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**"Resilient Agribusiness for Global Food Security:
Transformative Pathways to Sustainability"**

Hybrid Conference

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TOPIC

Resilient agribusiness plays a vital role in ensuring global food security by adapting to challenges such as climate change, supply chain disruptions, and resource constraints. This topic explores transformative pathways that integrate innovation, sustainable practices, and policy support to enhance agricultural resilience. By strengthening food systems, improving efficiency, and promoting sustainability, agribusiness can contribute to a more stable and equitable global food supply.

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Abstract Submission

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Does social capital enhance the subjective well-being of maize farmers? Findings from Madura Island, Indonesia

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Abstract

The problem of maize farmers in Madura facing climate change and socioeconomic pressures has an impact on their subjective well-being (SWB). There are findings that social capital affects SWB, but not many have explored how it affects dryland areas. This study fills this gap by assessing the influence of social capital on the subjective well-being (SWB) of maize farmers in the drylands of Madura. Using 158 randomly selected maize farmers, we measured social capital using bonding, bridging, and linking. Ordered probit analysis showed that bonding, bridging, and linking social capital contribute positively to farmers' subjective well-being (SWB), along with the factors of household income and yard crop diversity. Therefore, it is recommended that agricultural development programs not only focus on economic aspects, but also strengthen the social and psychological dimensions to sustainably improve farmers' SWB.

Keyword: Subjective Well-Being; Social Capital; Maize Farmers; Dryland Agriculture; Ordered Probit Analysis

1. Introduction

Madura is an area with unique geographical conditions because it consists of infertile limestone soils, uneven rainfall, dry season temperatures of 30 degrees Celsius, and dry land (Iswahyudi, 2022; Wasonowati et al., 2019). These conditions are considered suitable for corn, which is a heat-loving C4 crop (Fan et al., 2023). (Suhartono et al., 2020) identified that around 456,622.3 ha in Madura can be used for corn cultivation, with 15.4% highly suitable, 46.3% suitable, 35.1% less suitable, and 3.2% unsuitable. Meanwhile, according to (BPS Jawa Timur, 2024), the contribution of maize production from four districts in Madura (Bangkalan, Sampang, Pamekasan, and Sumenep) to the total maize production in East Java reached 10.07%, with Sumenep and Bangkalan as the largest contributors. This shows that maize is one of the leading commodities in Madura. Ironically, maize farmers in Madura face various challenges. One of the main obstacles is climate change, which causes temperature instability, erratic rainfall, and increased risk of drought (Fan et al., 2023). (Zhang et al., 2022) found that temperature and rainfall have a significant impact on maize production, while excessive sunlight can actually inhibit plant growth.

Subjective well-being (SWB) is a concept that describes an individual's level of satisfaction with their overall life (Voukelatou et al., 2021). In the context of farmers, SWB is influenced by economic, social, and environmental factors. Studies (Whitaker, 2024) show that farmers often experience high levels of stress due to government regulations, market price uncertainty, and limited resources. (Li et al., 2023) found that farmers' participation in markets has a positive relationship with their SWB. Farmers who are more active in market transactions tend to have higher levels of life satisfaction, due to better access to income and economic opportunities. Drylands are characterized by low rainfall, high evaporation rates, and limited water resources that lead to low agricultural productivity (Sahara et al., 2023). These limitations make communities in dryland areas more vulnerable to economic stress. (Niranjan & Bose, 2020) assert that dryland agriculture is a challenging task, especially due to frequent droughts

and erratic rainfall. This in turn leads to decreased income, and consequently increased poverty insecurity (Sahara et al., 2023). In addition, farmers often experience social pressures such as marginalization, economic inequality, and vulnerability to economic shocks due to unstable crop yields (Reddy et al., 2021).

Social capital is a factor that assists farmers to overcome challenges in the agricultural sector. Social capital includes social networks, norms and trust that support cooperation within communities to improve efficiency (Markowska-Przybyla, 2020). In the context of agriculture, social capital assists farmers to access information, share technology, and strengthen bargaining power, which is obtained from fellow farmers, agricultural extension workers, and government agencies or financial institutions (Cofré-Bravo et al., 2019). According to (Fukuyama, 2001), social capital plays a role in increasing the effectiveness of cooperation in a group, so as to strengthen the economic resilience of members. Social capital can be categorized into bonding social capital, namely relationships with neighbors, friends, family, farmer group members. Bridging social capital is the relationship between communities, for example with members from other villages. While linking social capital is the relationship with institutions such as government and agricultural organizations (Cofré-Bravo et al., 2019).

Previous research shows that social capital has an important role in improving SWB. The study (Calcagnini & Perugini, 2019) shows social trust and community networks have a positive impact on individual happiness and life satisfaction. (Nugroho et al., 2022a), highlighted how the social capital of urban and rural residents affects SWB using indicators of happiness and life satisfaction. (Appau et al., 2020) explored the effect of social capital inequality on population well-being using longitudinal data. The finding is that locations with high social capital inequality correlate with low SWB. Social capital also contributes to reducing economic uncertainty by improving access to information and technology (Cofré-Bravo et al., 2019). However, there is still a research gap regarding the impact of social capital on SWB among dryland farmers. Most previous studies have focused on farming communities in general or in the context of developed countries. Therefore, this study seeks to fill this gap by analyzing how social capital affects SWB of maize farmers in Madura.

2. Methods

Location and data collection

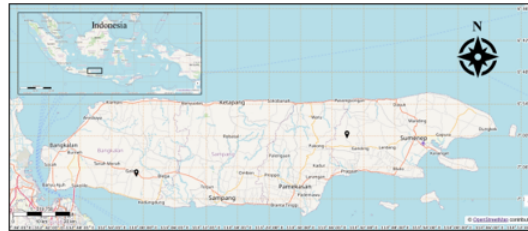


Figure 1. Study area (geoportal.big.go.id)

The research was conducted on Madura Island. Madura Island was chosen because it is a potential location for maize cultivation. The majority of Madura is ideal for maize farming. About 15.4% of Madura's land area or 70,279.5 ha is suitable for maize farming. A total of

211,512.3 ha, or 46.3%, is suitable. 161,098.6 ha, or 35.3%, and 13,732.0 ha, or 3%, of the total Madura area are not suitable for maize farming, respectively (Amzeri, 2018). In addition, Madura hybrid maize is also known to have competitive and comparative advantages (Rahmadiyah & Rum, 2020). The research was conducted in Paterongan Village, Bangkalan District and Bragug Village, Bangkalan District (Figure 1). Primary data were collected from maize farmers in June-December 2023.

The sampling method of this research is simple random sampling. This method ensures that all elements in the population are considered and have an equal probability of being selected as subjects, thus increasing the generalizability of the research results to the population as a whole (Sekaran, 2016). In addition, simple random sampling is the simplest method and can eliminate bias (Jawale, 2012). This study was conducted among 158 maize farmers in Paterongan Village, Bangkalan District and Bragug Village, Sumenep District.

Measurement of social capital and subjective well-being

We divided social capital into 3 variables: bonding, bridging, and linking. To measure each variable, a 5-point Likert scale was used with response categories 1: Strongly disagree, 2: Disagree, 3: Undecided, 4: Agree, and 5: Strongly agree. Each statement begins with the words "I..." to make it clear that the viewpoint of this statement is from the respondent. The indicators used to measure bonding are a) "... get along well with people in this village", b) "... get along well with other farmers in this village", c) "... get along well with family", d) "... trust family and friends", e) "... trust other farmers in this village", f) "... feel safe in this village", and "... trustworthy people". The same measurement is used for the bridging variable with indicators a) "... get along well with other farmers in other villages", b) "... trust other farmers in other villages", c) "... trust people of the same ethnicity more", d) "... trust people of the same religion more", and e) "... trust mosques and their people". Meanwhile, the indicators used to measure linking are a) "... trust the city government and police", b) "... trust the Department of Agriculture", and c) "... trust the Agricultural Research Institute".

There are differences in the approaches we use to measure SWB. First, we only use the SWB variable with 3 indicators: a) life satisfaction with the question "How satisfied are you with your current life?", b) happiness with the question "How happy are you with your current life?", and c) confidence in the future with the question "How confident are you that things will get better in the future?". Second, we used a 4-point Likert scale with response categories for life satisfaction being 1: Very dissatisfied, 2: Dissatisfied, 3: Satisfied, and 4: Very satisfied. The response categories for happiness are 1: Very unhappy, 2: Unhappy, 3: Happy, 4: Very happy. While the response categories for confidence in the future are 1: Very unconfident, 2: Unconfident, 3: Confident, and 4: Very confident.

The variables and indicators in this study were formulated according to previous research. Social capital and indicators of bonding, bridging, and linking were chosen based on a study (Iqbal et al., 2024) that examined the influence on social well-being among youth in Pakistan. The results found that these three variables had a direct effect on the social well-being of youth in Pakistan. The selection of indicators of bonding, bridging, and linking social capital variables was formulated based on research (Zelege et al., 2023). The study examined how social capital influences technology adoption as a result of seed access constraints in Ethiopia. Finally, for indicators of SWB variables, firstly life satisfaction and happiness are commonly used by various studies. (Diener et al., 2018) suggested that SWB using happiness and life satisfaction reflects a combination of how a person assesses various aspects of their life. In addition, (Nugroho et al., 2022b) examined how social capital affects the happiness and life satisfaction of urban and rural residents. Meanwhile, (Pleeging et al., 2021) aimed to make a broader study of SWB indicators. They found a strong correlation between hope and SWB.

Data analysis technique

Ordered probit regression was applied to determine the effect of bonding, bridging, and linking social capital on SWB of Madura Island farmers. This analysis is used because the dependent variable (SWB) in this study is ordinal. Ordinal data is data that has sequential and ordered nature but the distance between categories has no value. According to (Greene, 2012) ordered probit analysis is formed on latent outcome variables, shown by the following equation:

$$Y_i^* = X_i\beta + \varepsilon_i$$

where Y_i^* is an unobserved latent variable; X_i shows the explanatory variables that this study observed, namely financial inclusion variables, farmer demographics, household characteristics, and household assets; β shows the coefficient of the explanatory variable; ε_i shows the error term; and i shows the category of farmer's SWB ($i=0, 1, 2, \text{ and } 3$).

In the ordered probit analysis known as cut off or threshold on each category of SWB farmers. Thus, the model to be analyzed is shown by the following equation:

$$Y_i = \begin{cases} 0 & \text{jika } Y_i^* \leq a_0 \text{ (Level 0 SWB)} \\ 1 & \text{jika } a_0 < Y_i^* \leq a_1 \text{ (Level 1 SWB)} \\ 2 & \text{jika } a_1 < Y_i^* \leq a_2 \text{ (Level 2 SWB)} \\ 3 & \text{jika } Y_i^* > a_2 \text{ (Level 3 SWB)} \end{cases}$$

where Y_i indicates the SWB proxy score; a_1 and a_2 indicate the cut off categories. The ordered probit regression model in this study is shown in the following equation:

$$SWB = \alpha + \beta_1 \text{BOND} + \beta_2 \text{BRIDG} + \beta_3 \text{LINK} + \beta_4 \text{AGE} + \beta_5 \text{EDU} + \beta_6 \text{INC} + \beta_7 \text{ACR} + \beta_8 \text{NACR} + \beta_9 \text{LVST} + \beta_{10} \text{YCR} + \beta_{11} \text{HDDS} + \varepsilon$$

where SWB is household subjective well-being (consists of 4 levels: 0, 1, 2, 3); BOND is bonding score; BRIDG is bridging score; LINK is linking score; AGE is age of household head (years); INC is household income (million IDR); ACR is 1 if have access to agricultural credit, 0 otherwise; NACR is 1 if access to non-agricultural credit, 0 otherwise; LVST is Livestock ownership (total livestock); YCR is Yard crop ownership (total crop types); HDDS is Household food security (HDDS score); α is the Constant or intercept of the model, and β_i is the Coefficient of variable i , where i is the order of the variable.

3. Result and Discussion

3.1. Social capital of maize farmers

Table 1 shows the indicators used to measure bonding, bridging, and linking social capital. We conducted a validity test using item-total correlation (ITC) and reliability using Cronbach's Alpha. In the bonding aspect, the mean of all indicators was above 4, indicating good relationships with neighbors, friends, family, and members of farmer groups. Most respondents stated that they agreed or strongly agreed that they were harmonious with their families (mean = 4.63) and felt trust in their families and friends (mean = 4.55). Even the feeling of safety living in the village was reflected in a high score (mean = 4.52). The only indicator that was slightly lower, although still high, was the statement "I am a trustworthy person" (mean = 4.43). All indicators were declared valid and reliable with ITC and Alpha values of 0.860 and 0.902, respectively.

In the bridging aspect, which shows interconnectedness with different but equal social groups, such as farmers from other villages, other ethnic groups, and other religions, the values tended to be lower than bonding. However, they remained in a fairly high range (mean = 4.29). The highest average indicator appeared in trust towards people of the same ethnicity and religion, at 4.48 and 4.44 respectively. This indicates that the similarity of social identity remains an important foundation in building trust across communities (Neville et al., 2022). Meanwhile, relationships with farmers from other villages were lower compared to farmers

from the same village. Cronbach's Alpha for bridging was 0.753, indicating adequate reliability, and all ITCs were above the threshold value.

Table 1. Indicators of social capital among maize farmers on Madura Island

| Indicator | Mean | Std. Dev. | Min-Max | ITC |
|---|-------|-----------|---------|-------|
| Bonding ($\alpha = 0,902$) | | | | |
| Get along well with people in this village | 4,513 | 0,501 | 4-5 | 0,840 |
| Get along well with other farmers in this village | 4,456 | 0,500 | 4-5 | 0,831 |
| Get along well with family | 4,633 | 0,484 | 4-5 | 0,803 |
| Trust family and friends | 4,551 | 0,499 | 4-5 | 0,842 |
| Trust other farmers in this village | 4,285 | 0,480 | 3-5 | 0,711 |
| Feel safe in this village | 4,519 | 0,514 | 3-5 | 0,860 |
| Trustworthy people | 4,430 | 0,509 | 3-5 | 0,665 |
| Bridging ($\alpha = 0,753$) | | | | |
| Get along well with other farmers in other villages | 4,133 | 0,376 | 3-5 | 0,560 |
| Trust other farmers in other villages | 4,051 | 0,353 | 3-5 | 0,673 |
| Lebih mempercayai orang dari suku yang sama. | 4,481 | 0,514 | 3-5 | 0,753 |
| Lebih mempercayai orang dari agama yang sama | 4,449 | 0,512 | 3-5 | 0,790 |
| Percaya masjid dan umatnya | 4,329 | 0,485 | 3-5 | 0,770 |
| Linking ($\alpha = 0,860$) | | | | |
| Percaya kepada pemerintah kota dan polisi | 3,044 | 1,079 | 1-5 | 0,889 |
| Percaya pada Dinas Pertanian | 3,506 | 1,133 | 1-5 | 0,890 |
| Percaya pada Lembaga Penelitian Pertanian | 3,759 | 0,718 | 1-5 | 0,873 |

Note: The criterion for item validity was determined by ITC > 0.1562, and instrument reliability was considered adequate if Cronbach's Alpha > 0.7.

On the linking social capital variable, we found more mixed values. Trust in agricultural research institutions is high (mean = 3.76), but trust in the city government and police is relatively low (mean = 3.04), with a wider spread of scores (SD = 1.08). In general, the scores of the linking variables are lower than those of the bonding and linking variables. We suspect that public distrust is due to the public's view of corruption that often occurs in Indonesia (Tjptjoherjanto & Rowen, 2010), resulting in public generalization to all government institutions. In addition, rigid programming, inaccurate targeting, and poor communication are the causes of farmers' distrust (Gronevold et al., 2012). Therefore, while there is an appreciation of government institutions, trust needs to be strengthened. Nonetheless, linking reliability is good with an Alpha of 0.860 and an ITC greater than 0.1562.

3.2. Maize farmer well-being

We categorized 4 levels of SWB where level 0 if the total indicators equal 12; level 1 if 13; level 2 if 14; and level 3 if 15. The results show that 37.34% of respondents are satisfied with their current life, happy, and confident about their future. This shows that most farmers at this level feel positive about their living conditions. At Level 1, there are variations that show that there are some farmers who feel happier and more satisfied than others, although they only feel confident. 9.49% of farmers are highly motivated when they are very confident that they will be successful in the future, even though they currently have lower life satisfaction and happiness than others. 12.03% of farmers have SWB at Level 2, which is the level where one of the SWB indicators has a lower score than the other two indicators. This indicates a higher level of SWB compared to Level 1, with more respondents feeling very satisfied and very happy. Level 3 shows the highest level of SWB with 34.18% of respondents feeling very satisfied, very happy, and fully confident in their future. This indicates that a third of the farmers

have very high levels of SWB, reflecting very positive life conditions and strong optimism for the future.

Table 2. Madura Island maize farmers' well-being indicators

| SWB level | Life satisfaction | Happiness | Confidence | Total (%) |
|-----------|-------------------|---------------|-------------------------|-----------|
| Level 0 | 4: Satisfied | 4: Happy | 4: Confident | 37,34 |
| Level 1 | 4: Satisfied | 4: Happy | 5: Completely confident | 9,49 |
| | 4: Satisfied | 5: Very happy | 4: Confident | 5,70 |
| | 5: Very satisfied | 4: Happy | 4: Confident | 1,27 |
| Level 2 | 4: Satisfied | 5: Very happy | 5: Completely confident | 5,70 |
| | 5: Very satisfied | 4: Happy | 5: Completely confident | 3,80 |
| | 5: Very satisfied | 5: Very happy | 4: Confident | 2,53 |
| Level 3 | 5: Very satisfied | 5: Very happy | 5: Completely confident | 34,18 |

3.3. Effect of social capital on well-being using ordered probit regression

Table 3 shows the characteristics of farmers based on the research variables. The average SWB score is 1.43 (from a scale of 0 to 3), with considerable variation between respondents, as seen from the standard deviation of 1.30. This means that most respondents reported low to moderate levels of well-being. If we look at social relations, the average score for bonding social capital is high, at 31.39 out of a maximum total score of 35. This shows that relationships between individuals in the community are well maintained, and even tend to be strong. Bridging social capital is also in the moderately high category with an average score of 21.44 out of 25. Meanwhile, trust in formal institutions, as measured through linking social capital, is actually the lowest compared to other social capital variables, with an average score of only 10.31 out of a total of 15.

The average age of respondent household heads is 43 years old, with an age range from 23 to 80 years old. This means that the majority of respondents are at a productive age, which is usually more active in economic and social decision-making. Household income per month is quite varied, with an average of around 6 million rupiah. In terms of access to credit, only 7% of respondents have access to agricultural credit. In contrast, access to non-agricultural credit is higher, at around 31%. This could be an important note that the agricultural sector is still not widely touched by formal financial services, or that respondents rely more on sources of financing from outside the sector.

In terms of production assets, the average household owns around 3.7 head of livestock, although the number varies widely between respondents. In addition, they also have about one type of yard crop as an additional source of food or income. Interestingly, when looking at the food security aspect, the HDDS (Household Dietary Diversity Score) is quite high, with an average of 7.17 out of a maximum score of 9. This means that, in general, households have good access to a variety of food consumption.

Table 3. Descriptive statistics of research variables

| Variable | Mean | Std. Dev. | Min | Max |
|----------|--------|-----------|-----|------|
| SWB | 1,430 | 1,299 | 0 | 3 |
| BOND | 31,386 | 2,766 | 27 | 35 |
| BRIDG | 21,443 | 1,622 | 17 | 25 |
| LINK | 10,310 | 2,601 | 3 | 14 |
| AGE | 43,456 | 11,764 | 23 | 80 |
| INC | 6,021 | 3,870 | 0,4 | 23,5 |
| ACR | 0,070 | 0,255 | 0 | 1 |
| NACR | 0,310 | 0,464 | 0 | 1 |
| LVST | 3,728 | 5,150 | 0 | 40 |

| | | | | |
|------|-------|-------|---|---|
| YCR | 1,228 | 1,526 | 0 | 7 |
| HDDS | 7,165 | 1,188 | 4 | 9 |

Bonding social capital, which involves close relationships and support from family and close friends, can indeed enhance the subjective well-being of corn farmers by providing a sense of security and emotional support. This type of social capital is characterized by elements such as social trust, reciprocity, and norms, which facilitate cooperation and mutual assistance among fellow farmers (Wahid et al., 2024). Maize farmers may borrow production inputs from other farmers, togetherness in cultivation (Ingrida et al., 2023) share information about market trends, or provide emotional support during difficult times (Wibisono & Darwanto, 2016). These interactions can foster a sense of belonging and security, which can positively impact the farmers' subjective well-being (Begho & Odeniyi, 2024).

Bridging social capital entails relationships with diverse individuals or groups, such as neighbors or other communities, which can enhance the subjective well-being of maize farmers. This finding supports previous studies on maize agribusiness, indicating that bridging social capital enables farmers to access various farm supplies, innovations from agricultural extension workers, and capital loans from Village-Owned Enterprises (Wahid et al., 2024). Additionally, it is based on the principle of value equality, fostering the sharing of knowledge and best practices among farmers (Ingrida et al., 2023).

Linking social capital, which connects farmers with formal institutions such as the government, financial institutions, or non-governmental organizations, plays a crucial role in enhancing the subjective well-being of maize farmers. Access to government support programs, microcredit, and training from these institutions can provide significant financial and technical assistance (Ping et al., 2022; Yunus & Jalil, 2021). Interaction with these entities also creates opportunities for better policy advocacy, which can improve working conditions and economic well-being for farmers.

Table 5. Ordered probit regression

| SWB | Coef. | Std. Err. | z | P> z |
|-----------|----------|-----------|-------|-------|
| BOND | 0,142*** | 0,055 | 2,58 | 0,010 |
| BRIDG | 0,205*** | 0,070 | 2,92 | 0,003 |
| LINK | 0,137** | 0,068 | 2,02 | 0,043 |
| AGE | -0,001 | 0,009 | -0,14 | 0,888 |
| INC | 0,159*** | 0,036 | 4,45 | 0,000 |
| ACR | 0,678 | 0,464 | 1,46 | 0,144 |
| NACR | -0,359 | 0,271 | -1,33 | 0,185 |
| LVST | -0,006 | 0,021 | -0,29 | 0,770 |
| YCR | 0,133* | 0,073 | 1,83 | 0,068 |
| HDDS | -0,002 | 0,085 | -0,02 | 0,981 |
| /cut1 | 10,735 | 1,893 | | |
| /cut2 | 11,383 | 1,911 | | |
| /cut3 | 11,838 | 1,922 | | |
| Obs | 158 | | | |
| LR Chi | 98,64 | | | |
| Prph>chi2 | 0,000*** | | | |
| Pseudo R2 | 0,2426 | | | |

Note: ***, **, and * indicate significance of 1%, 5%, and 10% respectively.

Family income has a significant positive effect on SWB. This indicates that an increase in household income will increase SWB. Higher income provides the ability to meet basic needs such as food, housing, and education (Mirowsky, 2017; Wolfson et al., 2019), as well as secondary needs that improve quality of life (Hassan et al., 2017). Family income also refers

to financial security, the more secure it is, the less stress and anxiety related to economic issues (Badrudin et al., 2025). It will allow farmers to focus more on their work and feel more satisfied with their lives overall.

A greater number of yard crops can improve maize farmers' SWB by providing a variety of food sources and additional income. Yard crops provide an immediate source of food that can be accessed and consumed, reducing family expenditure on products in outside markets and increasing family food security (Csortan et al., 2020). In addition, yard crops can be sold to supplement income (Irfham et al., 2021). The presence of various plants increases psychological satisfaction and pride. In line with previous studies which state that there is a relationship between humans and plants, especially the role of plants in improving human well-being and health (Niazi et al., 2023).

4. Conclusions and Policy Recommendations

Based on the research results, we found that bonding social capital showed the highest value, with an average indicator score above 4, reflecting the strong relationships between individuals in the community such as family, friends, and farmer group members. Meanwhile, bridging social capital showed a slightly lower score than bonding and linking social capital showed the lowest score of the two. We also found that farmers' subjective well-being was generally moderate, with an average SWB score of 1.43 on a scale of 0-3. However, about one-third of the farmers were at "Level 3 SWB", indicating that most farmers were optimistic and satisfied with their lives.

We used ordered probit analysis to determine the effect of bonding, bridging, and linking on SWB. We found that Bonding social capital increases maize farmers' SWB through emotional support and a sense of community from family and close friends. Bridging social capital expands farmers' access to information, innovations, and resources from outside the community, which has a positive impact on SWB. Meanwhile, linking social capital provides access to formal institutions such as the government and NGOs, which support SWB through technical assistance, finance, and policy advocacy. Other variables also have a significant positive effect such as household income and the number of yard plants were also found to have a significant positive effect on SWB. Higher incomes enable the fulfillment of basic needs and increase financial security. Meanwhile, the diversity of yard crops supports food security, income, and provides psychological pride.

We suggest that agricultural development programs should not only focus on production and economic aspects, but also strengthen bonding, bridging, and linking social capital. The government needs to improve communication and policy transparency in order to rebuild public trust. An approach that combines social, economic, and psychological aspects holistically is believed to improve farmers' welfare in a sustainable manner.

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