

# The Effect of Land Conversion, Farmer Exchange Rate (NTP), Generation Crisis and Availability of Subsidized Fertilizers on Food Security Mediated by Sustainable Economy and Agricultural Labor Productivity (Case Study on Farmers in Lamongan Regency)

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## ABSTRACT

This study aims to analyze the effect of land use conversion, farmers' terms of trade (NTP), generation crisis, and the availability of subsidized fertilizers on food security, mediated by sustainable economy and agricultural labor productivity, among farmers in Lamongan Regency. A quantitative approach was employed using SEM-PLS (SmartPLS 3.3.7) with a sample of 200 farmer respondents drawn from 20 villages in Sukodadi District, Lamongan. The outer model results confirm the validity and reliability of all constructs (outer loading >0.70, AVE >0.50, Composite Reliability >0.70). The inner model shows strong explanatory power for food security ( $R^2=0.810$ ). Key findings reveal that land use conversion has a significant negative effect on food security ( $\beta=-0.146$ ,  $p=0.014$ ) and on agricultural labor productivity ( $\beta=-0.256$ ,  $p<0.001$ ), while it positively affects the sustainable economy ( $\beta=0.354$ ,  $p<0.001$ ). The availability of subsidized fertilizers demonstrates the strongest positive effect on food security ( $\beta=0.911$ ,  $p<0.001$ ). Generation crisis positively influences food security ( $\beta=0.120$ ,  $p=0.004$ ) and agricultural labor productivity ( $\beta=0.292$ ,  $p<0.001$ ). Farmers' terms of trade do not significantly affect food security directly but positively impact agricultural labor productivity ( $\beta=0.811$ ,  $p<0.001$ ), through which indirect effects on food security are realized. Agricultural labor productivity significantly mediates the effects of land use conversion, farmers' terms of trade, and generation crisis on food security. The sustainable economy does not significantly mediate any of these relationships. These findings highlight the critical role of subsidized fertilizer policy and labor productivity enhancement in securing food resilience at the local level.

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## INTRODUCTION

Food security is one of the strategic issues of Indonesia's national development. The agricultural sector plays a role as the backbone of the national economy as well as a

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contributor to the country's foreign exchange, but faces various structural pressures that threaten food production capacity. Lamongan Regency as one of the food barn areas in East Java has 8,652 farmers with a cultivated land area of 3,580.7 hectares, but the phenomenon of conversion of agricultural land to non-agricultural continues to occur. This condition is exacerbated by the low exchange rate of farmers, the reluctance of the younger generation to enter the agricultural sector, and the problem of subsidized fertilizer distribution that is not optimal.

The conversion of agricultural land causes farmers who were originally able to meet their household food needs independently to become dependent on the market. The generational crisis—marked by the low interest of the younger generation in the farming profession due to negative stigma, unstable income, and lack of social security—has the potential to reduce long-term productivity and food production capacity (Arviyanti et al., 2019). On the other hand, the availability of subsidized fertilizers is one of the government policy instruments that most directly affects agricultural production and food security. Several previous studies have examined the individual influence of each of these variables on food security, but studies that integrate all four factors while including the sustainable economy and agricultural labor productivity as mediation variables are still very limited, especially in the context of sub-district farmers in Indonesia. This research gap became the academic foundation of this study. This study aims to empirically examine the influence of land conversion, farmer exchange rates, generation crisis, and the availability of subsidized fertilizers on farmers' food security in Lamongan Regency, as well as analyze the role of sustainable economic mediation and agricultural labor productivity in these relationships.

Food security is a condition for fulfilling sufficient, safe, quality, and sustainable food needs for the community. Sustainable food availability is greatly influenced by the success of agricultural sector development, labor productivity, and sustainable management of agricultural resources. Thus, improving farmers' welfare and economic sustainability are factors that support the creation of strong food security.

#### **Literature Review And Problem Statement**

Food security is defined as the condition of food fulfillment for the state and individuals which is reflected in the availability of sufficient food, both in quantity and quality, safe, diverse, nutritious, equitable, and affordable (Law No. 18 of 2012). The conversion of agricultural land is a real threat to food sovereignty because it reduces the production capacity of food commodities and has an impact on the welfare of agricultural communities (Amalia TA et al., 2022). The Farmer Exchange Rate (NTP) is the ratio of the price index received by farmers to the price index paid by farmers, used as a proxy for farmers' welfare. A high NTP reflects the purchasing power of farmers to meet their food and production needs. The generational crisis refers to the phenomenon of peasant aging and the reluctance of the younger generation to enter the agricultural sector, which is caused by internal factors (narrow land area, low income, limited access to capital) and external factors (family and community support) (Arviyanti et al., 2019). The availability of subsidized fertilizers is a government policy instrument to increase agricultural production by providing

fertilizers below market prices through the Definitive Plan for Group Needs (RDKK). Sustainable economy in the context of agriculture refers to a balance between production, consumption, and markets that provide decent income for farmers (Lestari RA, 2019). Agricultural labor productivity includes the ability of farmers to optimize technology, knowledge, and means of production to produce higher agricultural output.

From the literature review, it was identified that there has been no study that has simultaneously tested the four independent variables (land conversion, NTP, generation crisis, and subsidized fertilizers) on food security with two mediating variables (sustainable economy and agricultural labor productivity) using SEM-PLS, especially in the farmer population at the sub-district level of agricultural districts in East Java. Based on this gap, the study formulated 14 hypotheses that included the direct influence of the four X variables on Y, Z1, and Z2, the influence of Z1 and Z2 on Y, as well as the indirect influence through mediation.

## METHOD

This study uses a quantitative approach with a cross-sectional design. The location of the study is Sukodadi District, Lamongan Regency—selected based on the existence of 20 agricultural village areas with a total of 8,652 farmers and a cultivated land area of 3,580.7 hectares. A sample of 200 respondents was selected using the proportional random sampling technique from all villages. Primary data were collected through a structured questionnaire on a Likert scale of 1–5, consisting of 33 statement items measuring seven variables: Land Conversion / X1 (4 items), Farmers Exchange Rate/X2 (4 items), Generation Crisis/X3 (4 items), Availability of Subsidized Fertilizers/X4 (5 items), Sustainable Economy/Z1 (5 items), Agricultural Labor Productivity/Z2 (5 items), and Food Security/Y (5 items).

Data analysis was conducted using Partial Least Square – Structural Equation Modeling (PLS-SEM) with SmartPLS version 3.3.7. The measurement model (outer model) was evaluated through convergent validity (outer loading >0.7, AVE >0.5) and discriminant validity (cross-loading) tests. Reliability tests were conducted through Composite Reliability (CR >0.7) and Cronbach's Alpha (CA >0.6). The structural model (inner model) was evaluated through R-Square and the path coefficient test by bootstrapping, using hypothesis acceptance criteria: p-value <0.05 (t-table = 1.968 at  $\alpha = 5\%$ ). The influence of mediation was analyzed using Specific Indirect Effect.

## RESULTS AND DISCUSSION

### Measurement Model (Outer Model)

All indicators met the convergent validity criteria with an outer load of >0.70. Table 1 presents the AVE values of each construct, all of which are above the 0.50 threshold. The discriminant validity test through cross-loading showed that each indicator loaded higher on its own construct than the other. The Composite Reliability and Cronbach's Alpha of all variables above 0.70 and 0.60 (Table 2), prove the reliability of the research instrument.

**Table 1.** Convergent Validity (AVE) Test Results

| Variabel                                       | Outer Loading (min) | AVE   | Remarks |
|------------------------------------------------|---------------------|-------|---------|
| Land Conversion (x1)                           | 0.770               | 0.677 | Valid   |
| Farmer's Exchange Rate (X2)                    | 0.908               | 0.844 | Valid   |
| Generation Crisis (X3)                         | 0.713               | 0.552 | Valid   |
| Availability of Subsidized Fertilizers (X4)    | 0.755               | 0.623 | Valid   |
| Sustainable Economy (Z1)                       | 0.737               | 0.658 | Valid   |
| Productivity of Agricultural Kindergarten (Z2) | 0.776               | 0.692 | Valid   |
| Food Security (Y)                              | 0.730               | 0.646 | Valid   |

| Variabel                                       | Composite Reliability | Cronbach's Alpha | Remarks  |
|------------------------------------------------|-----------------------|------------------|----------|
| Land Conversion (x1)                           | 0.893                 | 0.841            | Reliabel |
| Farmer's Exchange Rate (X2)                    | 0.956                 | 0.938            | Reliabel |
| Generation Crisis (X3)                         | 0.831                 | 0.731            | Reliabel |
| Availability of Subsidized Fertilizers (X4)    | 0.892                 | 0.848            | Reliabel |
| Sustainable Economy (Z1)                       | 0.906                 | 0.872            | Reliabel |
| Productivity of Agricultural Kindergarten (Z2) | 0.918                 | 0.889            | Reliabel |
| Food Security (Y)                              | 0.901                 | 0.863            | Reliabel |

**Structural Models and Hypothesis Testing**

The R-Square value indicates that the model has strong predictive power: the variables X1, X2, X3, X4 simultaneously explain 81.0% of the variation in Food Security (Y), 69.5% variation in Sustainable Economy (Z1), and 53.1% variation in Agricultural Labor Productivity (Z2). Table 3 presents a summary of the results of the direct and indirect hypothesis tests.

**Table 3.** Path Coefficient and Specific Indirect Effect Test Results

| Hubungan                                | b      | T-Stat   | P-Value | T-Table | Verdict      |
|-----------------------------------------|--------|----------|---------|---------|--------------|
| H1: AFL (X1) → Food Security (Y)        | -0.146 | 2.472*   | 0.014   | 1.968   | Accepted (-) |
| H2: NTP(X2) → Food Security(Y)          | -0.052 | 1.109    | 0.268   | 1.968   | Rejected     |
| H3: KG(X3) → Food Security(Y)           | 0.120  | 2.893**  | 0.004   | 1.968   | Accepted (+) |
| H4: KPB (X4) → Food Security (Y)        | 0.911  | 22.216** | 0.000   | 1.968   | Accepted (+) |
| H5: AFL (X1) → Sustainable Economy (Z1) | 0.354  | 4.837**  | 0.000   | 1.968   | Accepted (+) |
| H6: NTP (X2) → Sustainable Economy (Z1) | 0.101  | 1.898    | 0.058   | 1.968   | Rejected     |
| H7: KG (X3) → Sustainable Economy (Z1)  | 0.226  | 3.693**  | 0.000   | 1.968   | Accepted (+) |
| H8: KPB (X4) → Sustainable Economy (Z1) | 0.358  | 6.061**  | 0.000   | 1.968   | Accepted (+) |

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|                                                |        |          |       |       |                     |
|------------------------------------------------|--------|----------|-------|-------|---------------------|
| H9: AFL (X1) → Kindergarten Productivity (Z2)  | -0.256 | 3.920**  | 0.000 | 1.968 | Accepted (-)        |
| H10: NTP (X2) → Productivity TK (Z2)           | 0.811  | 13.512** | 0.000 | 1.968 | Accepted (+)        |
| H11: KG (X3) → Productivity TK (Z2)            | 0.292  | 4.914**  | 0.000 | 1.968 | Accepted (+)        |
| H12: KPB (X4) → Kindergarten Productivity (Z2) | -0.169 | 2.317*   | 0.021 | 1.968 | Accepted (-)        |
| H13: Sustainable Economy (Z1) → Y              | -0.025 | 0.364    | 0.716 | 1.968 | Rejected            |
| H14: Productivity of TK (Z2) → Y               | 0.131  | 3.215**  | 0.001 | 1.968 | Accepted (+)        |
| Indirect: AFL (X1) → Z2 → Y                    | -0.034 | 2.537*   | 0.011 | 1.968 | Compl. Mediation    |
| Indirect: NTP (X2) → Z2 → Y                    | 0.106  | 3.079**  | 0.002 | 1.968 | Indirect-only Med.  |
| Indirect: KG (X3) → Z2 → Y                     | 0.038  | 2.644**  | 0.008 | 1.968 | Compl. Mediation    |
| Indirect: KPB (X4) → Z2 → Y                    | -0.022 | 1.741    | 0.082 | 1.968 | Direct-only nonmed. |

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; AFL=Land Conversion Transfer; NTP=Farmer's Exchange Rate; KG=Generational Crisis; KPB=Availability of subsidized fertilizers; TK=Workforce

## Discussion

Land conversion has a negative and significant effect on food security ( $\beta = -0.146$ ,  $p = 0.014$ ), confirming that any shrinkage of agricultural land directly reduces farmers' food production capacity. This finding is in line with Amalia TA et al. (2022) who affirm that land conversion threatens sovereignty and food security. Interestingly, land conversion actually had a positive effect on the sustainable economy ( $\beta = 0.354$ ,  $p < 0.001$ ), indicating that some farmers whose land was converted switched to income-generating non-agricultural economic activities, although this did not directly strengthen food security. However, land conversion has a negative impact on the productivity of agricultural labor ( $\beta = -0.256$ ,  $p < 0.001$ ), which then indirectly weakens food security (complementary mediation,  $\beta = -0.034$ ,  $p = 0.011$ ).

The Farmers Exchange Rate has no significant effect directly on food security ( $\beta = -0.052$ ,  $p = 0.268$ ). This can be explained by field conditions where even though grain prices are increasing, pre-harvest pest attacks force farmers to sell production to cover operational costs, so that the increase in NTP does not necessarily correlate with the fulfillment of farmers' household food. However, NTP had a very strong effect on agricultural labor productivity ( $\beta = 0.811$ ,  $p < 0.001$ ), which then significantly mediated its effect on food security (indirect-only mediation,  $\beta = 0.106$ ,  $p = 0.002$ ). These findings underscore the importance of grain price stabilization policies to strengthen farmers' production capacity.

The generational crisis has a positive and significant effect on food security ( $\beta=0.120$ ,  $p=0.004$ ). These findings indicate that active farmers, despite being dominated by old age (>50 years), still have a high commitment to food production. In addition, the generational crisis also had a positive effect on productivity ( $\beta=0.292$ ,  $p<0.001$ ), which mediated its effect on food security (complementary mediation,  $\beta=0.038$ ,  $p=0.008$ ). This shows that the remaining farmers are those with high experience and perseverance, thus resulting in measurable productivity.

The availability of subsidized fertilizers has the largest and most significant influence on food security ( $\beta=0.911$ ,  $p<0.001$ ), confirming the crucial role of fertilizer subsidy policies as a direct instrument to increase food production. This finding is in line with Jamil A (2022) who stated that subsidized fertilizers are one of the most effective forms of government support in realizing national food security. Sustainable economics has no significant effect on food security ( $\beta=-0.025$ ,  $p=0.716$ ), indicating that farmers' economic development is not strong enough to translate into improved food access and availability in the short term. In contrast, agricultural labor productivity had a positive and significant effect ( $\beta=0.131$ ,  $p=0.001$ ), suggesting that increasing farmers' efficiency and work capacity directly contributed to food security.

## CONCLUSION

This study concludes that: (1) land conversion has a significant negative effect on food security and labor productivity, but positive on a sustainable economy; (2) the farmers' exchange rate does not have a direct effect on food security, but has a very strong effect on labor productivity which then mediates the effect (indirect-only mediation); (3) the generational crisis has a significant positive effect on food security directly or through productivity mediation; (4) the availability of subsidized fertilizers was the variable with the strongest influence on food security ( $\beta=0.911$ ); (5) sustainable economics has not proven to be an effective mediator; and (6) agricultural labor productivity consistently plays a significant mediator. Implicitly, policies that ensure the availability and accessibility of subsidized fertilizers, increase the exchange rate of farmers through price stabilization, and encourage the regeneration of young farmers are top priorities in strengthening food security in agricultural areas. The limitations of this study include the coverage of an area that is limited to one sub-district, so the findings need to be validated on a wider scope and a variety of regional characteristics.

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