Food Security Analysis of Farmer Households in Subwatershed Keduang, Wonogiri Regency, Central Java, Indonesia

Agung Setyarini[1,2,*], *Sri* Marwanti[2], *Joko* Sutrisno[2], and *Endang* Siti Rahayu[2]

[1]Faculty of Agriculture, Department of Agribusiness, Veteran Bangun Nusantara University, Jl. Letjend Sujono Humardani No. 1, Sukoharjo 57521, Indonesia
[2]Doctoral Program of Agriculture Science, Graduate School, Sebelas Maret University, Jl. Ir. Sutami No. 36, Surakarta 57126, Indonesia

Abstract. Food security is the individual ability to access sufficient food physically and economically, safe, and nutritious. Limited fulfillment of food in farmer households is determined by restricted physical access, economical, and another social factor. The geographical conditions of Wonogiri Regency which is dominated by dry land, climate change, and high input prices for agricultural production facilities certainly affect the food security of farmer households. This study aims to determine the proportion of food expenditure; analyze the energy consumption level; and analyze the degree of farmers household's food security in the subwatershed Keduang, Wonogiri Regency, Central Java. This research was conducted in Sidoharjo, Jatipurno, and Jatisrono sub-district with a purposive sampling method. Data analysis was performed using the farmer household's income and expenditure method, energy and protein consumption, and cross indicators between the food expenditure and energy consumption adequacy. The results show that the farmer households food expenditure was IDR 1 571 956 or 61.11 % from the share of total expenditure; energy consumption level of 80.34 % is moderate; the degree of household food security of farmer households shows that 44.44 % are food resistance, 3.33 % are food vulnerable, and 52.22 % are lack of food.

Keywords: Energy consumption, food expenditure, household farmer.

1 Introduction

Food is a basic human need. Food has a meaning and an important role in the life of a nation. The staple food for the Indonesian is rice, so it has a strategic value.

According to Law No. 18 of 2012, food security is a condition for the fulfillment of food for the state to individuals, which is reflected in the availability of sufficient food, both in quantity and quality, safe, diverse, nutritious, equitable, and affordable and does not conflict with religion. beliefs, and community culture, to be able to live healthy, active, and

* Corresponding author: setyoriniagung16@gmail.com

productive in a sustainable manner. Food security is the ability of individuals to access food that is physically and economically sufficient, safe, and nutritious. The definition of food security is based on the availability, access, use of food, and food stability [1].

The state's food security condition which is guaranteed does not always show that household food security is also guaranteed. Household food security is an indicator of regional food security [2]. Income is an important factor for determining household expenses. If household income increases, consumption patterns will become more diverse, this will affect household food consumption that is diverse and nutritious. Household expenditure is one indicator that describes the welfare of the population. The higher the household income, the portion of expenditure will shift from food expenditure to non-food expenditure. Engel's theory states that the higher the income level, the lower the percentage of household expenditure for food consumption.

The portion of food expenditure is an indicator of food security, the larger the portion of food expenditure means less food security. If the distribution of food expenditure is more than 65 % of the total expenditure, then the distribution of household expenditure is categorized as poor [3]. The household with the lowest expenditure, nearly 60 % of total expenditure is used for food expenditure compared to only 40 % for households with the highest expenditure. Cross-classify 80 % of calorie needs with 60 % of total expenditure [4].

Efforts to achieve food security at the household level are not a simple problem. Fulfillment of farmer households food needs is limited, due to the limited access to physical, economic, and other social factors. The geographical conditions of Wonogiri Regency which are dominated by dry land, climate change, and high input prices for agricultural production facilities will certainly affect the food security of farmers' households.

The purpose of this study is to determine the proportion of food expenditure; analyze the level of energy consumption; and analyzing the degree of farmers household food security in the subwatershed Keduang, Wonogiri Regency, Central Java.

2 Methods

This research used a descriptive method. The population in this study were all farmers in subwatershed Keduang, which included Sidoharjo, Jatipurno, and Jatisrono sub-district, Wonogiri Regency, Central Java. The method of determining the research location using purposive sampling, namely the upstream, middle, and downstream areas of the subwatershed Keduang.

The sample was determined by the survey method. Respondents used in this study were 90 farmers. The sampling method of respondents was done proportionally in each selected sub-district so that 90 farmers were selected. Types and sources of research data include primary and secondary data.

2.1 Farmer household income and expenditure

Farmer's household income consists of household income from farming (on-farm) and outside farming (off-farm). Farmers household income is formulated in Equation (1):

$$\mathrm{Pd} = \mathrm{Pd\ on} + \mathrm{Pd\ off} \tag{1}$$

Where,

Pd = Total farm household income (IDR)
Pd on = Income from farming (IDR)

Pd off = Income from outside the farm (IDR)

Total household food expenditure for farmers is calculated by adding up food and non-food expenditures, the Equation (2) is used:

$$TP = Pp + Pn \tag{2}$$

Where,
TP = Total household expenditure of farmers (IDR)
Pp = Food expenditure (IDR)
Pn = Non-food expenditure (IDR)

The proportion of food expenditure to total farm household expenditure. The calculation of the Share of Food Expenditure (PPP) under various conditions and various income groups uses the Equation (3):

$$PPP = \frac{FE}{TE} \times 100\ \% \tag{3}$$

Where,
PPP = Share of food expenditure (%)
FE = Expenditures for food expenditure (IDR mo^{-1})
TE = Total expenditure (IDR mo^{-1})

2.2 Farmers household food consumption

Food consumption is information regarding the type and amount of food consumed by individuals or households at a certain time. Food consumption is calculated using the Equation (4):

$$Gij = \frac{BPj}{100} \times \frac{Bddj}{100} \times KGij \tag{4}$$

Where,
KGij = The content of certain nutrients (i) from food (j) or food is eaten according to its unit
BPj = Weight of food/food consumed (g)
Bddj = Edible portion (in % g^{-1} of 100 % food j)
Gij = Nutrients consumed from food j

The quantity of food consumption can be seen from the volume of food consumed and the consumption of nutrients contained in the food ingredients. To assess food consumption, it is measured by the Energy Consumption Level (TKE) in Equation (5) and the Protein Consumption Level (TKP) in Equation (6):

$$TKE = \frac{AKEi\ aktual}{AKEi} \times 100\ \% \tag{5}$$

$$TKP = \frac{AKPi\ aktual}{AKPi} \times 100\ \% \tag{6}$$

Where,
TKE = Energy Consumption Rate (%)

TKP = Protein Consumption Rate (%)

2.3 Farmers household food security

The level of household food security is measured using a cross indicator between the share of food expenditure and the adequacy of energy consumption [4]. Food security indicators can be seen in Table 1.

Table 1. Measurement of degree of food security at household level.

Energy consumption	Rate proportion of food expenditure	
	Low (< 60 % of total expenditure)	High (≥ 60 % of total expenditure)
Enough (> 80 % energy sufficiency)	1. Food resistant	2. Food vulnerable
Less (≤ 80 % energy sufficiency)	3. Less food	4. Food insecurity

3 Results and discussions

Farmer characteristics are very important and related to agricultural activities that will affect the food security of farming households. Age characteristics of respondents are shown in Table 2.

Table 2. Distribution of respondent farmers by age.

Number	Age (year)	Category	Total respondents (person)	Percentage (%)
1	15 to 64	Productive	64	71.11
2	≥ 65	Unproductive	26	28.89
Amount			90	100.00

Based on Table 2, it shows that most of the respondent farmers (71.11 %) belong to the productive age group who have the potential to apply new technologies and innovations. Productive age has an effect in optimizing their work so that they can generate income to fullfill the household needs which has an impact on household food availability for farmers. On the other hand, the older the farmers, their physical ability decreases, so they need labor assistance, both from within and outside the family [5].

The age had an influence on the farmers absorption and decision making in applying technology or innovation. The age has a significant influence on the application of technology related to income diversification outside of farming [6]. The reason put forward is that age has a negative relationship with physical strength. Therefore, as the head of the household gets older, his work capacity decreases so that he is less likely to be involved in income activities outside of farming. According to Abdullah *et al.* [7], age is an important factor in determining food security status.

The length of farming is a benchmark for farming experience, so it is hoped that the longer a farmer carries out his farming activities, the more experienced he will be in running his farm and the better he will be in managing his farm [8]. The length of time in farming can be seen in Table 3.

Table 3. Distribution of respondent farmers by length of farming.

Number	Length of farming (year)	Total respondent (person)	Percentage (%)
1	< 10	1	1.11
2	10 to 20	8	8.89
3	>20	81	90.00
Amount		90	100.00

The number of family members affects the income and food consumption of farming households. The number of family members can be seen in Table 4.

Table 4. Distribution of respondent farmer by number of family members.

Number	Number of family members (person)	Category	Number of respondents (person)	Percentage (%)
1	1 to 3	Small	65	72.22
2	4 to 6	Medium	24	26.67
3	> 6	Large	1	1.11
Amount			90	100.00

Based on Table 4, it is known that 72.22 % of respondent farmers have a relatively small number of family members. Many members of the respondent's farmer family went to migrate outside the city or the island to earn a living. Farmers' children who have graduated from high school would leave and do not want to become farmers in the village. The larger households tend to weaken the household income because it increases consumption expenditure, thus leaving little or no funds available for further activities outside of agriculture [6]. This contradicts by Asravor; Mango *et al.* [9, 10] states that a larger household size means having a large number of workers thus increasing income and allowing for diversification activities outside of agriculture to increase income. The availability of large household labor reflects the human resources available to households for agronomic activities so that food security is more secure because they can carry out farming activities on time.

According to Niragira *et al.* [11] the household structure determines the availability of labor, this is not the case with the condition of farmer households in the study area because farmers use labor outside the family in cultivating their farming. Labor within the family only the head of household and his wife. When cultivating the land, planting and harvesting are all carried out by workers outside the family, while plant care and fertilization activities are carried out by workers in the family.

Household size is also decisive for the farmers to adopt the technology. Larger households have more family labor which can be used to practice the technology [12].

The level of education affects one's way of thinking, attitude and mentality, and determines one's tendency to respond to new things. The education level of respondent farmers can be seen in Table 5.

Table 5. Distribution of respondents farmers by education.

Number	Education	Amount	Percentage (%)
1	Elementary school (0 yr to 6 year)	65	72.22
2	Junior high school (7 yr to 9 year)	9	10.00
3	High school (10 yr to 12 year)	16	17.78
Amount		90	100.00

Based on Table 5 shows that the highest level of education of family heads in elementary school at 72.22 %. According to Ehiakpor *et al.* [12], states that the educational level did not affect the farmers in adopting the technology, but gender, marital status, the experience of farmers, and institutional factors are affecting farmers in adopting the technology in Ghana.

3.1 Household income

The source of household income for the respondent farmer is obtained from on and off farming. The amount of income of respondent farmers can be seen in Table 6.

Table 6. Average income of respondent.

Number	Source of income	Income per month (IDR)	Percentage (%)
1	On farm	724 372	27.74
2	Off farm	1 886 667	72.26
Amount		2 611 039	100.00

Table 6 shows that 72.26 % of the farmers' household income comes from off-farm. Low household income also affects farmer household food consumption. Low rice farming income is due to the topography in the Keduang sub-watershed area and influenced by prices at harvest, where food availability is high while prices are low [11].

The topography of the study area is mostly hilly land with different slopes. Paddy fields in the study area are not in a flat land, it also affects the rice productivity. That kind of topography also affects water irrigation. Lack of technical irrigation means that paddy fields can only be planted two times a year. Climate change [13], erratic rainfall, and poor soil conditions are challenges in increasing rice productivity [14].

Paddy fields can only be planted in the first planting season (November to February) and in the second planting season (March to June), while in the dry season (July to October) the fields can not be cultivated because they only rely on rainwater. In the dry season, many family heads work outside the region, either as traders or construction workers.

Diversification incomes will reduce poverty and improve the welfare of small farmers [6]. In line with the research by Niragira *et al.* [11] states that most of the majority of farming households have jobs off-farm to sustain family life. Jobs outside farming are as traders, construction workers, carpenters, drivers, and so on. Besides, it is also supported by income housewives who work as traders, laborers, and so on.

Farm households require off-farm income as a solution for survival, but the income is not reinvested into agricultural production. This income is used to become a way to access food, to build a family home, and nothing more than a household's survival [11].

3.2 Household expenditures

Household expenditure consists of food and non-food expenditure. Food consumption include grains (rice, glutinous rice, corn, rice flour, etc.), tubers (cassava, sweet potato, taro, potato, etc.), fish (fresh fish and fish preserves), meat, eggs and milk, vegetables, nuts (tofu, tempeh, soybeans, etc.), fruit, oils and fats, beverage ingredients (sugar, tea, coffee, etc.), seasonings (salt, soy sauce, pepper, other spices), other food (instant noodles, noodles, noodles, crackers, and other), cigarettes and tobacco. The amount of food expenditure of farmer households can be seen in Table 7.

Table 7. The average food expenditure of farmer household.

Number	Food expenditure	IDR per month	Percentage (%)
1	Cereals	270 167	17.19
2	Tubers	44 400	2.82
3	Fishes	167 778	10.67
4	Meats	142 944	9.09
5	Egs and milk	294 067	18.71
6	Vegetables	63 600	4.05
7	Nuts	85 467	5.44
8	Fruits	97 067	6.17
9	Oil dan fat	135 700	8.63
10	Beverages	81 978	5.22

Continue on the next page.

Table. 7 Continue.

11	Seasonings	70 889	4.51
12	Foodstuffs	61 467	3.91
13	Cigarettes and tobacco	56 422	3.59
Amount		1 571 946	100.00

The largest food expenditures were eggs and milk, cereals, and fish, amounting to 18.71 %, 17.19 %, and 10.67 % respectively of the total food expenditure. The largest proportion of farmer household food expenditure is eggs and milk and fish. According to research by Korir *et al.* [15] that shopping for meat and milk is higher than buying staple foods such as cereals and bread. This is due to the fact that food prices are relatively more expensive when compared to other food prices. According to Statistics Indonesia (*Badan Pusat Statistics* - BPS) [16] the average egg consumption of rural communities is around eight eggs per month. Eggs and fish are still consumed because these foods are easily obtained in the study area, and the prices are also more affordable than meat. Access to farmers' household market is easier to get these foodstuffs. Farmers household usually obtain eggs and milk from local food stalls, grocery stores, and markets.

The expenditure on cereals is lower because farmer households mostly consume rice from their own harvest. This is consistent with Galli *et al.* [17] that small farmer households usually consume most of what is produced. Consumption of food sources of carbohydrates indicates that rice has become the dominant staple food pattern and has a single character. Farm households rarely consume local food other than rice. Sources of carbohydrates as a source of energy consumed other than rice are cassava and sweet potato. Local foods such as tubers (taro, suweg, uwi-uwian (*Dioscorea esculenta* L.) are rarely consumed.

Non-food expenditures include housing (rent/contract, electricity costs, LPG, water), miscellaneous goods and services (soap, laundry soap, toothpaste, gasoline, communication costs, vehicle maintenance costs, etc.), education costs (school fees, books, and stationery), health costs (drugs, hospital costs, doctor/midwife), clothing, durable goods (kitchenware and household appliance), taxes (property tax, vehicle tax), social needs (marriage, death, circumcision, religious celebrations, and traditional celebrations). The amount of non-food expenditure of farmer households can be seen in Table 8.

Table 8. The average non food expenditure of farmer household.

Number	Non food expenditure	IDR per month	Percentage (%)
1	Housing	147 133	14.71
2	Miscellaneous goods and services	299 261	29.91
3	Education costs	52 111	5.21
4	Health costs	53 056	5.30
5	Clothing	73 333	7.33
6	Durable goods	80 333	8.03
7	Taxes	43 987	4.40
8	Social needs	251 222	25.11
Amount		1 000 436	100.00

Table 8 shows that the largest non-food expenditures are various goods and services, social needs, and housing amounting to 29.91 %, and 25.11 %, respectively, and 14.71 % of the total non-food expenditure. Social needs include donations for marriage, circumcision, death, religious activities, and customary activities. This can be understois understandable because the culture in the research area is still closely related to social solidarity. In this culture, individuals who are not involved in social activities will receive targeted sanctions in the form of social and community gossip or direct strikes, while research conducted by Khalili *et al.* [18] showed that the cost of education expenditure is necessary. Rural farming households in Iran affected by drought increase their spending on the education of their children. The income elasticity analysis shows that a 1 % decrease in farm income causes an increase in education spending by 0.86 %.

3.3 The proportion of food and non-food expenditure against total household expenditure

According to Engel's Law, the share of food expenditure will decrease as income increases. The share of household expenditure for respondent farmers was 61.11 %, indicating that the farmer's household was not prosperous. When compared with national data [16] the share of household food expenditure of respondent farmers is greater than the share of food expenditure in aggregate of 50.64 % and the share of food expenditure in rural areas is 57.25 %. This indicates that the welfare of farmer households in the research area is worse than the welfare of national rural households. The amount of food and non-food expenditure of farmer households can be seen in Table 9.

Table 9. The proportion of food and non-food expenditure for total expenditure of farmer households.

Number	Expenditure	Amount (IDR per month)	Percentage (%)
1	Food expenditure	1 571 946	61.11
2	Non-food expenditure	1 000 436	38.89
Amount		2 572 382	100.00

The proportion of food expenditure is higher than that the non-food, indicating that farmer households are not yet prosperous. The welfare of influence on household economic access to food also affects the quantity and quality of food consumed [2]. Market access has an important influence on small farmers because of the easy market access farmers have off-farm income sources and increasing the diversity of nutrients [19, 20].

Food utilization is measured by the consumption approach. Food consumption is the type and amount of food consumed by households or individuals at a certain time. In this study, the recall method was used to calculate energy and protein intake by recording all food intake of all farm household members within 24 hours. The amount of energy and protein consumption of farmer households can be seen in Table 10.

Table 10. The average of energy and protein consumption and the level of nutritional consumption of farmer households.

Nutrient content	Nutritional adequacy rate	Average nutritional adequacy	Percentage (%)
Energy (kkal person^{-1} d^{-1})	2167.26	1687.16	80.34
Protein (g person^{-1} d^{-1})	60.05	54.69	95.94

The results showed that the average nutrient consumption rate (TKG) of farmer household energy was 80.34 % when compared to the recommended energy nutritional adequacy ratio (AKG) of 2 100 kcal per person per day. The population whose staple food is rice are at risk of deficiency in micronutrient sources (minerals and vitamins), even though rice is a good source of energy. This nutritional deficiency can be overcome by diversifying food [14].

The level of consumption of protein nutrition (TKG) is 95.94 % of the recommended amount of 57 g per person per day. The average protein adequacy rate is almost equal to the recommended protein adequacy rate (AKP), this is presumably because household preferences affect choosing and consuming food, both quantity, and quality, not only in consideration of income but also the taste and socio-culture of the local community.

Housewife education has an important role in household food security because housewives provide a variety of foods to suffice family nutrition [7], but food consumption is also influenced by income and access to food [20]. The average percentage of energy and protein consumption of farmer household in the Keduang Subwatershed area can be seen in Table 11.

Table 11. Distribution of energy and protein consumption of farmer households.

Level of nutrition adequacy	Energy		Protein	
	Number of households	%	Number of households	%
Good (TKG ≥ 100 % AKG)	8	8.89	36	40.00
Moderate (TKG 80 % to 99 % AKG)	36	40.00	30	33.33
Less (TKG 70 % to 80 % AKG)	22	24.44	5	5.56
Defisit (TKG < 70 % AKG)	24	26.67	19	21.11
Amount	90	100.00	90	100.00

Table 11 shows that the level of protein consumption by farm households is better than the level of energy consumption. Farmer households rely on rice as an energy source. Apart from rice, foodstuffs as a source of energy consumed by farmer households are cassava and sweet potato.

The results of the research on farmer households in the Keduang sub-watershed area shows that around 8.89 % of households have good energy consumption levels, and 40 % with moderate levels of energy consumption, 24.44 % less, and 26.67 % deficits. The level of protein consumption in the good category of farmer households is 40 % adequacy of protein either within the household farmers have fulfilled their animal protein intake of eggs, fish and meat. Eggs and fish are food items that are easily available in traditional markets in the research area. Market access has an important and significant role in food diversity [19, 21]. Vegetable protein is obtained from tofu and tempeh. Where the price of these foodstuffs is relatively cheaper than animal protein.

Household food security is calculated using the cross-classification of Food Expenditure Share and Energy Adequacy Level. The level of food security of farmer households can be seen in Table 12.

Table 12. Food security of farmer households.

Level of food security	Number of households	Percentage (%)
Food Resistant : > 80 % energy sufficient and food expenditure < 60 % total expenditure	40	44.44
Food Vulnerable : > 80 % energy sufficient and food expenditure ≥ 60 % total expenditure	3	3.33
Lack Food : ≤ 80 % energy sufficient and food expenditure < 60 % total expenditure	47	52.22
Food Insecure: ≤ 80 % energy sufficient and food expenditure ≥ 60 % total expenditure	0	0.00
Amount	90	100.00

Table 12 shows that 44.44 % of farmer households are food resistant, 3.33 % are vulnerable and 52.22 % lack food. The results shows that the proportion of the food expenditure share and the level of energy consumption of household farmers were less food category amounted to 52.22 %. A low proportion of food expenditure (< 60 % of total expenditure) does not mean that the farmers' household income in the research area is already high. The low food expenditure is because most of the farmer households consume their own harvested rice as an energy source. The high non-food expenditures are caused by housing costs (electricity, water, LPG, etc.), costs of miscellaneous goods and services (soap, laundry soap, shampoo, vehicle maintenance costs, etc.), as well as social costs. The low level of energy consumption is caused by a lack of knowledge about food nutrition, so that many households have not reached a good level of energy consumption. Therefore, the role of housewives is needed to adjust the food menu to be more varied and highly nutritious [22].

The results of the study by Galli *et al.* [17], explain that small farming contributes to nutrition, food security, and has an impact on socio-economic and other environments for farm households at the local, regional and global levels. To ensure food and nutrition security from the supply side are technologies and practices that support adaptation to climate change, linking to food markets, the need for collaboration and collective action to ensure adequate access to markets, and consumer habits and preferences [23].

4 Conclusion

The share of household food expenditure for farmers is IDR 1 571 956 (61.11 %) of non-food expenditure of IDR 1 000 436 (38.89 %) and total expenditure of IDR 2 572 382. It shows that farmer's households have not yet prosperous. Energy consumption level of 1 687.16 kcal person^{-1} d^{-1} or 80.34 % of the recommended energy consumption level. Farmer's household energy consumption level is in the moderate category. The degree of household food security based on the criteria for food classification and the adequacy of energy consumption shows that 44.44 % of farmer households are food resistant, 3.33 % are food vulnerable, and 52.22 % are lack of food.

References

1. K. Reincke, E. Vilvert, A. Fasse, F. Graef, S. Sieber, M.A. Lana, Food Secur., **10**: 911–924 (2018) https://doi.org/10.1007/s12571-018-0814-3
2. A. Arida, S. Sofyan, K. Fadhiela, J. Agrisep, **16**,1: 20–34 (2015) [in Bahasa Indonesia] https://jurnal.usk.ac.id/agrisep/article/view/3028
3. National Food Agency. *Peta Ketahanan dan Kerentanan Pangan* [Food Security and Vulnerability Atlas (FSVA)] [Online] from https://fsva.badanpangan.go.id/ (2020) [in Bahasa Indonesia]
4. D. Maxwell, C. Levin, M. Armar-Klemesu, M. Ruel, S. Morris, C. Ahiadeke, *Urban livelihoods and food and nutrition security in greater accra, Ghana*. International Food Policy Research Institute (2000). p.172 https://www.researchgate.net/publication/5056934_Urban_livelihoods_and_food_and_nutrition_security_in_Greater_Accra_Ghana
5. K. Suratiyah, *Ilmu usaha tani* [Agricultural science]. Jakarta: Penebar Swadaya (2015) [in Bahasa Indonesia]
6. G. Danso-Abbeam, G. Dagunga, D.S. Ehiakpor, Heliyon, **6**,11: 1–11 (2020) https://doi.org/10.1016/j.heliyon.2020.e05393
7. A. Abdullah, D. Zhou, T. Shah, S. Ali, W. Ahmad, I.U. Din, et al., J. Saudi Soc. Agric. Sci., **18**,2: 201–210 (2019) https://doi.org/10.1016/j.jssas.2017.05.003
8. H. Ernantje, W. Wiendiyati, S.S.P. Pudjiastuti, L. Bernadina, L.R. Levis, Bulletin Excellentia, **8**,2: 186–195 (2019) [in Bahasa Indonesia] https://core.ac.uk/download/pdf/270189104.pdf
9. R.K. Asravor, J. Int. Dev., **30**,8: 1318–1338 (2017) https://doi.org/10.1002/jid.3330
10. N. Mango, B. Zamasiya, C. Makate, K. Nyikahadzoi, S. Siziba, Dev. South. Afr., **31**,4: 625–640 (2014) https://doi.org/10.1080/0376835X.2014.911694

11. S. Niragira, J. Ndimubandi, J.V. Orshoven, Encyclopedia Food Sec. Sustain., **1**: 534–539 (2019) https://doi.org/10.1016/B978-0-08-100596-5.22375-5
12. D.S. Ehiakpor, G. Danso-Abbeam, G. Dagunga, S.N. Ayambila, Technol. Soc., **59**,101189: 1–8 (2019) https://doi.org/10.1016/j.techsoc.2019.101189
13. J.S. Bandara, Y. Cai, Econ. Anal. Policy, **44**,4: 451–465 (2014) https://doi.org/10.1016/j.eap.2014.09.005
14. B.B. Abera, B. Terefe, K. Baye, N. Covic, Encyclopedia Food Sec. Sustain., **3**: 257–263 (2019) https://doi.org/10.1016/B978-0-08-100596-5.21538-2
15. L. Korir, M. Rizov, E. Ruto, Econ. Model., **92**: 99–108 (2020) https://doi.org/10.1016/j.econmod.2020.07.015
16. BPS-Statisticsc Indonesia, *Excecutive summary of consumption and expenditure of population of Indonesia*. Jakarta, BPS-Statistics Indonesia (2018). p.78 https://www.bps.go.id/publication/2018/11/01/a865996eaf45bd695d95a7d8/ringkasan-eksekutif-pengeluaran-dan-konsumsi-penduduk-indonesia-maret-2018.html
17. F. Galli, S. Grando, A. Adamson-Fiskovica, H. Bjørkhaug, M. Czekaj, D.G. Duckett, et al., Glob. Food Sec., **26**,100427: 1–12 (2020) https://doi.org/10.1016/j.gfs.2020.100427
18. N. Khalili, M. Arshad, Z. Farajzadeh, H. Kächele, K. Müller, J. Environ. Manage, **260**: 110136 (2020) https://doi.org/10.1016/j.jenvman.2020.110136
19. M. Qaim, K.T. Sibhatu, V.V. Krishna, *Market access and farm household dietary diversity* [Online] from https://www.rural21.com/fileadmin/downloads/2016/en-01/rural2016_01-S12-14.pdf (2016)
20. E.N. Kihiu, F. Amuakwa-Mensah, Food Policy, **100**: 102004 (2021) https://doi.org/10.1016/j.foodpol.2020.102004
21. R. Nandi, S. Nedumaran, P. Ravula, Glob. Food Sec., **28**,100484: 1–13 (2021) https://doi.org/10.1016/j.gfs.2020.100484
22. S. Suyudi, H. Nuryaman, M.I. Mamoen, T. Tedjaningsih, J. Agribisnis Terpadu, **13**,1: 91–107 (2020) [in Bahasa Indonesia] http://dx.doi.org/10.33512/jat.v13i1.7631
23. L. Arnalte-Mur, D. Ortiz-Miranda, P. Cerrada-Serra, V. Martinez- Gómez, O. Moreno- Pérez, R Barbu, et al., Glob. Food Sec., **26**,100395: 1–8 (2020) https://doi.org/10.1016/j.gfs.2020.100395