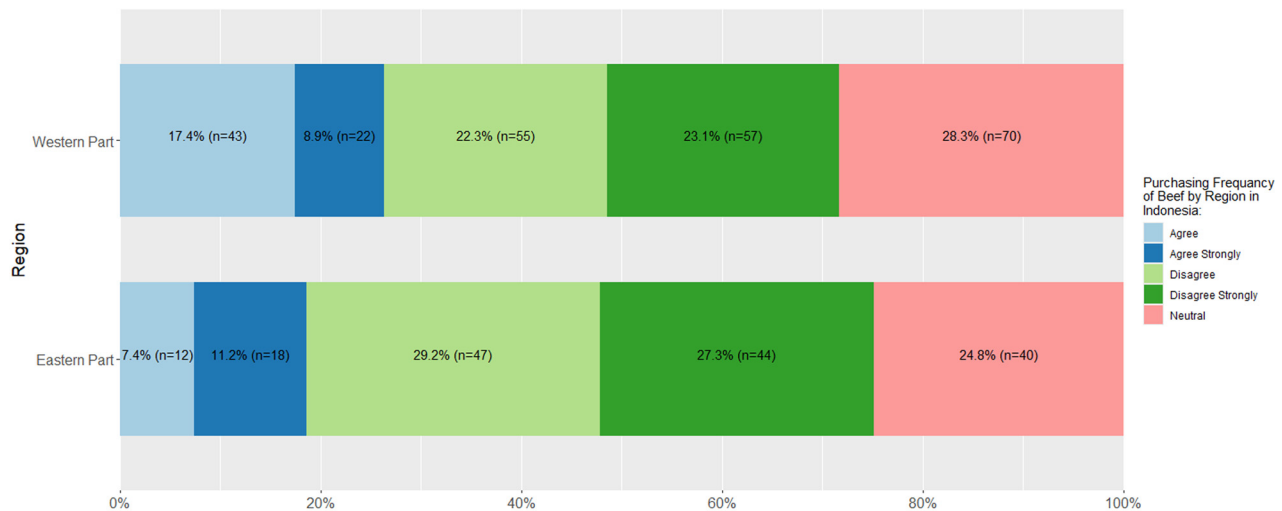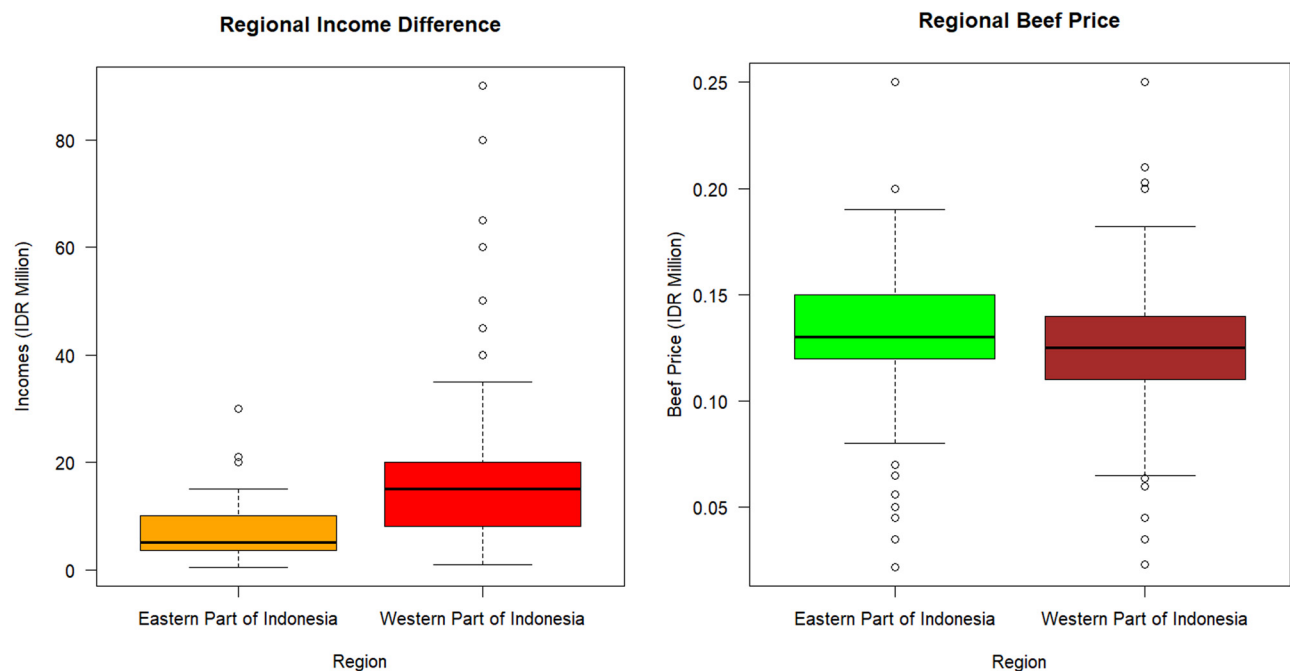Source: authors (original).

Figure 4: Monthly purchasing frequency of beef by region in Indonesia (Source, Authors, original).

Figure 5: Incomes (Left) and beef price (Right) in Indonesia's western and eastern regions (Source, Authors, original).

Figure 6: The consuming habit of beef in Indonesia by region (top) geographic residence (coastal and non-coastal) of people in western and eastern Indonesia (bottom) (Source, Authors, original).

higher prices. The higher price of beef in eastern Indonesia is sketched in Figure 5 (right-hand side). The beef price in eastern Indonesia is mostly between IDR 125,000 and 150,000, while the beef price in the western part is below IDR 140,000. The present study's findings confirm the previous studies [30,32,33,38,53,54] that the high price of meat causes a decline in meat purchasing, and low incomes purchase less meat. Otherwise, the present study does not align with the findings of a study in inland China [31] that rural Chinese households overly consume meat because of affordable prices, high incomes, and more convenient storage of meat.

Third, people in eastern Indonesia have more irregular beef consumption habits than those in western Indonesia. It can be seen from Figure 6 (the top) that fewer people in eastern Indonesia agree on the habit of eating beef. The irregular habit of beef consumption is mainly attributed to infrequent purchasing, high beef prices, and low incomes in eastern Indonesia, which is confirmed by the acceptance of H_{7a}, H_{7b}, and H_{7c}. Verplanken [55] argued that habit is shaped by repeated behaviour; repeated purchasing of beef can shape beef consumption habits in the context of the present study. According to a previous study [36], consumption can be purchasing and using (eating). Thus, scholars [36,55] imply that the consequences of repeated beef purchases can be beef purchasing and using (eating) habits. Since the present study's findings are that infrequent purchasing affects irregular beef eating habits, it means that less repetition of beef purchasing shapes irregular beef consumption habits (eating). In addition, the present findings confirm that

fewer incomes and high prices cause less beef consumption among low-income groups [12,14,15,17,25,32,35,37,56]. In line with Smil's argument [42], the society in eastern Indonesia (having low beef consumption) has not yet transformed into a modern society because regular beef consumption is the proxy of a modern high-income society.

More specifically, the present study also confirms the previous comparative studies between Indonesian regions that the people in the eastern part of Indonesia lack access to certain groups of foods, worsening food security [16,27]. This study also confirms the existence of within-country food access inequality amidst the decline in between-country food access inequality, as found by some scholars [45]. The lacked access to beef contributed to lower meat intake in Indonesia, compared to other countries, as found by a previous study [2]. Moreover, the current study rejects the findings from a previous study in Southeast Sulawesi, one of the eastern part of Indonesia's provinces, stating that incomes positively affect food expenditure [57]. The present study also rejects the findings from a previous study stating that beef prices in a city in the eastern part of Indonesia are affordable [26].

In addition to price and income, irregular beef consumption habits in eastern Indonesia are due to cultural factors, such as the fact that people live primarily in coastal areas (Figure 6, on the bottom). Most of the people in coastal areas consume seafood, not beef. The socio-cultural factor of beef consumption has been argued by previous studies [13,38,44]. It aligns with the findings of some

scholars [40,43] that some people in eastern Indonesia culturally consume more seafood and less meat. In addition, the findings from the present study confirm the previous studies that seafood consumption mostly occurs in coastal countries while meat consumption mainly occurs in landlocked countries [2,39]. Less beef consumption in coastal areas is probably because coastal people lack physical access to beef and better physical access to seafood, leading to seafood preference. As found in this study, irregular beef consumption among coastal people is also associated with the physical accessibility of foods, as argued by some scholars [11,13,29,34].

One consequence of irregular beef consumption is the limited nutritional gain among low-income people in eastern Indonesia because beef contains specific macronutrients and micronutrients. According to Tume [10], beef is one of the rich-nutritious foods containing macronutrients such as protein, lipids/fat, and cholesterol, besides containing energy. In addition, beef contains micronutrients that are important for human growth and health, such as iron, zinc, selenium, vitamin D, vitamin B12, vitamin B6, niacin, vitamin B1, vitamin B2, and pantothenic acid [9]. However, among coastal people in eastern Indonesia, animal-sourced nutrition can be fulfilled from seafood consumption. The present findings emphasise that even though Indonesia has higher beef consumption than other countries at the national level [1], the beef intake at the regional level still demonstrates a disparity. Even if Indonesia has a better rank in food security for general food commodities at the national level [5], accessibility to certain commodity (e.g., beef) still demonstrates disparity among regions and becomes a national challenge.

In sum, the acceptance of some hypotheses (i.e., H_{1b}, H_{2a}, H_{6a}, H_{6b}, and H_{7a}) above confirms the proposed extended model in the literature review section's Figure 2, developed by Turner et al. [13]. The next section covers further discussion of the confirmed model.

5 Conclusion

This study aims to identify the cause of beef purchasing frequency and consumption habits in eastern parts of Indonesia (compared to western Indonesia) and test the workability of Turner's and colleagues' extended model in Figure 2. This study concludes that people in eastern Indonesia purchase beef less frequently than those in western Indonesia. The infrequent purchase of beef in the region is caused by low incomes (proved by the acceptance of H_3 and H_{6a}) and high beef prices (proved by H_{6b}). From the perspective of habit, people in eastern Indonesia have irregular beef consumption habits compared to those in Western Indonesia. It is because people in the region have infrequent purchases of beef, low incomes, and high commodity prices, which are confirmed by H_{7a}, H_{7b}, and H_{7c}.

Regarding Turner et al.'s model in Figure 2, it is partially workable under the non-moderation test that H_{1b} (i.e., the purchasing frequency of beef is affected by incomes) and H_{2a} (the consumption habits of beef are affected by the purchasing frequency of beef) are accepted. Moreover, the extended model in Figure 2 is fully workable under a moderation test with limited variables such as price, income, geographical factor, and food purchase. It is proved by the acceptance of H_{6a}, H_{6b}, and H_{7a}.

This study discloses the phenomenon of food accessibility in some regions of Indonesia that suffer from poor access to beef. It implies that people in the eastern part of Indonesia (a low-income region) have a lower nutritional beef intake. The difference in intake causes different health status. Less nutrition intake from beef can affect the health of people in the region because of macronutrient and micronutrient deficiency. However, less beef consumption has a positive impact by minimising some diseases caused by beef overconsumption.

The present study has some scientific contributions to the literature on access to beef. The findings of this study not only strengthen the previous studies on the impact of price and income on beef consumption in the low-income group [14–17,35] but also successfully prove the extended model of Turner et al. [13] in Figure 2. The extended model works as follows: geographical position (eastern Indonesia, mostly coastal areas), price, and income affect food acquisition (food purchase), and then, food acquisition affects habitual food consumption. However, the extended model in Figure 2 needs further studies with a wide array of exogenous constructs, as proposed by the original study [13]. The consideration of price and income as the predictor of beef acquisition and consuming habits indicates that the present study considered supply push (price) and demand-pull (incomes) in studying beef accessibility, as argued by FAO [28]. Beef acquisition (purchasing) and consumption can be named access to beef. Thus, the present study also contributes to the specific study of the accessibility dimension under a food security framework, as FAO suggested [11,28].

The comparative study between the eastern and western parts of Indonesia also contributes to the comparative study of beef access between the marginal and non-marginal communities in addition to previous studies [29,32,33,38]. The present study also put an emphasis on comparative beef access in developing countries. The present findings of poor accessibility to beef in eastern

Indonesia also contribute to the study of the dimension of regional beef accessibility so that it can enrich existing literature on food access [27,28,30,31]. The geographic dispersion of respondents of the study who live in eastern Indonesia (mostly coastal areas) and western Indonesia (mostly non-coastal areas) indicates that the present study contributes to the comparative study on the access to beef between coastal and non-coastal areas that enrich previous studies explicitly and implicitly comparing typical food consumption between coastal and non-coastal areas [2,39,42]. Lastly, this study found cultural-geographical factors affecting the accessibility to beef. The previous studies argue that beef consumption is affected by cultural or socio-cultural factors or traditions [11,13,38,44,58,59]. The present study argues that geographical factors shape tradition or culture. For example, the geographic situation in coastal areas shapes the culture and tradition of seafood consumption (not beef), as found by some scholars [2,39–41,43].

Besides the scientific contributions, this study makes managerial contributions to improving beef accessibility. The improved beef access aims to improve nutritional quality, leading to improved life quality. It can be done by implementing some efforts to supply affordable beef among people in low-income, marginalised regions and coastal areas, such as increasing the number of cattle farming in the low-income and marginalised region and their neighbouring areas, supplying imported beef to the regions, improving supply chain and business governance of beef, and improving supporting physical infrastructures. In addition, improved access to beef can be conducted through governmental programmes or corporate social responsibility programmes on food (beef) aids to low-income people so that they can fulfil their necessary beef intake. The food aids are relevant because low-income people can increase their beef intake without spending money to purchase it. Thus, their limited incomes can be spent to meet other important daily needs. The economic instruments to enhance incomes are also essential to drive up beef purchasing. The beef intake in coastal areas can also be increased by raising awareness among people in the regions about the importance of food diversification, including animal protein intake, for nutritional balance. Improving food accessibility will contribute to achieving the zero hunger goal of Sustainable Development Goals, as suggested by the UN [60].

The present study has some limitations. In the research design stage, samples were distributed unevenly among all provinces in the eastern and western parts of Indonesia, which may affect the inferences of the results. It might be that the results are only valid for some provinces. In addition

to the lack of sampling, this study partially considers the dimension of food security (only the accessibility dimension) and factors affecting beef consumption. From the perspective of examining the extended model in Figure 2, the present study's findings are not mature and need further studies because this study adopted limited indicators of the food environment.

Finally, this study suggests some potential future research areas. Further studies on the comprehensive model in Figure 2 should be conducted to provide a more valid extended model of the interface between the food environment and the food system. Future studies can be conducted based on commodities (e.g., under beef commodities, other commodities, or food commodities in general) and based on different geographical contexts. In addition, comprehensive studies on the consumer behaviour of beef in archipelagic versus non-archipelagic regions are essential to comprehending consumers' behaviour and accessibility to food in those regions. Finally, further studies on macronutrient and micronutrient intake and health status of people living in archipelagic versus non-archipelagic regions are highly recommended to uncover the state of nutritional intake and health status of the people so that some actions can be conducted to mitigate the deficiency and over-consumption of animal-source protein.

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