

Analysis of Food Security and Livestock-Based Food Consumption Patterns among Poor Households in the Coastal Area of Demak Regency

Analisis Ketahanan Pangan dan Pola Konsumsi Pangan Ternak pada Rumah Tangga Miskin di Wilayah Pesisir Kabupaten Demak

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ABSTRACT

Demak Regency, despite being a food-producing area, faces potential food insecurity. This study analyzed household income, food and non-food expenditures, spending and consumption of livestock-based foods, and food security based on energy adequacy levels (EAL) and the share of food expenditures. The role of animal protein consumption was emphasized due to its importance in improving nutrition and food security among poor households. The research was conducted from October 2024 to March 2025 in Sayung (Tugu, Banjarsari) and Bonang (Purworejo, Morodemak) Subdistricts, purposively selected for their highest poverty levels. Using a survey of 104 households, data were collected through interviews, 2×24-hour food recall, and observation. The results showed that average income IDR 1,790,290.89/month; food expenditure IDR 1,041,490.40; livestock-based food expenditure IDR 193,389.42; non-food expenditure IDR 744,884.16; livestock-based food consumption 48.10 g/capita/day; food insecurity dominated (73.08%), while 26.92% were food secure.

Kata Kunci: Household Food Security, Household Income, Food Expenditure, Energy Adequacy Level

ABSTRAK

Kabupaten Demak berpotensi mengalami kerawanan pangan, meskipun merupakan wilayah penghasil pangan. Tujuan dari penelitian ini adalah untuk menganalisis pendapatan rumah tangga, pengeluaran pangan, pengeluaran non-pangan, dan kondisi ketahanan pangan berdasarkan tingkat kecukupan energi serta proporsi pengeluaran pangan. Penelitian ini dilaksanakan dari bulan Oktober 2024 hingga Maret 2025 di Kecamatan Sayung (Desa Tugu dan Banjarsari) dan Kecamatan Bonang (Desa Purworejo dan Morodemak). Lokasi penelitian dipilih secara purposif berdasarkan pertimbangan tertentu, dengan mengambil daerah yang memiliki jumlah rumah tangga miskin tertinggi. Metode penelitian yang digunakan adalah survei. Jumlah sampel sebanyak 104 rumah tangga. Metode pengumpulan data menggunakan wawancara dengan kuesioner terbuka, food recall 2x24 jam, dan metode observasi. Data yang digunakan terdiri dari data primer dan sekunder. Metode analisis kondisi ketahanan pangan menggunakan analisis silang (cross-classification) antara Tingkat Kecukupan Energi (TKE) dan pangsa pengeluaran pangan. Hasil penelitian menunjukkan bahwa: 1) rata-rata pendapatan rumah tangga miskin di Kabupaten Demak adalah Rp 1.790.290,89 per bulan; 2) rata-rata pengeluaran untuk konsumsi pangan sebesar Rp 1.041.490,40 per bulan; 3) rata-rata pengeluaran non-pangan sebesar Rp 744.884,16 per bulan; 4) kondisi ketahanan pangan rumah tangga miskin di wilayah pesisir didominasi oleh kategori rawan pangan sebesar 73,08% dan sisanya 26,92% masuk dalam kategori aman pangan

Keywords: Ketahanan Pangan Rumah Tangga, Pendapatan Rumah Tangga, Pengeluaran Pangan, Tingkat Kecukupan Energi

INTRODUCTION

Maintaining global food security is essential to ensure that individuals, households, and nations consistently have access to food. Moreover, food production will need to grow by 50 to 70% by 2050 in order to meet the demands of an additional two billion people (Ingram *et al.*, 2012). A primary cause of food insecurity is the inability to afford a nutritious diet because of limited purchasing power (Riches and Silvasti, 2014; Pollard and Booth, 2019; FAO, 2018). Food security remains a critical challenge for many households (Penne & Goedemé, 2021; Singh *et al.*, 2021; Fang *et al.*, 2022), especially those living in vulnerable coastal regions such as Demak Regency. A household is considered food insecure when it cannot afford or consistently access sufficient quantity and quality of food necessary for a healthy life (Obayelu & Orosile, 2015). According to Akbar *et al.* (2023), household food security is attained when all household members have adequate food intake, ensuring both the amount and nutritional quality are sufficient.

Meanwhile, protein deficiency is not only a crucial issue that affects the quality of future generations but also poses a serious threat to food security, as it reflects the inability of food systems to provide sufficient, nutritious, and accessible protein sources essential for a healthy and productive population. There is evidence showing that insufficient protein intake can negatively affect growth and cognitive development (Grantham-McGregor and Baker-Henningham, 2005; Stephenson *et al.*, 2010). According to Wu (2016) and Qin *et al.* (2022) protein is essential for human health and development, and therefore it affects our future quality of life.

However, the livestock sector offers promising solutions to improving food security by ensuring a steady supply of high-quality protein. Livestock products contribute about 13 percent of the world's total calorie intake and around 28 percent

of protein consumption, making them an important part of the global food security (Falvey, 2015). By providing accessible and sustainable protein sources, these sectors play a vital role in supporting nutritional needs and promoting long-term health, especially in the face of growing global food demands.

In low-income rural households, livestock are typically viewed as valuable assets. Building up livestock holdings enables these households to invest in small enterprises, diversify their sources of income, and reduce poverty, factors that collectively contribute to improved food and nutrition security (Ellis & Freeman, 2004). Livestock ownership is gaining prominence in food security strategies due to the multiple benefits farm animals offer, including nutrient-rich foods, steady income, and various other advantages (Jodlowski *et al.*, 2016). Livestock contribute variably to household income in many developing countries, from 2% to more than 33% in a number of developing countries (Staal *et al.*, 2009; Pica-Ciamarra *et al.*, 2011).

The findings by Jones *et al.* (2014) indicated that integrating livestock into cropping systems was associated with increased farm and household dietary diversity. Further, according to Megersa *et al.* (2014), their study found that greater diversity in livestock and higher per capita livestock holdings were strongly linked to better household food security. Regassa and Stoecker (2012) also found that the variety of livestock species owned by a household has an impact on its food security status. Bleich *et al.* (2005) showed that diversifying livestock can play an important role in enhancing food security and increasing the income of low-income households. Several studies also have examined the extent to which livestock savings contribute to household food security (Kazianga & Udry, 2006; Hänke & Barkmann, 2017). According to Rodríguez *et al.* (2016) selling livestock products can increase income for poor households, therefore will increase the food security

condition, however it does not always lead to better nutrition. Moreover, according to Banda & Tanganyika (2021) and Zant (2023), livestock perform various essential functions within rural livelihoods, providing both direct and indirect benefits to local communities.

From the discussion above, it can be understood that livestock consumption or ownership serves two main functions: (1) enhancing access to animal-source nutrition, thereby strengthening the “utilization” dimension of food security. Similar conclusions were drawn by Bundala *et al.* (2020), who found that households engaged in livestock keeping consume more animal-source foods than others, which in turn reinforces food security; and (2) acting as a liquid asset that can be sold when food access or income declines, thus strengthening the “stability” dimension of food security.

Despite these recognised importance of livestock products for food security, several gaps remain in the literature especially when focusing on poor households in coastal regions. The intersection of household food security, livestock-source food consumption, and poor coastal households remains under-explored. Much of the food security literature focuses on staple crops or fisheries and less on livestock-source food consumption among the poorest households, particularly in coastal zones. Moreover, there is limited empirical evidence on how the consumption of livestock-derived foods (and the household’s access to them) contributes to the multiple dimensions of household food security (availability, access, utilisation, stability) in poor, coastal location. These gaps underscore the need for a focused examination of how livestock-derived food consumption interplays with household food security among poor coastal households.

METHOD

This research was conducted from October 2024 to March 2025 in Sayung District (Tugu and Banjarsari Villages/Sub-districts) and Bonang District (Purworejo and Morodemak Villages/Sub-districts). The

method used in this study was a survey. The selection of districts and villages was done purposively, considering the highest number of poor households according to the Target Data for the Acceleration of Extreme Poverty Eradication (P3KE) 2023 in Demak Regency. The total number of samples was calculated using the Taro Yamane formula (1973), as cited in Ferdinand (2006), as follows.

$$n = \frac{N}{(N \times d^2) + 1}$$

n : sample size

N : population size

d : margin of error (10%)

Therefore,

$$n = \frac{2.463}{(2.463 \times 0,1^2) + 1}$$

$$n = \frac{2.463}{(2.463 \times 0,01) + 1}$$

$$n = \frac{2.463}{25,63}$$

$$n = 96,10 \sim \text{rounded up } 97$$

The sample size was increased by 7.5% to anticipate potential respondent dropouts, bringing the total number of respondents included in the study to 104 respondents. The number of respondents in each village was determined using a proportional random sampling approach, resulting in a total sample of 104 households. The formula for proportionate quota sampling is as follows:

$$N_i = \frac{N_k}{N} \times n$$

N_i : the number of household samples to be taken from each village

N_k : the total number of poor households in each village

N : the total population

n : the total number of samples to be taken

Table 1. Number of Respondent Households in Each Village

Number	Sub-District	Village	Nk	N	n	Ni
1	Sayung	Tugu	677	2.463	104	29
2		Banjarsari	376	2.463	104	16
3	Bonang	Purworejo	710	2.463	104	30
4		Morodemak	700	2.463	104	29
Total						104

The distribution of 104 sample households by sub-district and village in the coastal area of Demak can be seen in Table 1. The data collection techniques in this study used several methods, including interviews, 2x24-hour food recall, and observation. Meanwhile, the analysis of food security among poor households is assessed by cross-analyzing food expenditure shares and energy consumption measures (Maxwell *et al.*, 2000).

Energy Consumption Adequacy

This indicator measures the proportion of energy (calorie) intake of a household relative to the recommended daily energy requirement. The steps involved are:

□ Data Collection: Household food consumption data were collected using a structured questionnaire that includes a 2-days food recall section. Respondents reported the types and quantities of food consumed by the household.

□ Conversion to Energy: The reported food items were converted into energy (kilocalories) using the Indonesian Food Composition Table (Daftar Komposisi Bahan Makanan - DKBM).

□ Adequacy Level: The total household energy consumption was then compared to the household energy requirement. A household is classified as:

Sufficient: if the energy intake $\geq 80\%$ of the required intake

Insufficient: if the energy intake $< 80\%$ of the required intake

Food Expenditure Share

This indicator reflects the proportion of household income or total expenditure that is allocated to food, which serves as a proxy for household vulnerability.

□ Data Collection: The questionnaire included sections on monthly household expenditure, broken down into food and non-food components.

□ Calculation: Food expenditure share = (Food expenditure / Total household expenditure) $\times 100\%$

□ Classification:

Low: $< 60\%$ of total expenditure

High: $\geq 60\%$ of total expenditure

Household Expenditure on Animal-Sourced Foods from Livestock

Here is the formula for calculating expenditure on animal-based food products derived from livestock.

$$PF = x \ 100\%$$

Description:

PF = Share of household expenditure on animal-sourced foods from livestock (%)

PT = Expenditure on animal-sourced foods from livestock (IDR/month)

TP = Total household expenditure on both food and non-food items (IDR/month).

Non-Food Expenditure

The formula for calculating non-food expenditure is:

$$\text{Non-food Expenditure} = \text{Total Expenditure} - \text{Food Expenditure}$$

Table 2. Food Security Classifications

Energy Consumption	Food Expenditure Shares	
	Low (<60% of total expenditure)	High (>60% of total expenditure)
Sufficient (>80% from the level of energy adequacy)	Food Secure (Food Secure)	Food Vulnerable (Food Insecure)
Insufficient (<80% from the level of energy adequacy)	Food Less Secure (Food Insecure)	Food Insecure (Food Insecure)

Total Consumption of Animal-Based Foods from Livestock Products

The data on the consumption of animal-based foods from livestock among low-income households were collected using the 2x24-hours food recall method. In this method, respondents were asked to report all animal-based foods derived from livestock that they had consumed during the previous 2x24 hours. The quantities of food consumed were recorded in Household Measures (URT), which were then converted into grams. Here is the formula for calculating the consumption of animal-sourced foods from livestock.

$$G_j = \left(\frac{B_{pj}}{100} \times \frac{B_{ddj}}{100} \right) \times K G_j$$

Description:

G_j = amount of protein consumed from animal-based foods derived from livestock (grams)

B_{pj} = weight of food consumed (grams)

$K G_j$ = protein content per 100 grams of food consumed

B_{ddj} = edible portion of 100 grams of food (%)

Food Security Analysis

Based on the combination of the two indicators above (food expenditure shares and energy consumption), households are categorized as follows (Tabel.2). The classification of food security in this study follows the framework proposed by Maxwell (2000), which combines two key indicators: energy consumption adequacy and food expenditure share. These two indicators are

used together to categorize households into four food security statuses: Food Secure, Food Less Secure, Food Vulnerable, and Food Insecure.

Chi-Square Test

A Chi-Square test was employed to assess the statistical relationship between energy consumption adequacy and food expenditure share. The test aimed to confirm whether differences in energy adequacy levels are associated with variations in household food expenditure patterns.

RESULT AND DISCUSSION

Overview of the Research Location

Sayung District

In the fisheries sector, the primary catches consist of mackerel at 43.13 tons, crabs at 499.65 tons, and shrimp at 83.67 tons. Among these, crabs contribute the highest production value, reaching IDR 3,755,422,298.67. The production of aquaculture fisheries include water fisheries at 601.11 tons, open water fisheries at 211.18 tons, and brackish water pond at 2,447.39 tons. The highest production value of aquaculture by commodity is brackish water pond at IDR 80,228,566,209 (Sayung District Central Bureau of Statistics, 2023).

In the livestock sector, the animal population in Sayung Subdistrict includes 98 cows, 24 buffaloes, 3 horses, 595 goats, 578 sheep, and 185 rabbits. Cow meat has the highest production volume among livestock, totaling 43,798 kg per year. As for poultry, the population includes 10,672,504 broiler chickens, 17,288 native (kampong)

Table 3. Characteristics of Respondent Households in Demak Regency

Number	Component	Average Result
1	Age (years)	
	a. Husband	55.43+11.31
	b. Wife	52.01+14.34
2	Education Level (years)	
	a. Husband	6.55+1.88
	b. Wife	5.88+2.92
3	Household Size (person)	3.73+1.48

chickens, 8,229 ducks, 2,482 geese/turkeys, and 5,000 quails. Broiler chickens account for the largest poultry meat production, with a total of 10,672,504 kg annually. Poultry egg production by type includes 23,752 eggs from purebred chickens, 68,352 from ducks, and 9,942 from quails (Sayung District Central Bureau of Statistics, 2023).

Bonang District

Besides the agricultural sector, the fisheries and marine sectors have also developed, largely due to the fact that Bonang Subdistrict is located along the northern coast of Java Sea. As a coastal area, it is naturally dominated by an abundance of marine resources. In the fisheries sector, the main catches include anchovies with a production volume of 1,048.20 tons, mackerel at 1,116.49 tons, crabs at 5,094.81 tons, cobs at 594.59 tons, and shrimp at 11.66 tons. The highest production value is from crabs, amounting to IDR 38,017,855,369.21. Production of aquaculture by commodity in Bonang District include freshwater fisheries at 8,559.87 tons, open water fisheries at 33.47 tons, brackish water pond at 2,367.03 tons. The aquaculture commodity with the highest production value is freshwater fisheries, amounting to IDR 137,925,553,174 (Bonang District Central Bureau of Statistics, 2023).

In the livestock sector, the animal population in Bonang Subdistrict includes 48 cows, 145 buffaloes, 13 horses, 1,614 goats, 1,815 sheep, and 78 rabbits. The highest meat production is from cow, reaching 14,533 kg per year. Meanwhile, poultry population

includes 12,000 layer chicken, 2,944,250 broiler chickens, 77,270 kampung chickens, 9,697 ducks, 551 geese/turkeys, 625 quails. The largest poultry production comes from broiler chickens, with a total output of 2,944,250 kg per year. Egg production by poultry type consists of 143,660 eggs from purebred chickens, 14,400 eggs from free range chicken, 76,318 eggs from ducks.

Household Characteristics

The characteristics of respondent households describe the general conditions and backgrounds of the respondent households. The respondent characteristic data in this study include age, education level, and number of family members. The following data present the characteristics of respondent households in Demak Regency, as shown in Table 3.

Based on Table 3, it can be seen that the average age of husbands in poor households in the coastal area is 55 years, while for wives it is 52 years. The average age of the husbands and wives of the respondents is still within the productive age range, although they are nearing retirement, so they are still capable of engaging in productive activities that can increase income and strengthen their household food security. This is supported by Simanjuntak (1985) in Suparmin and Dipokusumo (2022), who state that the productive age population is those aged between 15 and 64 years, where age is closely related to productivity as a workforce since age affects a person's physical ability to manage their business. For housewives, age can also

influence their way of thinking in decision-making, including decisions regarding the selection and presentation of food types for family members, which ultimately affects their food security condition.

On the other hand, the formal education of individuals within a household is a significant factor influencing the household's food security condition. The respondent households in this study have varied formal education backgrounds, ranging from not completing elementary school to completing high school. The education levels of both the heads of households and their wives in poor coastal households are mostly elementary school graduates, which is still considered low. Low education levels affect respondents' mindset in managing household finances, which ultimately impacts food consumption patterns and food security. This aligns with the opinion of Sinaga *et al.* (2017), who stated that the mother's education level is one of the factors affecting household food security, with food expenditure as an indicator. The low education level of respondents is partly due to economic factors and a lack of interest in pursuing further education. Low parental income results in insufficient funds to pursue higher education, along with an environment that lacks support or motivation to continue education at higher levels.

Based on Table 3, it is known that the average number of family members is 4 people per household. The number of family members affects the total food expenditure incurred by the household (Nadia *et al.*, 2022), making the number of family members closely related to the household's welfare level. The larger the number of family members, the higher the food expenditure tends to be, which can negatively impact the household's food security condition (Handayani and Yulistiyono, 2023).

Household Income

Household income is the total amount of money earned by each household member from work carried out within one month. The sources of household income come from the

husband as the head of the household, the wife, children, and other family members. The average income of poor households in Demak Regency is IDR 1,790,290.89. The following shows the employment status of the heads of households surveyed in Demak Regency.

The level of household income will affect the pattern of food consumption and the level of expenditure on both food and non-food items of a household. Households with low income tend to prioritize their food needs over non-food needs. Furthermore, low-income households tend to focus more on the quantity of food that is considered filling rather than the nutritional quality contained in the food, which in turn affects the low diversity of food they consume. Conversely, households with high income prioritize both the quality and quantity of nutrients contained in their food, resulting in a tendency to achieve higher diversity of food they consume. The higher a person's income, the greater their ability to select and purchase various types of food, which influences the improvement of their food consumption patterns (leading to better food security). The higher the food purchasing power, the better the food consumption pattern (Falatehan and Pariyasi, 2021). The higher food purchasing power leads to better food security conditions.

From the above explanation, it can be concluded that the level of household income can be used as an indicator of household food security. This is because income is one of the key factors that determine whether a household can access a variety of balanced and nutritious food, which subsequently affects their food security condition.

Family income serves as the economic foundation for residents' consumption and plays a vital role in determining their intake of livestock products (Xie, 2019; Daba *et al.*, 2021; Mohammadi *et al.*, 2023). As family income levels rise, rural households increasingly emphasize nutritional quality in their diets, which results in greater consumption of livestock products rich in protein and essential nutrients (Chen *et al.*, 2023), which can improve food security.

Table 4. Total Food Expenditure of Extremely Poor Households

No	Food Groups	Food Expenditures	
		Total (IDR/month)	Percentage (%)
1	Cerealia	439,507.21+189,797.43	42.20
2	Starchy Roots	41,634.62+27,730.08	4.00
3	Fisheries products	105,294.68+40,119.11	10.11
4	Livestock products	88,110.09+28,440.42	8.46
5	Oils and fats	67,610.58+40,244.03	6.49
6	Grains	15,771.63+13,640.81	1.51
7	Legumes	27,509.62+20,277.20	2.64
8	Sugars	52,466.35+23,403.21	5.04
9	Vegetables and Fruits	175,966.35+72,821.75	16.90
10	Others	27,634.62+33,010.17	2.65
Total		1,041,490.40+395,488.60	100.00

Food Expenditure

The amount of money spent by a household on food and non-food consumption is called the total household expenditure. Food expenditure is calculated as the average monthly expenditure, while non-food expenditure is calculated based on the expenditure over the past year and then converted into an average monthly expenditure. Food expenditure for households in this study is divided into 10 groups of food ingredients, including: cereals, tubers, fisheries products, livestock products, oils and fats, grains, legumes, sugar, vegetables and fruits, and others. The detailed breakdown of food expenditure can be seen in Table 4.

The average expenditure on food consumption for poor households in coastal areas is IDR 1,041,490.40 per month. According to Lesi *et al.* (2024) and Wibowo *et al.* (2024), the level of food security and the share of food expenditure have an inverse relationship (negative correlation). In other words, a household's food security level decreases or becomes more vulnerable as its food expenditure increases, and conversely, if the food expenditure decreases, the household's food security level improves (becomes better).

In Table 4 above, it can be seen that the cereal group has the largest percentage of expenditure for poor households in the coastal area, amounting to IDR 439,507.21 or 42.20%. The high expenditure on cereals is due to rice being the staple food for every household. This is because rice is the biggest expense to meet the staple food needs for poor households, as it must be available daily to provide energy for family members to carry out their activities. This also influences the community's food consumption patterns in meeting rice as a primary necessity (Anzaini *et al.*, 2022). Meanwhile, the food group with the smallest expenditure among poor households in the coastal area is the grain group. This result shows that poor households rarely consume grains. Grains are alternative carbohydrate sources. However, the majority of poor household respondents prefer rice as their carbohydrate source, which leads to low consumption of grain-type foods. The low consumption of grains among poor households is caused by several factors. First, low income limits their ability to purchase other types of food. Second, spending priorities tend to focus on staple foods that are cheaper and more accessible, reducing the budget allocated for grains. Third, a lack of nutritional knowledge also plays a role, as poor households do not

Table 5. Total Non-Food Expenditure of Extremely Poor Household

No	Non-Food Groups	Non-Food Expenditures	
		Result	
		Total (IDR/month)	Percentage (%)
1	Housing	56,846.15+23,744.71	7.63
2	Goods and Services	163,100.96+50,886.87	21.90
3	Education expenses	165,312.17+60,624.56	22.19
4	Health expenses	62,211.54+22,042.99	8.35
5	Clothing	30,288.46+9,270.47	4.07
6	Durable Goods	112,782.05+34,184.13	15.14
7	Taxes and Insurance	7,445.22+2,703.45	1.00
8	Social Activities	14,841.83+4,373.41	1.99
9	Savings	1,153.85+380.90	0.15
10	Electricity costs	67,153.85+5,010.90	9.02
11	Others	63,748.08+6,710.19	8.56
Total		744,884.16+207,010.19	100.00

understand the health benefits of consuming grains and therefore do not include them in their daily dietary consumption.

Importantly, expenditure on fisheries and livestock products not only reflects household dietary preferences but also serves as an important indicator of access to high-quality protein sources, which are essential for achieving food and nutrition security. This finding indicates that fish remains the most accessible and affordable source of animal protein for low-income households in coastal area. This finding is supported by the statement from Robinson *et al.* (2022) as well as Akpalu and Okyere (2023), who stated that in low-income, food-deficit coastal countries, fish constitutes a critical source of animal protein. In coastal areas, access to fresh fish is relatively easier and more affordable due to proximity to fishing activities. Fish often serves as the primary source of animal protein because it is not only readily available but also culturally integral to the local diet.

Adequate consumption of such protein-rich foods contributes significantly to dietary diversity and the intake of essential nutrients. Ensuring that protein sources and dietary patterns adequately meet protein needs is crucial, affecting nutrient intake, nutrient

adequacy, and diet quality (Phillips *et al.*, 2015). This is directly linked to food security, as access to diverse and sufficient protein-rich foods supports both nutritional adequacy and long-term health.

Household Expenditure on Animal-Sourced Foods from Livestock

An expenditure of 8.46% of total food spending on livestock-source foods indicates that poor households in coastal areas allocate nearly one-tenth of their food budget to meeting their animal protein needs from the livestock sector. This percentage reflects the importance of livestock-based protein sources in their consumption patterns, despite economic constraints. Among the types of products consumed, eggs are the most dominant source of protein from the livestock sector (5.46%), followed by processed livestock products such as sausages and nuggets (2.18%), and chicken meat (0.82%).

Meanwhile, animal products that are rarely consumed include pork, goat, and sheep. These findings are consistent with Cornelsen *et al.* (2016), who found that low-income urban households in Nairobi, Kenya, less commonly purchased animal-source foods such as pork, sausages, and sheep or goat meat. This is because goat and

Table 6. The Average Food and Non-Food Expenditures of Respondent Households in Demak Regency

Type of Expenditure	Result	
	Total (IDR/month)	Percentage (%)
Food Expenditure	1,041,490.40	58.30
Non-Food Expenditure	744,884.16	41.70
Total	1,786,374.56	100.00

sheep meats tend to be more expensive and are rarely available in traditional markets in coastal areas. Additionally, preferences for pork consumption may be limited by religious or cultural factors. This consumption pattern shows that poor households tend to choose animal-source products that are durable, affordable, and easily accessible, such as eggs and processed livestock products, rather than fresh meat, which is more expensive and often beyond their purchasing power.

Non-Food Expenditure

Non-food expenditures in this study are divided into 11 categories, including housing, various goods and services, education costs, health expenses, clothing, durable goods, taxes and insurance, social activities, savings, electricity costs, and others. The following data presents the average non-food expenditures of respondent households, as shown in Table 5.

Table 6 shows that total expenditures for food needs are far greater than expenditures for non-food needs. This outcome aligns with prior research that prioritizing food needs is the primary concern (Fafard St-Germain & Tarasuk. 2018; Riptanti *et al.*, 2020). According to Lesi *et al.* (2024) and Wibowo *et al.* (2024), there is a negative correlation between food security levels and the proportion of food expenditure. In other words, the food security status of the family tends to decrease or become more vulnerable as food expenditure increases. Conversely, when household's food security improves or becomes stronger.

Based on Table 5, it is known that the average non-food expenditure of poor households in the coastal area is IDR

744,884.16. The largest expenditure is on education costs, amounting to IDR 165,312.17 or 22.19%. The high expenditure on education among poor households in the coastal area is due to the fact that these households have children who are still of school age. Meanwhile, the smallest expenditure is on savings. This is because of limited income and the priority of other essential needs that must be met. Poor households typically face financial resource constraints, so most of their spending is focused on urgent basic needs such as food, clothing, and shelter.

After identifying the average food and non-food expenditures of poor households in the coastal area of Demak Regency, the conclusions can be drawn as presented in Table 6.

Based on Table 6, it is known that the average total expenditure of poor households in the coastal area is IDR 1,786,374.56. From Table 6, it is observed that the total expenditure on food needs is significantly higher than the expenditure on non-food needs. According to Engel's Law, poorer households spend a larger proportion of their income on food compared to wealthier ones, meaning that any increase in food prices or reduction in income disproportionately affects their ability to secure adequate food. This makes poor households more vulnerable to food insecurity, as a significant share of their limited resources must go toward basic food needs, leaving less available for other essentials. Consequently, food price shocks or income instability can severely disrupt their food consumption and nutritional intake.

Total Consumption of Animal-Based Foods from Livestock Products

Table 7. Protein Consumption from Animal-Based Foods by Livestock Source

Livestock Products	Protein Contribution (g/day)	Percentage of Total (%)
Eggs	25.50+3.20	53.00
Processed Livestock Products	15.30+1.13	31.80
Chicken Meat	7.30+1.03	15.20
Total	48.10+5.16	100.00

The total consumption of animal-based foods from livestock products among low-income households was analyzed based on the intake of eggs, processed livestock products, and chicken meat. The analysis showed that the total protein consumption from these livestock products was 48.10 grams per day. Table 7 is the breakdown of protein consumption contributions from each group.

The results showed that eggs contributed the highest amount of protein intake, followed by processed livestock products and chicken meat. On average, they consume eggs almost every day, processed meat products 2–3 times per week, and chicken meat 1–2 times per week. This limited consumption frequency aligns with findings by Daba *et al.* (2021) in Ethiopia, which showed that many households consume animal-source foods only a few times per month due to limited access and purchasing power. Several factors influence this consumption. For example, a study in China by Chen *et al.* (2023) demonstrated that the number of people eating at home, education level, access to nutrition and health information, ethnicity, and age structure significantly affect the consumption patterns of livestock products among rural residents.

Chicken meat, on the other hand, was consumed less frequently among these households. This is likely due to its higher cost compared to locally available fish and eggs, making it a less accessible option for families with limited financial resources. Additionally, the need to prioritize essential expenditures such as rice may limit the frequency of purchasing chicken. Nevertheless, livestock such as chickens and eggs hold significant potential for enhancing food security, as they

can provide a reliable source of high-quality animal protein (Walker and Baum, 2022; Vlaicu *et al.*, 2024), and can be integrated into household farming systems to improve both nutrition and income over time (Pius *et al.*, 2021; Singh *et al.*, 2022; Abassi *et al.*, 2024).

In the agricultural sector, poultry production is a key component of the global food system, supplying consumers with an important source of high-quality animal protein through both meat and eggs (Henchion *et al.*, 2021). It plays a critical role in delivering affordable, nutrient-rich protein to millions worldwide, directly contributing to the achievement of SDG 2 by promoting food security (Sheffield *et al.*, 2024). Nutritionally, poultry products such as chicken meat and eggs are among the most widely consumed animal-derived foods, providing essential proteins, amino acids, fats, vitamins, and minerals that support vital bodily functions, including immune system performance and cognitive development, which are particularly important in developing countries. Moreover, poultry meat generally contains lower levels of saturated fats compared to red meats (Bergeron *et al.*, 2019), making it a healthier choice and aiding in the reduction of diet-related non-communicable diseases.

To improve food security, incorporating livestock ownership can be an effective strategy for enhancing household food security (Sekaran *et al.*, 2021; Hashmiu *et al.*, 2022; Balana *et al.*, 2023; Raholiarimanana *et al.*, 2023; Woleba *et al.*, 2023). According to Taruvinga *et al.* (2022) and Asale *et al.* (2024) livestock ownership among rural farming households is often seen as a crucial strategy for addressing food insecurity challenges.

A study from Workicho *et al.* (2016)

Table 8. The Level of Food Security among Poor Households in Demak Regency

The Level of Food Security	Result	
	Total	Percentage (%)
Food Secure (Food Secure)	28	26.92
Food Vulnerable (Food Insecure)	24	23.08
Food Less Secure (Food Insecure)	37	35.58
Food Insecure (Food Insecure)	15	14.42
Total	104	100.00
Chi-Square Result (p-value)	0.024 (less than 0.05)	

found that owning livestock positively associated with higher HDDS (household dietary diversity), which can improve food security level. Moreover, the findings from Christian *et al.* (2019) found that household ownership of livestock was associated with higher ASF consumption among children and improved household-level food security. Moreover, the findings by Jones *et al.* (2014) indicated that integrating livestock into cropping systems was associated with increased farm and household dietary diversity.

Livestock not only serve as a source of food consumption but also as a liquid asset for poor households. Livestock can function as an asset that can be sold or liquidated in times of emergency (e.g., children's school fees, healthcare costs, or food crises) or as a "living fund" when agricultural or fishery yields decline. For instance, a study by Naz and Khan (2018) showed that part of the value of livestock products is sold to obtain emergency cash.

Food Security Level

To determine the level of household food security, a cross-classification analysis was conducted between the proportion of food expenditure and the household's energy consumption level. The distribution of the food security level analysis results for poor households in the coastal area can be seen in Table 8. In poor households in coastal areas, the majority fall into the food less secure category (food expenditure <60% and energy consumption <80%), accounting for about 35.58%. This is because poor households

prioritize spending on their children's education, as education is considered a crucial investment for the future. Consequently, non-food expenditures, such as school fees and supplies, become greater than food expenditures. The low proportion of food expenditure is not due to sufficient income, but rather because of high non-food expenses (Anzaini *et al.*, 2022). However, to improve food security conditions, poor households need to increase their income streams. This is supported by the opinion of Khotimah *et al.* (2024), who state that higher income levels lead to the improvement of the quality of food consumption. As income rises, spending on food also increases, but spending on non-food items grows even more, which eventually causes the percentage of income spent on food to decrease (Rashid *et al.*, 2024). Poor people allocate the largest portion of their income to food, whereas wealthy people dedicate most of their income to non-food items (Wenban-Smith *et al.*, 2016). Amrullah *et al.* (2020) stated a larger share of household food expenditure indicates a declining food security.

Households categorized as food vulnerable have a high share of their total expenditure spent on food (60% or more), but maintain sufficient energy consumption levels (above 80% of the recommended energy adequacy). This means that although they are currently able to meet their energy needs, they allocate a large portion of their limited income to food, leaving them financially fragile. Such households are particularly at risk of becoming food insecure

if they experience any negative shocks, such as rising food prices or income loss, because their financial capacity to absorb these shocks is minimal.

A total of 14.42% of households fall into the food insecure category, characterized by spending 60% or more of their total expenditure on food while having insufficient energy consumption (at or below the recommended level of energy adequacy). According to Anzaini *et al.* (2022), respondents allocate a larger portion of their spending to food consumption due to limited income and a lack of nutritional knowledge, which leads them to prioritize feeling full over meeting nutritional needs. This also indicates that these households not only allocate a very high proportion of their limited income to food but still fail to meet their basic energy requirements, reflecting a severe level of food insecurity. These households are highly vulnerable to malnutrition and other negative health outcomes. This finding is also related to Megersa *et al.* (2014) who demonstrated that a low level of dietary diversity appears to be a major indicator of food insecurity in the study area, with the vast majority of households (81%) consuming just one to three food groups. The near absence of micronutrient-rich foods such as fish, eggs, and organ meats suggests a potentially high risk of specific micronutrient deficiencies in the region.

From Table 8 it can be concluded that 73.08% of poor households in Demak Regency categorized as food insecure. Households face food insecurity mainly due to economic limitations (Okpala *et al.*, 2023), which restrict their ability to buy adequate and nutritious food. Limited resources restrict their ability to afford food which can limit both the quantity and diversity of food available to them (Mutisya *et al.*, 2016). According to Sophia *et al.* (2022), in poor families, especially those receiving social food aid, food expenses are higher than non-food expenses, affecting family food security and nutritional fulfillment.

Based on the primary data collected,

the food insecure households—comprising 73.08% of the sample—share several distinct socio-economic and demographic characteristics. Most of these households have low levels of formal education, with the majority of household heads having only completed elementary school or less. Employment is generally informal and unstable, with many working as laborers, fishermen, or in small-scale trading activities with low and uncertain incomes. The average household size tends to be relatively large, often with more than four members, which increases dependency ratios and pressures on household resources. In addition, access to basic services such as clean water, sanitation, and health facilities is limited, further exacerbating their vulnerability. These characteristics suggest that food insecurity in these coastal areas is closely linked to a combination of low income, limited education, high dependency, and inadequate access to essential services.

A total of 26.92% of households are categorized as food secure (food expenditure <60% and energy consumption more than 80%). A food-secure household is defined as one that meets both adequate energy (calorie) intake and a reasonable proportion of food expenditure. A household is considered food-secure if it consumes enough calories to meet nutritional needs while not allocating an excessively large portion of its income to food, indicating stable access to sufficient and nutritious food.

These food-secure households are likely to have more stable access to nutritious and energy-dense foods, including animal-based products. Adequate consumption of animal-based foods plays a significant role in supporting energy and nutrient sufficiency among food-secure low-income households. In coastal areas, such as Demak Regency, poor households often fulfill their protein needs primarily through fishery products. Good access to marine resources enables them to obtain animal-based foods—particularly fish—at relatively low cost, thus helping maintain their dietary energy and protein

adequacy. In addition, affordable livestock-based products such as eggs and chicken meat also contribute to meeting household protein requirements and improving diet quality.

Expanding the diversity of food sources by incorporating livestock contributes to a broader range of essential nutrients necessary for optimal health (Wodajo *et al.*, 2020). Livestock production can enhance the quality of household diets through the provision of animal source foods such as milk, meat, and eggs. Further, livestock function as a buffer against food insecurity during times of crisis or shock, such as droughts or crop failures. They offer a form of insurance, allowing households to rely on them for food or income when access to other food sources is limited (Danso-Abbeam *et al.*, 2024).

Livestock also play a crucial role in maintaining food security through the supply of traditional meat products. It provides a variety of nutritious, protein-rich foods like meat, eggs, milk, and cheese, helping to diversify family diets and improve the food security (García-Díez *et al.*, 2021). Furthermore, according to Smith *et al.* (2013) animal-based foods are rich in energy, protein, and essential micronutrients, making them highly nutritious. They align closely with the dietary needs required for healthy development, proper body function, and overall well-being.

Adesogan *et al.* (2020) state that livestock production enhances household food security by ensuring convenient access to high-quality protein and essential nutrients like vitamins, minerals, and fats. Similarly, Andriamparany *et al.* (2021) found that households in Madagascar that raise livestock are more resilient to food insecurity compared to those that do not. Moreover, a study from Radeny *et al.* (2022) showed that the adoption of improved and resilient livestock breeds led to a 38% increase in household dietary diversity and a 90% reduction in household food insufficiency.

Proteins derived from animal sources typically have an amino acid profile that closely matches the human body's needs,

providing all nine essential amino acids in roughly sufficient amounts (FAO, 2013). Protein sources like meat, poultry, fish, eggs, isolated soy protein, and dairy products (including milk, cheese, and yogurt) supply all nine essential amino acids and are recognized as high-quality protein sources. Additionally, animal-based proteins are generally more digestible and therefore more readily absorbed by the body. For example, egg protein is frequently used as a benchmark to evaluate the biological value of other proteins (Elmadfa and Meyer, 2017).

ANALYSIS OF CHI-SQUARE

The Chi-Square test result shows an Asymp. Sig. value of less than 0.05, indicating a statistically significant relationship between Energy Consumption Adequacy and Food Expenditure Share. This means that variations in the level of energy consumption adequacy are not random but are systematically associated with differences in the proportion of food expenditure. In other words, households with higher energy adequacy levels tend to allocate a smaller share of their total expenditure to food, suggesting greater economic stability and better access to adequate nutrition. Conversely, households with low energy adequacy levels often spend a larger proportion of their income on food, reflecting economic vulnerability and limited access to diverse and sufficient food sources.

This finding reinforces the concept that both indicators—energy adequacy and food expenditure share—are interrelated dimensions of household food security. The combination of these two measures provides a more comprehensive and multidimensional view of household food security status, capturing both the economic access to food and the nutritional adequacy of consumption. Similar relationships have been identified in previous studies, which emphasize that food security cannot be fully understood by income or expenditure indicators alone, but must also consider the quality and adequacy of dietary intake (Wodajo *et al.*, 2020; Adesogan *et al.*,

2020). Therefore, the significant Chi-Square relationship in this study empirically validates the use of these two parameters together in assessing household food security in coastal low-income communities.

CONCLUSION

The findings indicated that the average monthly income of poor households in Demak Regency was IDR 1,790,290.89, while their average monthly food expenditure reached IDR 1,041,490.40. On average, households spent IDR 193,389.42 per month on livestock-based foods and IDR 744,884.16 on non-food items. The daily consumption of livestock-based foods, including eggs, processed livestock products, and chicken meat, was 48.10 grams per capita. In terms of food security, 73.08% of poor households in coastal areas were classified as food-insecure, with only 26.92% falling into the food-secure category. These results highlight the important role that livestock products play in meeting the nutritional needs of poor households and contributing to their overall food security. However, the study did not explore the potential for livestock development or interventions to further strengthen food security, suggesting an area for future research and policy focus.

RECOMMENDATION

Based on the findings, it is recommended that efforts to improve food security among poor households in Demak's coastal areas focus on expanding access to income-generating opportunities, particularly through livestock-based programs such as village poultry farming, goat rearing, and small-scale cattle fattening. These initiatives can provide both nutritional benefits and additional income for vulnerable households. Furthermore, implementing a regular monitoring system for household food security will help inform data-driven policy decisions, ensuring support is accurately targeted. Policy

implications should emphasize integrating livestock development as a core strategy within food security programs to strengthen both economic resilience and nutritional outcomes among coastal poor communities.

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REFERENCES

- Abbasi, I. A., Shamim, A., Shad, M. K., Ashari, H., & Yusuf, I. (2024). Circular economy-based integrated farming system for indigenous chicken: Fostering food security and sustainability. *Journal of Cleaner Production*, 436, 140368.
- Adesogan, A. T., Havelaar, A. H., McKune,

- S. L., Eilittä, M., & Dahl, G. E. (2020). Animal source foods: sustainability problem or malnutrition and sustainability solution? Perspective matters. *Global Food Security*, 25, 100325.
- Akbar, A., Darma, R., Fahmid, I. M., & Irawan, A. (2023). Determinants of household food security during the COVID-19 pandemic in Indonesia. *Sustainability*, 15(5), 4131.
- Akpalu, W., & Okyere, M. A. (2023). Fish protein transition in a coastal developing country. *Environmental and Resource Economics*, 84(3), 825-843.
- Amrullah, E. R., Pullaila, A., Hidayah, I., & Rusyiana, A. (2020). Dampak bantuan langsung tunai terhadap ketahanan pangan rumah tangga di Indonesia. *Jurnal Agro Ekonomi*, 38(2), 91-104.
- Andriamparany, J. N., Hänke, H., & Schlecht, E. (2021). Food security and food quality among vanilla farmers in Madagascar: The role of contract farming and livestock keeping. *Food Security*, 13(4), 981-1012.
- Anzaini, B. K., Gantini, T., & Srimenganti, N. (2022). Analisis Ketahanan Pangan Berdasarkan Proporsi Pengeluaran Dan Konsumsi Energi (Suatu Kasus Pada Rumah Tangga Petani Buruh Di Desa Gunungmanik Kecamatan Tanjungsari Kabupaten Sumedang). *OrchidAgri*, 2(2).
- Asale, M. A., Danso-Abbeam, G., & Ogundeji, A. A. (2024). Livestock ownership and household food security in Northern Ghana: is there a nexus?. *SN Social Sciences*, 4(3), 60.
- Balana, B. B., Ogunniyi, A., Oyeyemi, M., Fasoranti, A., Edeh, H., & Andam, K. (2023). COVID-19, food insecurity and dietary diversity of households: Survey evidence from Nigeria. *Food Security*, 15(1), 219-241.
- Banda, L. J., & Tanganyika, J. (2021). Livestock provide more than food in smallholder production systems of developing countries. *Animal Frontiers*, 11(2), 7-14.
- Bergeron, N., Chiu, S., Williams, P. T., King, S. M., & Krauss, R. M. (2019). Effects of red meat, white meat, and nonmeat protein sources on atherogenic lipoprotein measures in the context of low compared with high saturated fat intake: a randomized controlled trial. *The American journal of clinical nutrition*, 110(1), 24-33.
- Bleich, E. G., Rhissa, Z., & Mack, S. (2005). The FAO special programme for food security: livestock diversification—a case study in Chad. *World's Poultry Science Journal*, 61(1), 23-30.
- Bundala, N., Kinabo, J., Jumbe, T., Rybak, C., & Sieber, S. (2020). Does homestead livestock production and ownership contribute to consumption of animal source foods? A pre-intervention assessment of rural farming communities in Tanzania. *Scientific African*, 7, e00252.
- Chen, F., Wei, T., & Zhu, N. (2023). Determinants of consumption structure of livestock products among rural chinese residents: household characteristics and regional heterogeneity. *Agriculture*, 13(9), 1839.
- Christian, A. K., Wilson, M. L., Aryeetey, R. N., & Jones, A. D. (2019). Livestock ownership, household food security and childhood anaemia in rural Ghana. *PLoS One*, 14(7), e0219310.
- Cornelsen, L., Alarcon, P., Häslér, B., Amendah, D. D., Ferguson, E., Fèvre, E. M., ... & Rushton, J. (2016). Cross-sectional study of drivers of animal-source food consumption in low-income urban areas of Nairobi, Kenya. *BMC nutrition*, 2(1), 70.
- Daba, A. K., Murimi, M., Abegaz, K., & Hailu, D. (2021). Determinants and constraints to household-level animal source food consumption in rural

- communities of Ethiopia. *Journal of nutritional science*, 10, e58.
- Danso-Abbeam, G., Ogundej, A. A., Asale, M. A., & Baiyegunhi, L. J. (2024). Effects of livestock ownership typology on household food security in rural Lesotho. *GeoJournal*, 89(2), 63.
- Ellis, F., & Freeman, H. A. (2004). Rural livelihoods and poverty reduction strategies in four African countries. *Journal of development studies*, 40(4), 1-30.
- Elmadfa, I., & Meyer, A. L. (2017). Animal proteins as important contributors to a healthy human diet. *Annual review of animal biosciences*, 5(1), 111-131.
- Fafard St-Germain, A. A., & Tarasuk, V. (2018). Prioritization of The Essentials In The Spending Patterns of Canadian Households Experiencing Food Insecurity. *Victorian Literature and Culture*, 21(11), 2065-2078.
- Falatehan, S. F., & Pariyati, P. (2021). Motif Dalam Perilaku Memilih Pangan Dan Hubungannya Dengan Ketahanan Pangan Di Komunitas Nelayan. *Jurnal Sosial Ekonomi Kelautan dan Perikanan*, 16(1), 103-119. <https://doi.org/10.15578/jsekp.v16i1.8216>
- Falvey, L. (2015). Food security: the contribution of livestock. *Chiang Mai University Journal of Natural Sciences*, 14(1), 103-118.
- Fang, D., Thomsen, M. R., Nayga Jr, R. M., & Yang, W. (2022). Food insecurity during the COVID-19 pandemic: evidence from a survey of low-income Americans. *Food security*, 14(1), 165-183.
- FAO. (2018). *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*. Rome: FAO.
- Ferdinand, A. 2006. *Metode Penelitian Manajemen*. Semarang: Badan Penerbit Universitas Diponegoro.
- Food and Agriculture Organization of the United Nations. (2013). *Dietary protein quality evaluation in human nutrition: Report of an FAO expert consultation, 31 March–2 April 2011, Auckland, New Zealand*, Food Nutr. Pap. 92, Food Agric. Organ., UN, Rome.
- García-Díez, J., Gonçalves, C., Grisoldi, L., Cenci-Goga, B., & Saraiva, C. (2021). Determining food stability to achieve food security. *Sustainability*, 13(13), 7222.
- Grantham-McGregor, S., & Baker-Henningham, H. (2005). Review of the evidence linking protein and energy to mental development. *Public health nutrition*, 8(7a), 1191-1201.
- Handayani, S. dan H. Sulistiyono. (2023). Pengaruh Pendapatan, Jumlah Anggota Keluarga dan Pendidikan Terhadap Konsumsi Rumah Tangga Miskin Di Kabupaten Banyuwangi. *Neo-Bis*, 12(1), 32-47.
- Hänke, H., & Barkmann, J. (2017). Insurance Function of Livestock: Farmers' Coping Capacity with Crop Failure in South-Western Madagascar. *World Development*, 96, 264-275.
- Hashmi, I., Agbenyega, O., & Dawoe, E. (2022). Cash crops and food security: Evidence from smallholder cocoa and cashew farmers in Ghana. *Agriculture & Food Security*, 11(1), 12.
- Henchion, M., Moloney, A. P., Hyland, J., Zimmermann, J., & McCarthy, S. (2021). Trends for meat, milk and egg consumption for the next decades and the role played by livestock systems in the global production of proteins. *Animal*, 15, 100287.
- Ingram, J., Ericksen, P., & Liverman, D. (2012). *Food security and global environmental change*. Routledge.
- Jodlowski, M., Winter-Nelson, A., Baylis, K., & Goldsmith, P. D. (2016). Milk in the data: food security impacts from a livestock field experiment in Zambia. *World development*, 77, 99-114.

- Jones, A. D., Shrinivas, A., & Bezner-Kerr, R. (2014). Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data. *Food Policy*, 46, 1-12.
- Kazianga, H., & Udry, C. (2006). Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso. *Journal of Development Economics*, 79(2),413-446.
- Khotimah, Y. K., Munawaroh, A., & Suryani, H. F. (2024). Analisis Pengeluaran Pangan Rumah Tangga Peternak Sapi Perah di Kecamatan Tengaran Kabupaten Semarang. *Media Informasi Penelitian Kabupaten Semarang*, 6(1), 92-102.
- Lesi, K., Anggreini, T., Yuprin, Y., Asiaka, F. K., & Sunariyo, S. (2024). Kontribusi Pendapatan Perempuan Tani terhadap Ketahanan Pangan Rumah Tangga Petani Di Kelurahan Kalampangan Kecamatan Sebangau Kota Palangka Raya. *Journal Socio Economics Agricultural*, 19(1), 72-79.
- Maxwell, D. (Ed.). (2000). Urban livelihoods and food and nutrition security in Greater Accra, Ghana (Vol. 112). International Food Policy Research Institute.
- Megersa, B., Markemann, A., Angassa, A., & Valle Zárate, A. (2014). The role of livestock diversification in ensuring household food security under a changing climate in Borana, Ethiopia. *Food Security*, 6(1), 15-28.
- Mohammadi, H., Saghaian, S., & Boccia, F. (2023). Antibiotic-free poultry meat consumption and its determinants. *Foods*, 12(9), 1776.
- Mutisya, M., Ngware, M. W., Kabiru, C. W., & Kandala, N. (2016). The effect of education on household food security in two informal urban settlements in Kenya: a longitudinal analysis. *Food Security*, 8, 743–756.
- Nadia, S., Umar, M., & Juardi. (2022). The impact of the number of family members and education on the consumption patterns of poor households. *Bulletin of Economic Studies (BEST)*, 2(1), 35–43.
- Naz, S., & Khan, N. P. (2018). Financial contribution of livestock at household level in Federally Administered Tribal Areas of Pakistan: An empirical perspective. *J. Agric*, 34(1), 1-9.
- Obayelu, A. O., & Orosile, O. R. (2015). Rural livelihood and food poverty in Ekiti State, Nigeria. *Journal of Agriculture and Environment for International Development - JAEID*, 109(2), 307–323.
- Okpala, E. F., Manning, L., & Baines, R. N. (2023). Socio-economic drivers of poverty and food insecurity: Nigeria a case study. *Food Reviews International*, 39(6), 3444-3454.
- Penne, T., & Goedemé, T. (2021). Can low-income households afford a healthy diet? Insufficient income as a driver of food insecurity in Europe. *Food Policy*, 99, 101978.
- Phillips, S. M., Fulgoni II, V. L., Heaney, R. P., Nicklas, T. A., Slavin, J. L., & Weaver, C. M. (2015). Commonly consumed protein foods contribute to nutrient intake, diet quality, and nutrient adequacy. *The American journal of clinical nutrition*, 101(6), 1346S-1352S.
- Pica-Ciamarra, U., Tasciotti, L., Otte, J., & Zezza, A. (2011). Livestock assets, livestock income and rural households: cross-country evidence from household surveys.
- Pius, L. O., Strausz, P., & Kusza, S. (2021). Overview of poultry management as a key factor for solving food and nutritional security with a special focus on chicken breeding in East African countries. *Biology*, 10(8), 810.
- Pollard, C. M., & Booth, S. (2019). Food Insecurity and Hunger in Rich Countries-It Is Time for Action against

- Inequality. *International journal of environmental research and public health*, 16(10), 1-13.
- Qin, P., Wang, T., & Luo, Y. (2022). A review on plant-based proteins from soybean: Health benefits and soy product development. *Journal of Agriculture and Food Research*, 7, 100265.
- Radeny, M., Rao, E. J., Ogada, M. J., Recha, J. W., & Solomon, D. (2022). Impacts of climate-smart crop varieties and livestock breeds on the food security of smallholder farmers in Kenya. *Food Security*, 14(6), 1511-1535.
- Raholiarimanana, F., Rakotomanana, H., & Ishida, A. (2023). Does raising livestock improve household food security and child dietary diversity in a rural region of Madagascar?. *Children*, 10(5), 765.
- Rashid, F. N., Sesabo, J. K., Lihawa, R. M., & Mkuna, E. (2024). Determinants of household food expenditure in Tanzania: implications on food security. *Agriculture & Food Security*, 13(1), 13.
- Regassa, N., & Stoecker, B. J. (2012). Household food insecurity and hunger among households in Sidama district, southern Ethiopia. *Public health nutrition*, 15(7), 1276-1283.
- Riches, G., & Silvasti, T. (2014). Hunger in the rich world: food aid and right to food perspectives. In G. Riches, & T. Silvasti (Eds.), *First world hunger revisited: food charity or the right to food?* (pp. 1-14). UK: Palgrave Macmillan.
- Riptanti, E. W., Masyhuri, M., Irham, I., & Suryantini, A. (2020). The ability of dryland farmer households in achieving food security in food-insecure area of East Nusa Tenggara, Indonesia. *AIMS Agriculture & Food*, 5(1).
- Robinson, J. P., Mills, D. J., Asiedu, G. A., Byrd, K., Mancha Cisneros, M. D. M., Cohen, P. J., ... & Hicks, C. C. (2022). Small pelagic fish supply abundant and affordable micronutrients to low- and middle-income countries. *Nature Food*, 3(12), 1075-1084.
- Rodríguez, D. I., Anríquez, G., & Riveros, J. L. (2016). Food security and livestock: The case of Latin America and the Caribbean. *Ciencia e investigación agraria*, 43(1), 5-15.
- Sayung District Central Bureau of Statistics. (2024). *Sayung District in Figures 2024*. Central Bureau of Statistics.
- Sekaran, U., Lai, L., Ussiri, D. A., Kumar, S., & Clay, S. (2021). Role of integrated crop-livestock systems in improving agriculture production and addressing food security—A review. *Journal of Agriculture and Food Research*, 5, 100190.
- Sheffield, S., Fiorotto, M. L., & Davis, T. A. (2024). Nutritional importance of animal-sourced foods in a healthy diet. *Frontiers in Nutrition*, 11, 1424912.
- Simanjuntak, P. J. (1985). *Pengantar Ekonomi Sumber Daya Manusia*. Fakultas Ekonomi. Universitas Indonesia. Jakarta.
- Sinaga, R. J. R., Lubis, S. N., & Darus, M. B. (2017). Kajian faktor-faktor sosial ekonomi masyarakat terhadap ketahanan pangan rumah tangga di Medan. *Journal of Agriculture and Agribusiness Socioeconomics*, 2(5), 15067.
- Singh, D. R., Sunuwar, D. R., Shah, S. K., Sah, L. K., Karki, K., & Sah, R. K. (2021). Food insecurity during COVID-19 pandemic: A genuine concern for people from disadvantaged community and low-income families in Province 2 of Nepal. *Plos one*, 16(7), e0254954.
- Singh, M., Mollier, R. T., Paton, R. N., Pongener, N., Yadav, R., Singh, V., ... & Mishra, V. K. (2022). Backyard poultry farming with improved germplasm: Sustainable food production and nutritional security in fragile ecosystem. *Frontiers in Sustainable Food Systems*, 6, 962268.

- Smith, J., Sones, K., Grace, D., MacMillan, S., Tarawali, S., & Herrero, M. (2013). Beyond milk, meat, and eggs: Role of livestock in food and nutrition security. *Animal Frontiers*, 3(1), 6-13.
- Sophia, S., Erwandri, E., Dewi, R., & Varina, F. (2022). Analisis Tingkat Ketahanan Pangan Keluarga Penerima Manfaat Bantuan Sosial Pangan (KPM Bansos Pangan) di Kabupaten Batang Hari. *JAS (Jurnal Agri Sains)*, 6(2), 113-121.
- Staal, S., Poole, J., Baltenweck, I., Mwacharo, J. M., Notenbaert, A., Randolph, T., ... & Herrero, M. (2009). Targeting Strategic Investment in Livestock Development as a Vehicle for Rural Livelihoods. Bill and Melinda Gates Foundation-ILRI Knowledge Generation Project Report.
- Stephenson, K., Amthor, R., Mallowa, S., Nungo, R., Maziya-Dixon, B., Gichuki, S., ... & Manary, M. (2010). Consuming cassava as a staple food places children 2-5 years old at risk for inadequate protein intake, an observational study in Kenya and Nigeria. *Nutrition journal*, 9(1), 9.
- Suparmin, S., & Dipokusumo, B. (2022). Analisis Program Peningkatan Ketahanan Pangan Rumah tangga Petani Ikan Nila Di Kecamatan Pringgarata. *Jurnal Sosial Ekonomi dan Humaniora*, 8(2), 312-317.
- Taruvunga, A., Kambanje, A., Mushunje, A., & Mukarumbwa, P. (2022). Determinants of livestock species ownership at household level: Evidence from rural OR Tambo District Municipality, South Africa. *Pastoralism*, 12(1), 1-11.
- Vlaicu, P. A., Untea, A. E., & Oancea, A. G. (2024). Sustainable poultry feeding strategies for achieving zero hunger and enhancing food quality. *Agriculture*, 14(10), 1811.
- Xie, Z. Y. (2019). Influencing factors and changes in the consumption of livestock products and development trend in China. *Journal of Jiangsu Agricultural Sciences*, 15, 339-342. (In Chinese).
- Walker, S., & Baum, J. I. (2022). Eggs as an affordable source of nutrients for adults and children living in food-insecure environments. *Nutrition Reviews*, 80(2), 178-186.
- Wenban-Smith, H., Faße, A., & Grote, U. (2016). Food security in Tanzania: The challenge of rapid urbanisation. *Food security*, 8(5), 973-984.
- Wibowo, A. A., Suharno, S., & Alfariy, M. F. (2024, January). Mengukur Kesejahteraan Rumah Tangga Petani Melalui Pendekatan Pangsa Pengeluaran Sektor Pertanian Di Kecamatan Cilongok. In *Prosiding Seminar Nasional LPPM Unsoed* (Vol. 13, No. 1, pp. 127-135).
- Wodajo, H. D., Gameda, B. A., Kinati, W., Mulem, A. A., van Eerdewijk, A., & Wieland, B. (2020). Contribution of small ruminants to food security for Ethiopian smallholder farmers. *Small Ruminant Research*, 184, 106064.
- Woleba, G., Tadiwos, T., Bojago, E., & Senapathy, M. (2023). Household food security, determinants and coping strategies among small-scale farmers in Kedida Gamela district, Southern Ethiopia. *Journal of Agriculture and Food Research*, 12, 100597.
- Workicho, A., Belachew, T., Feyissa, G. T., Wondafrash, B., Lachat, C., Verstraeten, R., & Kolsteren, P. (2016). Household dietary diversity and animal source food consumption in Ethiopia: evidence from the 2011 welfare monitoring survey. *BMC public health*, 16(1), 1192.
- Wu, G. (2016). Dietary protein intake and human health. *Food & function*, 7(3), 1251-1265.
- Yamane, T. 1973. *Statistics: An Introductory Analysis*, Third Edition. Harper International Edition.
- Zant, W. (2023). How costly is using livestock as a savings device?. *Food Security*, 15(1), 77-110.