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ASSOCIATION OF DIGITAL TRANSACTION DECISIONS WITH HOUSEHOLD FOOD SECURITY: AN ANALYSIS OF SECONDARY DATA FROM A WORLD BANK SURVEY



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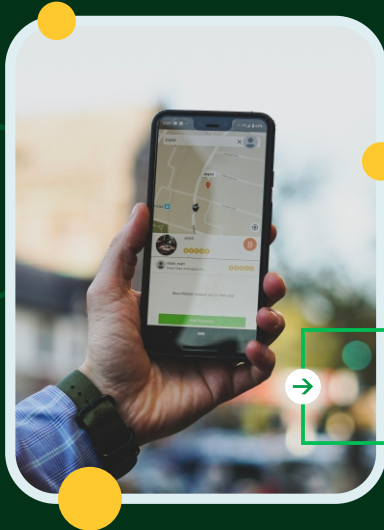
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➔ INTRODUCTION

Online shopping methods have become increasingly popular among the public over time, including for obtaining food and groceries. The time efficiency and ease of access offered form the basis of individuals' decisions to choose digital food shopping models (Hambalah & Herman, 2023). Over a three-year period, the average value of online food orders in Indonesia increased steadily, from less than IDR 40,000 in 2019 to more than IDR 60,000 in 2022 (Measurable AI, 2023). In addition, compared with other Southeast Asian countries, the transaction value of Indonesia's online food delivery services is also the highest. It reached USD 4.6 billion in 2023, surpassing Thailand (USD 3.7 billion), as well as the Philippines, Singapore, and Vietnam (each below USD 2.5 billion) (Annur, 2024; Momentum Works, 2024). These data underscore that food consumption through online platforms has become a significant part of the expansion of access and consumption patterns in Indonesia.

The expansion of access through online platforms does not automatically eliminate fundamental food-related problems. The number of people who are still unable to meet their daily nutritional needs is estimated to exceed 23 million, placing Indonesia at 67th out of 127 countries in the Global Hunger Index 2024 (WFP, 2025). This situation reflects a serious food insecurity problem. Food insecurity refers to a condition in which individuals or households do not have secure access to sufficient amounts of nutritious food for their lives (Dudek & Myszkowska-Ryciak, 2020). Amid rapid digital transformation, these issues of food insecurity and food security must remain part of the main agenda, so that technological innovation does not only serve groups with adequate access and supporting infrastructure.



Online ordering of food and groceries indeed indicates an expansion of options for the public to meet their needs (Aprilianti & Amanta, 2020). However, the extent to which this opportunity contributes to strengthening food security largely depends on households' ability to access and utilize such services. Theoretically, this is related to the capability to function perspective proposed by Amartya Sen, which emphasizes that the depiction of a household's food condition cannot be viewed in aggregate terms, but rather must be understood through each family's capacity to acquire and secure food in their daily lives (Burchi & De Muro, 2012). In other words, although the volume of online food-order transactions has increased, not all households possess the same capacity to benefit from these services. There is a possibility that the use of online platforms to obtain food is concentrated among certain groups, while households with limited resources continue to face constraints in accessing food.

In the context of recent technological developments, food systems continue to evolve in response to changing human needs. Drawing from the association between food and digital transactions during the pandemic, the discussion in this study is situated within a food system landscape that is increasingly digitalized and integrated with artificial intelligence (AI)–based technologies. Within this framework, household decisions to utilize digital platforms serve as an important indicator of their capacity to participate in technology-based food systems for the future.

➔ RESEARCH QUESTIONS

- ➊ Is the decision to use online platforms for purchasing food and groceries associated with the level of household food security?
- ➋ To what extent are socio-economic characteristics associated with household decisions to purchase food through online platforms?

➔ CONCEPTUAL FRAMEWORK

This study develops a conceptual framework that illustrates the relationship between household food security and digital transactions, while accounting for sociodemographic factors as control variables. Food security is conceptually positioned as the primary dependent factor in this study. Two variables are used to represent food security outcomes: food shortages and ate less. As the key determinant, digital transactions are treated as the independent variable, referring to household decisions to use digital platforms to access food and groceries.

Sociodemographic variables are incorporated as control variables, meaning that the relationship between digital transactions and food security is analyzed while accounting for associations with other relevant factors. These variables include gender, age, educational background, economic condition, and household location. The selection of these variables is informed by elements commonly used in previous studies on food security and food insecurity (Dudek & Myszkowska-Ryciak, 2020; Mutisya et al., 2016; Omonona & Agoi, 2007). Figure 1 provides an illustration of the conceptual framework employed in this study.

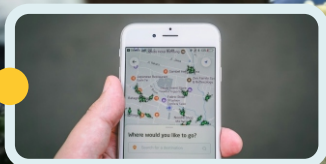
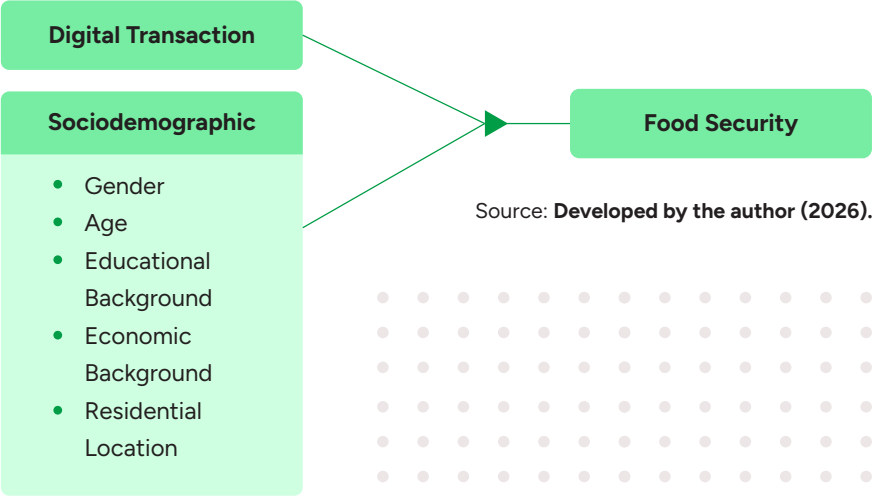


Figure 1. Conceptual Framework of the Relationship Between Digital Transaction Decisions and Household Food Security



➔ RESEARCH METHOD

○ Methods and Data Sources

This study uses a quantitative approach using secondary data. The data are obtained from the official website of the World Bank, titled “Indonesia: High-Frequency Monitoring of COVID-19 Impacts 2020” (World Bank, 2022). In the first round of the survey, a total of 4,338 households were successfully interviewed, representing 85% of the initial target of 5,100 households. For the purposes of this analysis, data from the fourth round of the survey (3–15 November 2020) are utilized, comprising 3,953 households (before cleaned) and representing 91% of the first-round sample. The fourth round is selected as it aligns with the objectives of this study, as it provides key variables related to digital transactions and household food security.



○ Research Variables

The variables adopted from the dataset are adjusted to the needs of the study, with reference to the full questionnaire provided on the official website of the World Bank. Food security is operationalized using two separate indicators (food shortages and ate less) to test the consistency of the analytical results and to obtain a more comprehensive understanding. To complement information on respondents' economic background, welfare status classification data from the 2019 National Statistical System (SSN) are incorporated. The use of these data is feasible because SSN-19 employs an identical household sample and is also available within the main dataset, allowing for methodological integration. For statistical analysis purposes, several variables are recoded to simplify categories and enhance the readability of the results. The following figure presents the original questionnaire items along with their recoded response categories.

No.	Variable	Questionnaire's Questions	Measurement Scale
1a.	Food Security	Food Shortages: During the past week, did your household experience food shortages due to a lack of money or other resources?	Ordinal categorical: Yes, often _____ 1 Yes, sometimes _____ 2 Yes, rarely _____ 3 No _____ 4
1b.		Ate Less: During the past week, did you or any household member eat less than you should have because of a lack of money or other resources?	
2.	Digital Transactions Decision	Since the pandemic (March 2020), has your household started using online platforms to purchase food and groceries?	Nominal categorical: No _____ 0 Yes _____ 1

No.	Variable	Questionnaire's Questions	Measurement Scale
3.	Gender	What is the gender of the household head/breadwinner?	Nominal categorical: Female _____ 0 Male _____ 1
4.	Age	What is the age of the household head/breadwinner?	Interval categorical (recoded): 15-34 years _____ 1 35-54 years _____ 2 > 55 years _____ 3
5.	Educational Background	What is the highest level of education attained by the household head/breadwinner?	Ordinal categorical: Junior secondary or lower _____ 0 Senior secondary equivalent _____ 1 Tertiary education _____ 2
6.	Economic Background	(Based on welfare status classification from the 2019 National Statistical System data)	Ordinal categorical: Bottom 40% _____ 0 Middle 40% _____ 1 Top 20% _____ 2
7.	Residential Location	Where is your place of residence?	Nominal categorical (recode): Rural _____ 0 Urban _____ 1



● Data Analysis

In conducting the empirical analysis, this study applies inferential data analysis using an ordinal logistic regression model. Ordinal logistic regression is employed because the dependent variable (food security) is measured as a categorical variable with more than two ordered categories. The ordinal logistic regression model analyzed in this study is specified as follows.

- Ordinal Logistic Regression Model of the Association Between Household Food Security and Its Determinants

$$\text{logit}(P(Y \leq j)) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \varepsilon$$

Note:

Dependent Variable (Y) : Food Security

β : Coefficient Values of Independent Variables (X)

β_0 : Intercept (constant term)

X_1 : Digital Transaction Decision

X_2 : Gender of Household Head

X_3 : Age of Household Head

X_4 : Educational Background of Household Head

X_5 : Economic Background of Household Head

X_6 : Place of Household Residence

➔ RESULTS

Food security is not solely a matter of food availability, but also of who is able to access it and who is most vulnerable to losing such access. Amid the accelerating pace of technological advancement, access to food is increasingly mediated by digital platforms that promise convenience. However, these opportunities do not guarantee that all segments of society can benefit equally.

The COVID-19 pandemic became both a turning point and an accelerator in shifts in consumption patterns. A survey conducted by Google, Temasek, and Bain & Company (2021) shows that approximately 64% of internet users in Indonesia used online food delivery services more frequently during the pandemic,

with the share of new users reaching 58% across Southeast Asia (Tenggara, 2022). Food shopping patterns that were previously conducted through direct purchases at traditional markets began to shift toward online ordering, driven in part by mobility restrictions and health protocols. In parallel, this transition also created gaps, particularly for social groups that lack adequate digital resources and infrastructure.

To examine these gaps, the study conducts a quantitative data analysis based on a household survey approach. After data cleaning, the final analytical sample consists of 3,941 households. As discussed earlier, the analysis is carried out by estimating an ordinal logistic regression model. This model requires several assumptions: (1) the dependent variable is measured on an ordinal scale; (2) independent variables may be continuous, categorical, or ordinal (with ordinal variables treated as non-ordered categorical variables); (3) there is no multicollinearity among the independent variables; and (4) the proportional odds assumption is satisfied. Assumptions (1) and (2) are verified through a review of the codebook, while assumptions (3) and (4) are tested using statistical software prior to running the regression analysis (Agresti, 2018; Laerd Statistics, 2018).

The fulfillment of the multicollinearity assumption is assessed by examining the Variance Inflation Factor (VIF) values of the independent variables in the model. An average VIF value greater than ($>$) 10 indicates the presence of multicollinearity in the data; therefore, it is necessary to ensure that the estimated model has VIF values below this threshold. Meanwhile, the proportional odds assumption is tested by examining the p-value from the Brant test. A p-value greater than ($>$) 0.05 indicates that the assumption is not violated in the model. To verify that both assumptions are satisfied, the following section presents the results of the calculations conducted using statistical software.

Food Security Indicator	VIF	P-Value Brant Test
Food Shortages	1,41	0,103
Ate Less	1,41	0,526



The table above presents the average VIF values and Brant test p-values for the ordinal logistic regression models. The VIF values for both the food shortages and ate less models are 1.41 or lower, which is well below the threshold of 10. In addition, the Brant test p-values are 0.103 and 0.526, both exceeding 0.05. Since all model assumptions are satisfied, the proportional odds model (POM) can be applied. This model is a commonly used form of ordinal logistic regression, as its parameters are more straightforward to interpret compared with alternative models (Williams, 2006).

Table 1 below presents the results of the ordinal logistic regression analysis using the proportional odds model (POM) to examine the association between digital transaction decisions and sociodemographic factors with household food security, using the first indicator; food shortages.

Table 1. Ordinal Logistic Regression Analysis of Household Food Security (Food Shortages) and Its Determinants

Variable	Coef	Std Err	P-value
Digital Transaction Decision			
No (did not conduct)	0	0	0
Yes (conducted)	0,496	0,109	0,000
Gender			
Female	0	0	0
Male	0,236	0,109	0,030
Age			
15-34 years	0	0	0
35-54 years	0,094	0,114	0,410
> 55 years	0,014	0,129	0,913
Educational Background			
1. Junior secondary or lower	0	0	0
2. Senior secondary equivalent	0,082	0,084	0,330
3. Tertiary education	0,332	0,126	0,009



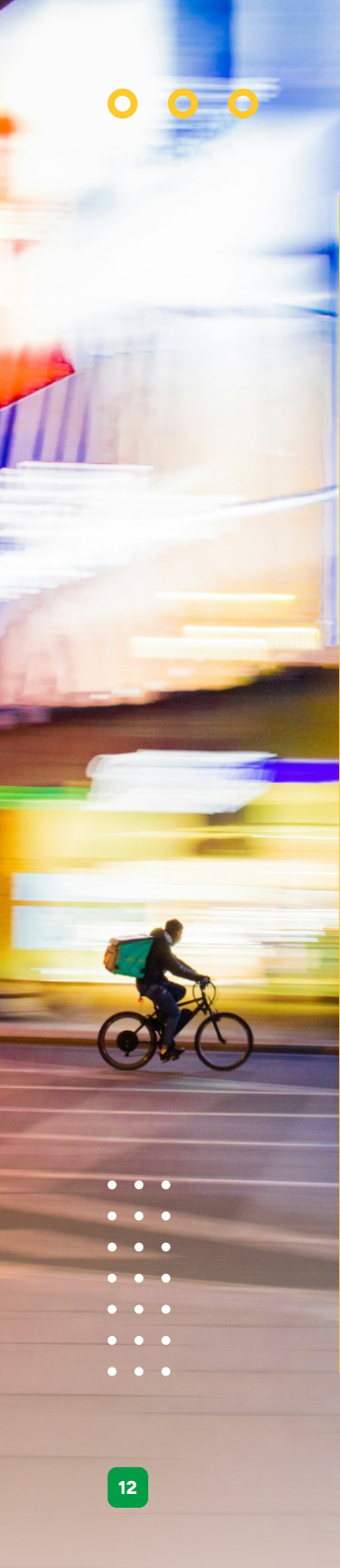
Variable	Coef	Std Err	P-value
Economic Background			
1. 40% Bottom	0	0	0
2. 40% Middle	0,226	0,088	0,010
3. 20% Top	0,934	0,172	0,000
Place of Household Residence			
Rural	0	0	0
Urban	0,003	0,081	0,963

The table above reports the estimated coefficients (log odds) from the ordinal logistic regression model, which indicate the direction and strength of the association between each independent variable and the chance that a household does not experience food insecurity. The results show that households that began using online platforms to purchase food and groceries during the pandemic have a 0.496 point higher likelihood of being in a better category (not experiencing food shortages), with significance at the 1% level, compared with households that did not engage in digital transactions, after controlling for other variables in the model.

Consistent and statistically significant coefficient patterns are also observed for households headed by males (0.236 higher), those with higher levels of educational attainment of the household head (0.332 higher in the highest category), and those belonging to higher economic groups (0.934 higher in the highest category), although some of these effects are significant at the 5% level. Meanwhile, the age variable does not exhibit a consistent pattern, and the place of residence variable is not statistically significant.

Table 2. Ordinal Logistic Regression Analysis of Household Food Security (Ate Less) and Sociodemographic Characteristics

Variable	Coef	Std Err	P-value
Digital Transaction Decision			
No (did not conduct)	0	0	0
Yes (conducted)	0,594	0,101	0,000
Gender			
Female	0	0	0
Male	0,233	0,102	0,022
Age			
15-34 years	0	0	0
35-54 years	0,254	0,103	0,014
> 55 years	0,303	0,119	0,011
Educational Background			
1. Junior secondary or lower	0	0	0
2. Senior secondary equivalent	0,149	0,079	0,061
3. Tertiary education	0,253	0,115	0,027
Economic Background			
1. 40% Bottom	0	0	0
2. 40% Middle	0,275	0,082	0,001
3. 20% Top	0,717	0,145	0,000
Place of Household Residence			
Rural	0	0	0
Urban	-0,048	0,076	0,523



In the second model, which uses ate less as the indicator, the results show more consistent patterns across a larger number of variables, with lower average significance levels compared with the previous model. The analysis indicates that households engaging in digital transactions to purchase food and groceries have a 0.594 point higher chance of being in a better food security category, with significance at the 1% level, compared with households that do not use digital transactions, after controlling for other variables in the model.

In terms of demographic characteristics, households headed by males have a higher likelihood of not experiencing food insecurity than those headed by females (coefficient 0.233; $p < 0.05$). The age variable shows a consistent pattern, with higher age groups being less likely to report ate less than usual, and each category is significant at the 5% level. Educational background is also positively associated, as households with a higher-educated household head have a greater likelihood of not experiencing food insecurity (coefficient 0.253; $p < 0.05$). From an economic perspective, households in the middle and upper welfare groups show significantly higher likelihoods ($p < 0.01$) of being in better food conditions compared with those in the bottom group. Meanwhile, the place of residence variable does not exhibit a statistically significant association with household food insecurity status.

➔ DISCUSSION

🟡 The Association Between Digital Transaction Decisions and Socioeconomic Characteristics with Household Food Security

Through test results on two food security indicators, the analysis shows that households' decisions to engage in digital transactions for food purchases are positively associated with their food security condition. This finding is consistent with previous studies showing that the use of online platforms can expand food access through time efficiency, a wider variety of choices, and ease of distribution (Bennett et al., 2025; Dillahunt et al., 2019; Hambalah & Herman, 2023), particularly in the context of mobility restrictions such as during the pandemic.

Furthermore, the analysis also includes place of residence, but it does not show a significant association with household food security. This indicates that disparities in food access in Indonesia are not solely tied to the spatial dimension, but also occur in both rural and urban areas. This finding can be understood as several studies have noted that although place of residence (urban–rural) is commonly used as an analytical variable, its relationship with food security is not always consistent and, in some contexts, does not show a strong association (Carter et al., 2014; Garrett & Ruel, 1999).

Compared to place of residence, household socioeconomic characteristics (particularly education level, gender of the household head, and level of economic condition) emerge as stronger determinants in explaining food insecurity. Theoretically, all of these findings are consistent with various previous studies emphasizing that food insecurity is associated with socioeconomic characteristics. Higher levels of education, for example, contribute to food security through improved access to information on food management and nutrition, thereby supporting better household decision-making (Burchi & De Muro, 2012; Mutisya et al., 2016). Furthermore, in the digital context, education also plays a role in enhancing digital literacy and the ability to adapt to changes in food distribution systems. Next, the gender of the household head also plays a role in the dynamics of household food security. Differences in social roles are associated with access to resources.



Empirical evidence from Nigeria shows differences in food security, where male-headed households tend to be more resilient due to the sharing of burdens and work roles with their partners. In contrast, female-headed households (mostly widows) face higher vulnerability because they must bear the entire burden of income provision and food management on their own (Omonona & Agoi, 2007). This condition places women in a disadvantaged position in terms of food security, ranging from availability, access, and utilization to stability (Oxfam, 2019).

It cannot be denied that household economic conditions are also closely associated with food insecurity, as they determine the basic ability to access food. Unlike extreme hunger, which generally occurs due to the physical absence of food (such as droughts in deserts or countries affected by natural disasters), food insecurity is more often associated with low-income individuals (Mollenkamp, 2025). Households with better economic conditions have stronger purchasing power to ensure access to food, thus helping communities move out of poverty becomes an important element in improving access to food (FAO, 2022).

The findings above once again affirm the relevance of the capability to function perspective by Amartya Sen, which emphasizes that food conditions are not determined solely by availability or physical factors (such as location and the food availability itself), but also by households' ability to utilize existing resources. As emphasized by Drèze and Sen (1989), control over food is instrumental in nature, while the ultimate goal is the fulfillment of basic human capabilities, the ability to avoid hunger and the various forms of deprivation that accompany it (Burchi & De Muro, 2012). In the context of this study, differences in household socioeconomic characteristics reflect differences in capabilities to utilize available food.

For example, households with limited income and low levels of education often rely on the nearest traditional markets with specific operating hours. In many cases, the division of roles within the household (related to gender) affects the availability of time and mobility in meeting food needs. When these conditions are combined with transportation constraints and the dominance of informal employment with inflexible working hours, households' ability to access markets becomes limited. In such situations, food is physically available, but it cannot be fully utilized by households with lower socioeconomic capacity.

Socioeconomic Readiness of Society in Facing AI-Based Food Systems

When limitations in time, mobility, and resources constrain access to food through conventional, digital transactions can serve as an alternative for fulfilling household food needs. The results of this study show that households engaging in digital transactions tend to have better food security conditions compared to those that do not. However, this finding does not imply that digital transactions are the sole driving variable of food security, as socioeconomic characteristics also play a role in accessing food. In other words, digital transactions function as a supporting mechanism, whose benefits depend on households' own capacity to utilize them effectively. This understanding becomes important when examining the food system in a more digital direction.

Current developments in digital food technology indicate that the role of technology is no longer limited to transaction mechanisms alone, but has expanded toward decision-making systems, including those based on AI. AI is considered to have strategic potential in driving the transformation of food systems in alignment with agricultural needs and the challenges of climate change in countries of the Global South, including Indonesia. Although the Global South possesses substantial agricultural resources and labor, the region faces relatively high levels of food insecurity as well as significant impacts from climate change (Marwala, 2024).



At the upstream level, AI in Indonesia's food system can be utilized to support agricultural production, particularly in rice commodities. The use of AI includes climate modeling to predict weather patterns and planting seasons, the use of soil sensors to monitor nutrient content, and the implementation of precision agriculture through drones to detect pests and nutrient deficiencies at an early stage (i3L University, 2025). Meanwhile, in urban areas, AI also has the potential to strengthen the connection between consumers and producers, thereby reducing transportation emissions and food waste (Marwala, 2024).

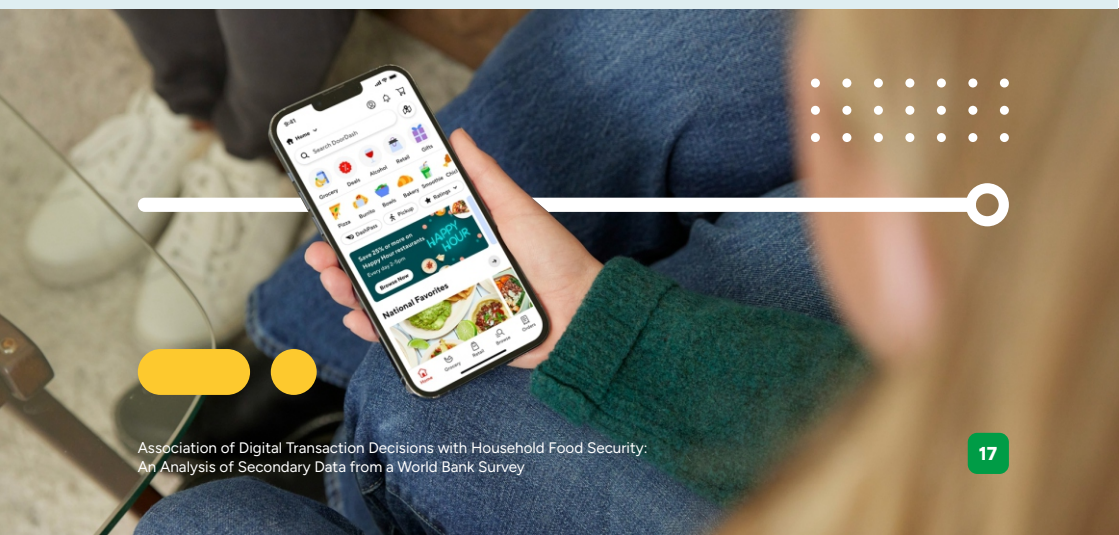
However, facts on the ground show that the availability of AI technology does not automatically guarantee improved system effectiveness. In Indonesia, the Badan Pengawas Obat dan Makanan (BPOM) has accelerated the use of AI-based data analytics to support faster and evidence-based regulatory decision-making. Nevertheless, its implementation still faces challenges in the form of low levels of utilization by users (Pusdatin POM, 2025). This condition highlights that the successful implementation of AI is highly dependent on users' ability to effectively utilize the available systems.

A similar dynamic is also observed at the downstream level, particularly on food delivery service platforms. AI no longer functions merely as a transaction intermediary, but has begun to be involved in the consumption selection process through personalized recommendation systems. A recent feature introduced by Just Eat offers a voice assistant to understand culinary preferences even when users submit highly random queries. This feature allows consumers to express their preferences freely without having to manually browse menus, and is designed to address the phenomenon of "choice overload" resulting from the abundance of food options. The system adjusts recommendations based on time context, taste preferences, and user needs (Sweeney, 2026). Although such innovations have the potential to enhance convenience and accessibility, their benefits remain highly dependent on individuals' ability to interact with digital systems. In the context of increasingly personalized food recommendations, households with limited digital access and technological literacy risk being unable to utilize the system optimally. Under such conditions, AI may potentially deepen inequalities in food security rather than expand choices and freedom of consumption.

Therefore, Indonesia's readiness in facing the transformation of an AI-based food system cannot be measured solely by the level of technological adoption or the advancement of industrial innovation. Such readiness must be understood as capability readiness, namely the extent to which each household has the real freedom to convert the presence of AI into functioning outcomes that support food security. Without interventions to strengthen the socioeconomic capabilities of society, the transformation of an AI-based food system risks becoming an exclusive rather than inclusive advancement. With this technological progress, even in geographically proximate locations, it is highly possible that individuals or households with certain levels of capability will enjoy numerous choices, convenience, and personalization when accessing food, while other groups may not obtain food at all.

➔ CONCLUSION

The results of this study indicate that the use of digital transactions is positively associated with household food security, while considering socioeconomic factors as control variables. Digital transactions have the potential to expand household access to food through payment convenience, however, their effectiveness is highly dependent on the ability to utilize them. This capability is not formed evenly, but rather develops in line with household sociodemographic characteristics. Households with higher levels of education, more stable economic conditions, and stronger decision-making structures (including the dominance of male gender roles) tend to have greater capacity to convert their resources to fulfilling food needs.



The challenge of socioeconomic readiness becomes more pronounced when technology (through the use of AI) no longer functions merely as a transactional tool, but is integrated into decision-making processes within the food system. Although AI has the potential to improve efficiency and food security, these benefits are not automatically distributed. The utilization of AI is closely related to households' ability to access and use the technology in the context of meeting their daily food needs. When digital access and resources remain unequal, the implementation of AI risks reinforcing existing patterns of exclusion. Therefore, in understanding food insecurity, the focus cannot rest solely on creating efficiency through technology, but must emphasize the importance of socioeconomic capabilities and technological literacy so that the benefits of AI can be accessed and experienced more equitably by society.

○ Limitation

The limitation of this study lies in data availability, particularly the absence of information regarding the use of digital transactions after 2020. This condition limits the analytical capacity to capture the most recent dynamics in the development of digital food systems, especially with the integration of AI. Therefore, the discussion of AI in this study is illustrative in nature, and further research using more recent data with specific AI related variables is needed to empirically examine the role of AI in the food system and its implications for community food security.



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ABOUT CfDS

Center for Digital Society (CfDS) is the research center established by the Faculty of Social and Political Sciences, Universitas Gadjah Mada. The institution is created under the concern over the contemporary dynamics of socio-political condition of the world that is accentuated by the impeccable influence of information technology. The phenomenon triggers the new patterns and complexities in the society, and thus requires new approaches in managing such complexities.

CfDS pledged to delve more on the study of contemporary digital society, including related issues surrounding the topic; such as the issues of smart city and urban development. The emphasis is then put on the utilization of technology to shape the society in becoming digitalized, as well as to bring solvency to social issues.

VISION

Solving Social Problem and Accelerating Prosperity through Indonesia Digital Society

ACTIVITIES

-  Research and Development
-  Dissemination and Publication
-  Education and Policy Advocacy



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