FOOD PRICE VOLATILITY AND KITCHEN EMERGENCY: TRANSFORMING COMMUNITY GREENHOUSES AS A LOW-COST FOOD SECURITY INTERVENTION

Ahmad Hafidz Lubis*, Ahmad Ihwanul Muttaqin, Ihya' Ulumuddin, Putri Nadiyatul Firdausi, Achmad Farid
Universitas Islam Syarifuddin Lumajang, Indonesia
*Email: ahmadhafidlubis@gmail.com

Abstract: This community service article examines the transformation of village land into bamboo-paranet community greenhouses as a low-cost solution to reduce household expenditures and strengthen food security. The service methodology uses Participatory Action Research (PAR) and religious social capital as a replication protocol. The activities are carried out through the PAR cycle (to know, to plan, to action, to reflect), utilizing socio-economic mapping and income mapping, Focus Group Discussions (FGDs) using problem-tree and hope-tree analysis, and technical assistance for the development of bamboo-rack paranet greenhouses. Initial results indicate an increase in the availability of fresh kitchen supplies at the household level, strengthening the role of women in food management for both families and communities, and a reduction in daily household expenditures as reliance on the market for vegetables and spices decreases. Additionally, the integration of religious social capital has proven to enhance compliance with duty schedules and usage regulations. Pre–post quantitative data related to household expenditures and harvest volume will be presented in the final manuscript to measure the effectiveness of the community greenhouse model as a low-cost/high-impact intervention within the framework of the six dimensions of food security.
Keywords: Food Security, Community Greenhouse, Participatory Action Research, Women's Groups

Introduction

Village Clarak is one of four hamlets (Krajan 1, Krajan 2, Karang Tengah, Karang Anyar) that are administratively part of one neighborhood unit (RW) and five neighborhood groups (RT). The participatory mapping (general mapping) reveals the distribution of settlements, religious-educational facilities, and agricultural spatial patterns, forming the agrarian landscape of the village. This is further illustrated in the figure below:

Figure 1. Map of Village Clarak, Leces District, Probolinggo Regency

The demographic data of Desa Clarak (±2,358 people, with the majority working as farmers, farm laborers, and onion peelers) and the boundary details are summarized in the village monograph, while thematic mapping sharpens the core household issues in Krajan 1.[1]

Behind the agricultural landscape, structural poverty and economic relational disparities are the primary sources of vulnerability. Around 70% of the residents of Krajan 1 work as farm laborers with fluctuating daily incomes, while many housewives depend on seasonal work as onion peelers. The majority of families rely on middlemen and markets to meet their daily consumption needs. To understand the conditions of the target community, an initial mapping was conducted, illustrating the socio-economic situation of the residents. This mapping helps identify vulnerability patterns and factors influencing household well-being before a more detailed analysis of each visual is presented.

[1] BPS Kabupaten Probolinggo, "Kecamatan Leces Dalam Angka 2024" (Probolinggo, 2024)2024.

Figure 2. Socio-Economic Landscape of Village Clarak Residents

The socio-economic mapping above illustrates income vulnerability and the high dependence on daily labor. To support the socio-economic analysis, income mapping is used to capture the real economic capacity of households and the dynamics of daily expenditures. This map provides a more detailed picture of income variations between residents and how these conditions affect their priority needs.

From the food security literature perspective, the pressures experienced by households in Krajan 1 are not only related to access to affordable prices but also to the availability and stability of food supply. The classic four pillars of food security (availability, access, utilization, and stability) have now been expanded to six dimensions by incorporating the elements of agency and sustainability into global policy discourse.[2] This approach emphasizes that without strengthening food production capacities at the family and community level, market price volatility will continue to erode the well-being and nutritional status of vulnerable households.[3]

In recent years, the trend of community garden initiatives and local food security programs utilizing simple greenhouses made from bamboo and paranet as a low-cost, appropriate technology has strengthened.[4] International reviews show that community gardens contribute to improved food access, household resilience, and

[2] Jennifer Clapp et al., "Viewpoint: The Case For A Six-Dimensional Food Security Framework," *Food Policy* 106 (January 2022), https://doi.org/10.1016/j.foodpol.2021.102164.
[3] Eric E. Calloway et al., "New Measures To Assess The 'Other' Three Pillars Of Food Security–Availability, Utilization, and Stability," *International Journal of Behavioral Nutrition and Physical Activity* 20, no. 1 (April 26, 2023): 51, https://doi.org/10.1186/s12966-023-01451-z; M. Fauzan 'Azhima et al., "Sic Pillars of Global Food Security in Indonesia: A Systemic Literature Review," *Sosiohumaniora* 25, no. 3 (November 1, 2023): 419–29, https://doi.org/10.24198/sosiohumaniora.v25i3.43549.
[4] Yusriadi Yusriadi and Andi Cahaya, "Food Security Systems in Rural Communities: A Qualitative Study," *Frontiers in Sustainable Food Systems* 6 (September 20, 2022), https://doi.org/10.3389/fsufs.2022.987853.

social cohesion, noting that the sustainability of such programs highly depends on participatory design and long-term governance.[5] Studies in developing countries, including Indonesia, have found that the adoption of greenhouses correlates positively with increased per capita income and improved food security status of small-scale farmers in East Java, making this model relevant for adaptation at the community village scale.[6]

In the context of Krajan 1, the urgency for intervention has become stronger due to the situation that can be formulated as a "kitchen emergency." This condition is clearly illustrated by the Household Income Map, which shows the concentration of households in the low-income category along with high daily food expenditure burdens. The dependency on the market for spices and vegetables increasingly pressures household daily spending. As a result, an intervention that can directly reduce kitchen expenses, particularly for vegetables and daily spices, is expected to have an immediate impact on family cash balance and open fiscal space for other essential needs.

Figure 3. Household Income Map of Village Clarak

[5] Nuhfil Hanani AR et al., "Does The Greenhouse Adoption Improve Farmers' Welfare? Evidence from Melon Farmers in Indonesia," *AGRARIS: Journal of Agribusiness and Rural Development Research* 10, no. 2 (December 20, 2024): 198–214, https://doi.org/10.18196/agraris.v10i2.416.
[6] Ferdous Farhana Huq and Leith Deacon, "A Systematic Review of Community Gardens and Their Role in Urban Food Security and Resilience," *Discover Sustainability* 6, no. 1 (July 25, 2025), https://doi.org/10.1007/s43621-025-01628-5.

At the same time, Desa Clarak possesses strong religious social capital, including the presence of TPQ (Qur'an reading groups), yasinan (prayer gatherings), rotibul haddad, and istighatsah (prayer meetings), which take place regularly. This religious network forms a social capital based on trust, shared norms, and a micro-leadership structure, which could serve as the foundation for organizing maintenance schedules, ensuring adherence to planting–harvesting rules, and the scheme for donations of seeds and labor.

Figure 4. Religious Social Activities of Residents

The documentation of the activities above shows the density of religious activities that can be mobilized as a collective asset. These findings are consistent with social-religious studies in Indonesia that show strengthening religious social capital contributes to increased participation, coordination, and sustainability in community-based economic empowerment programs.[7]

Based on the problem mapping and potential, this article outlines how the transformation of community greenhouses made from bamboo–paranet can be operationalized as a solution to reduce kitchen expenditures and strengthen food security in households in Hamlet Krajan 1. The applied research aims to address three main areas. First, to develop and manage community greenhouses based on citizen participation using local materials such as bamboo and paranet for daily vegetable and spice production. Second, to measure changes in kitchen expenditures and household food access after the intervention. Third, to formulate a model integrating the PAR

[7] Sutomo Sutomo et al., "Religious-Sociocultural Networks and Social Capital Enhancement in Pesantren," *Jurnal Pendidikan Islam* 10, no. 1 (June 25, 2024): 137–48, https://doi.org/10.15575/jpi.v10i1.19997.

approach with religious social capital as a replication protocol that can be adopted in other villages.

From a technical perspective, the selection of greenhouse technology is based on the literature regarding microclimate control. Temperature, relative humidity (RH), and vapor pressure deficit (VPD) regulation through simple ventilation systems have been proven to increase cultivation success consistently throughout the year. In various studies in the Global South context, optimized low-tech greenhouse configurations are considered the most efficient in terms of cost and energy and better suited to the social-technical capacity of communities.[8]

The development initiative for greenhouses in Krajan 1 is not viewed merely as the construction of physical infrastructure but as part of a broader community food security strategy that aligns with contemporary dynamics around food price volatility, household expenditure pressures, and the strengthening of community-based food self-sufficiency.[9]

Theoretical Frameworks

This study is grounded in several theoretical frameworks, one of which is the concept of household food security as formulated by FAO/CFS, which emphasizes the simultaneous fulfillment of four main pillars: availability, access, utilization, and stability. Recent developments have added two important dimensions: agency (the ability and control of households over food systems) and sustainability, thereby expanding the definition of food security not only as an outcome condition but also as a process that ensures sustainability and sovereignty for local actors.[10]

---

[8] Redmond Ramin Shamshiri et al., "Review of Optimum Temperature, Humidity, And Vapour Pressure Deficit For Microclimate Evaluation And Control In Greenhouse Cultivation Of Tomato: A Review," *International Agrophysics* 32, no. 2 (April 1, 2018): 287–302, https://doi.org/10.1515/intag-2017-0005; Ramin Shamshiri et al., "Advances in Greenhouse Automation and Controlled Environment Agriculture: A Transition to Plant Factories and Urban Agriculture," *IJABE: International Journal of Agricultural and Biological Engineering* 11, no. 1 (2018): 1–22.

[9] Clapp et al., "Viewpoint: The Case For A Six-Dimensional Food Security Framework"; Huq and Deacon, "A Systematic Review of Community Gardens and Their Role in Urban Food Security and Resilience"; Yusriadi and Cahaya, "Food Security Systems in Rural Communities: A Qualitative Study."

[10] Committe On World Food Security, "Global Strategic Framework for Food Security & Nutrition (GSF)," Food and Agriculture Organization of the United Nations, 2021, https://www.fao.org/cfs/policy-products/onlinegsf/en/; Committe On World Food Security, "Food Security and Nutrition: Building a Global Narrative Towards 2030" (Rome, 2020)2020.

In the context of Dusun Krajan 1, income mapping and thematic mapping reveal the dominance of farm laborers and onion peelers with uncertain incomes and high dependence on the market. Consequently, the six dimensions framework is relevant for understanding the vulnerability of the "kitchen emergency" that arises when price increases or harvest failures occur. The greenhouse-based intervention is positioned to strengthen availability (production of daily vegetables and spices), enhance access (cost reduction and proximity), improve utilization (freshness and consumption diversity), and support supply stability at the household scale.

From a technical perspective, community-scale greenhouses are designed as low-cost technologies, utilizing bamboo frames, paranet for protection and ventilation, tiered racks for space efficiency and protection, and polibags as planting media. This configuration allows for simple microclimate management through temperature, relative humidity, and vapor pressure deficit (VPD) adjustments, which, according to international studies, have a direct impact on successful year-round horticultural production.[11] These principles were adapted in RT 3 Dusun Krajan 1 through the construction of bamboo-paranet greenhouses with tiered racks and the planting of approximately 70 seedlings of chili, eggplant, tomato, celery, and herbs selected based on daily kitchen consumption needs. This design aligns with evidence showing that optimized, simple greenhouse configurations are the most efficient in contexts with limited resources.

The sustainability of greenhouse use is also linked to social and gender capital frameworks, particularly religious social capital and the role of women's groups. Religious networks in Desa Clarak, including TPQ (Qur'an reading groups), yasinan (prayer gatherings), rotibul haddad, and istighatsah (prayer meetings), help build social capital based on trust, shared norms, and networks that facilitate coordination, social monitoring of usage rules (such as the "take–replant" scheme), and discipline in collective care.

The women's group/PKK plays a crucial role as the primary operational actor in daily management, from scheduling, watering, to seed replacement. This is

[11] Shamshiri et al., "Review of Optimum Temperature, Humidity, And Vapour Pressure Deficit For Microclimate Evaluation And Control In Greenhouse Cultivation Of Tomato: A Review."

consistent with findings from various studies that show women and PKK groups significantly contribute to household food production, consumption diversification, local institutional strengthening, and household food security.[12]

From a state-of-the-art perspective, literature on food security, community gardens, and micro-greenhouses indicates that community gardens contribute to health, food access, and social cohesion, both in urban and rural contexts.[13] However, there is still limited research that systematically connects household income and price pressures, community garden trends, kitchen emergency situations, the transformation through participatory greenhouse adoption, and the formulation of solutions through community governance based on social-religious capital within a coherent analytical framework.

Method

The methodology used in this study is Participatory Action Research (PAR),[14] with household units and women's groups (PKK) as the units of analysis. PAR positions the community members as active subjects in diagnosing problems, planning, acting, and reflecting on the results through a cyclical and participatory process. In the context of Dusun Krajan 1, Desa Clarak, the PAR cycle begins with trust building, participatory mapping, and the collective formulation of problems and solutions alongside local leaders (RT/RW), women's groups, village officials, and religious figures.

---

[12] Ernoiz Antriyandarti et al., "The Dual Role of Women in Food Security and Agriculture in Responding to Climate Change: Empirical Evidence From Rural Java," *Environmental Challenges* 14 (January 2024): 100852, https://doi.org/10.1016/j.envc.2024.100852; Rasdiana Mudatsir and Sumarni, "Penguatan Kelompok Wanita Tani Dalam Mendukung Ketahanan Pangan Rumah Tangga Di Kabupaten Jeneponto," *Journal Galung Tropika* 14, no. 1 (April 30, 2025): 62–72, https://doi.org/10.31850/jgt.v14i1.1291; Muchamad Syaifuddin Zuhri and Lailul Mursyidah, "The Role of PKK in Sustainable Community Empowerment: Peran PKK Dalam Pemberdayaan Masyarakat Berkelanjutan," *Indonesian Journal of Cultural and Community Development* 15, no. 3 (2024), https://doi.org/10.21070/ijccd.v15i3.1092.

[13] Huq and Deacon, "A Systematic Review of Community Gardens and Their Role in Urban Food Security and Resilience"; Clare Hume et al., "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Outcomes: A Systematic Review," *BMC Public Health* 22, no. 1 (June 23, 2022): 1247, https://doi.org/10.1186/s12889-022-13591-1.

[14] Ahmad Hafidz Lubis and Ahmad Ihwanul Muttaqin, "Pendampingan Masyarakat Desa Sidomulyo Dusun Krajan Dalam Meningkatkan Kemampuan Publik Speaking Untuk Menjadikan Sektor Wisata Tumpak Sewu Sebagai Wisata Internasional," *Khidmatuna: Jurnal Pengabdian Masyarakat* 4, no. 1 (November 15, 2023): 44–54, https://doi.org/10.54471/khidmatuna.v4i1.2925.

The initial phase (*to know*) was carried out over approximately 10 days through cultural immersion, house visits, and preliminary interviews. This was followed by general mapping and thematic mapping to identify economic, religious, educational, and infrastructure issues. The mapping results revealed the dominance of farm laborers (approximately 70%) and household income vulnerability, which led to the identification of a "kitchen emergency." These findings were then brought into the planning phase (*to plan*) through a Focus Group Discussion (FGD) on January 18, 2025, using problem-tree/hope-tree analysis and a Venn diagram to analyze the root causes and key actors.

Figure 5. *Focus Group Discussion* with Community Members

From the FGD, the community agreed on developing a community greenhouse as a solution to minimize kitchen expenditures. The greenhouse design involved bamboo frames and paranet covers, located on village land in RT 3, with tiered racks and polibags for planting approximately 70 seedlings of chili, eggplant, tomato, celery, and herbs.

The implementation phase (*to action*) was realized through community mutual aid to construct the greenhouse and plant horticultural commodities relevant to daily kitchen needs. Governance was collectively organized with rules such as the "take–replant" scheme (each harvest was followed by replanting) and a weekly rotation system of women's groups for plant care, watering, and monitoring plant conditions.

Production and infrastructure were monitored using indicators such as the number of plants alive, the frequency and cycles of harvests, and facility damage (racks, paranet, polibags). Process indicators included the number of participants in mutual aid activities, social work hours, compliance with duty schedules, and the completeness

of the logbook (attendance, duty records, photo documentation). The primary outcome was measured at the household level by the reduction in weekly kitchen expenses and changes in access to fresh vegetables/herbs (days/week), as well as the level of participation from women's groups (percentage of active members).

Kitchen expenditure reduction was calculated using the formula for "baseline expenditure" (the initial expenditure before the intervention) and "expenditure during period t" (after utilizing the greenhouse), as shown below:

$$Kitchen\ Expenditure\ Reduction\ (\%) = \frac{Baseline\ Expenditure - Expenditure\ at\ period\ \tau}{Baseline\ Expenditure}\ x\ 100$$

The data were analyzed using a pre–post descriptive quantitative approach to observe changes in kitchen expenditures and frequency of food access. A thematic qualitative analysis was also performed on FGDs, fieldnotes, and community narratives to capture changes in food management practices and collective governance. Validity was ensured through source and method triangulation (field documents, observations, FGDs) and member checking, where a summary of the results was presented to community representatives for confirmation or correction, as recommended in current triangulation and member checking literature.[15]

Photo documentation accompanied all stages as visual evidence of the participatory process and the physical changes that occurred. From a technical perspective, the management of the microclimate (temperature–RH–VPD) within the greenhouse is based on findings that adequate ventilation and humidity control significantly affect successful year-round cultivation. Therefore, the bamboo-paranet low-tech greenhouse configuration, though optimized, is deemed adequate and suitable for the community's capacity within the context of limited resources.[16]

[15] Courtney McKim, "Meaningful Member-Checking: A Structured Approach to Member-Checking," *American Journal of Qualitative Research* 7, no. 2 (2023): 31–52, https://doi.org/10.29333/ajqr/12973; Ramakrishnan Vivek, Yogarajah Nanthagopan, and Sarmatha Piriyatharshan, "Beyond Methods: Theoretical Underpinnings of Triangulation in Qualitative and Multi-Method Studies"," *SEEU Review* 18, no. 2 (December 1, 2023): 105–22, https://doi.org/10.2478/seeur-2023-0088; Sasha M. Kullman and Anna M. Chudyk, "Participatory Member Checking: A Novel Approach for Engaging Participants in Co-Creating Qualitative Findings," *International Journal of Qualitative Methods* 24 (December 14, 2025), https://doi.org/10.1177/16094069251321211.

[16] Shamshiri et al., "Review of Optimum Temperature, Humidity, And Vapour Pressure Deficit For Microclimate Evaluation And Control In Greenhouse Cultivation Of Tomato: A Review."

Social-Economic Dynamics and Community Aspirations as the Starting Point for Intervention

The socio-economic dynamics of Dusun Krajan 1, part of Desa Clarak, reveal a fragile household economic structure that is highly influenced by seasonal factors, as depicted in general and thematic mapping. The mapping illustrates the dominance of seasonal labor, particularly as farm laborers and onion peelers, leading to income fluctuations and thin food security margins. The community's narrative highlights their dependency on middlemen (juragan) and local markets, as well as daily labor as the main source of income, with the peak of the rainy season exacerbating the situation by disrupting planting and harvesting activities.

The income map shows a concentration of households in the low-income category, confirming food security vulnerability at the hamlet level. This is further exacerbated by infrastructure limitations such as pothole-filled roads, waterlogging during the rainy season, and inadequate irrigation, all of which increase transaction costs and logistical risks, weakening price access and supply stability for producer-consumer households in Krajan 1.

The community describes this situation as a "kitchen emergency," a state where daily food expenses continue to rise while income remains unstable. These findings are consistent with thematic mapping. This local vulnerability pattern aligns with international evidence, indicating that food price volatility is triggered by climate dynamics, supply chain disruptions, and commodity market fluctuations, which undermine food security in low-income households that allocate a significant portion of their expenditures to food. These factors lead to reduced access, poorer consumption quality, and increased risks of malnutrition in developing countries.[17]

In the Indonesian context, the quality of road infrastructure and irrigation is positively correlated with regional food security; road improvements reduce transportation costs, streamline distribution, and enhance production efficiency, while

[17] Marwa Ben Abdallah, Maria Fekete-Farkas, and Zoltan Lakner, "Exploring the Link between Food Security and Food Price Dynamics: A Bibliometric Analysis," *Agriculture* 11, no. 3 (March 19, 2021): 263, https://doi.org/10.3390/agriculture11030263; Tesfamicheal Wossen et al., "Impacts of Climate Variability and Food Price Volatility on Household Income and Food Security of Farm Households in East and West Africa," *Agricultural Systems* 163 (June 2018): 7–15, https://doi.org/10.1016/j.agsy.2017.02.006.

irrigation supports the continuity of yields—findings that are relevant to the situation in Krajan 1, which faces limited access and waterlogging during the rainy season.[18]

At the same time, the local market structure, reliant on intermediaries (juragan), aligns with agricultural value chain studies that show weak bargaining power for household producers and lengthy distribution chains. This contributes to price instability at the consumer level and low returns for farmers, thus maintaining income uncertainty and poor welfare.[19] Amidst this vulnerability configuration, the community's collective aspiration to form a community garden in the form of a greenhouse emerged in the FGD as a realistic exit strategy: producing daily vegetables and herbs near residential areas, reducing dependency on the market, and alleviating kitchen expenditure burdens. The executive summary document notes the choice of a bamboo-paranet greenhouse design with tiered racks and polibags, listing priority commodities (chili, eggplant, tomato, celery, ginger, turmeric), along with the "take–replant" governance system and duty roster.

This aspiration is consistent with international studies on community gardens and horticulture, which show their contribution to increasing access to fresh food, social cohesion, and resilience to supply disruptions, especially during crises, when supported by participatory design and sustainable management.[20] To clarify the vulnerability structure experienced by the community, a participatory problem-tree analysis was conducted. This tool helped outline the relationships between root causes, the core problem (the "kitchen emergency"), and downstream impacts such as reduced consumption quality, daily expenditure pressure, and low food stability at the household level.

---

[18] Oryza Maulida Widunyah, Alia Fibrianingtyas, and Dwi Retnoningsih, "The Influence of Rural Road Infrastructure on Rice Crop Productivity in Indonesia," *Journal of Tropical Rural Development* 1, no. 1 (2024): 1–9; Erlisa Oktiani and Khoirunurrofik Khoirunurrofik, "Role of Roads and Irrigation on Food Security in Indonesia," *Economics Development Analysis Journal* 13, no. 2 (August 7, 2024): 259–74, https://doi.org/10.15294/edaj.v13i2.78981.

[19] Stefany Anindya Putri et al., "The Role of Farmers and Middlemen in The Perspective of Actor Network Theory: Study of Actors on Agricultural Product Distribution Chain in Kaponan Village, Magelang Regency, Central Java," *Agrisocionomics: Jurnal Sosial Ekonomi Pertanian* 7, no. 1 (March 31, 2023): 1–15, https://doi.org/10.14710/agrisocionomics.v7i1.14484; Widunyah, Fibrianingtyas, and Retnoningsih, "The Influence of Rural Road Infrastructure on Rice Crop Productivity in Indonesia."

[20] Kate A. Congreves, "Urban Horticulture for Sustainable Food Systems," *Frontiers in Sustainable Food Systems* 6 (August 19, 2022), https://doi.org/10.3389/fsufs.2022.974146.

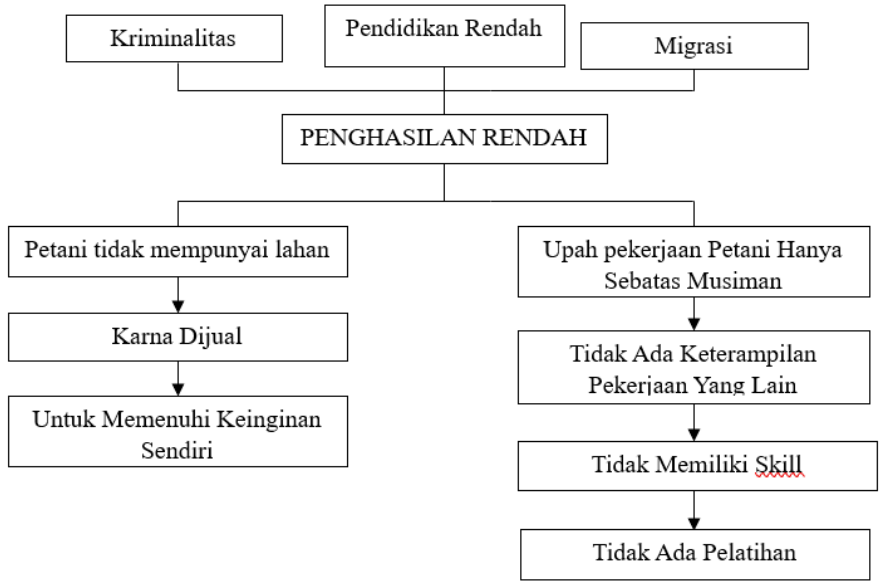

Figure 6. Problem Tree Analysis

The problem tree analysis shows that the root causes are structural and mutually reinforcing, particularly the combination of seasonal income, the oligopsonistic market controlled by intermediaries, and limited local food production capacity. This emphasizes that effective interventions must target strengthening internal production capabilities rather than merely improving market access.

After identifying the root problems, the community formulated a "hope tree" to illustrate the ideal condition they wished to achieve. This analysis highlighted key goals such as achieving community food self-sufficiency, reducing kitchen expenditures, and stabilizing daily consumption. The emerging solution branches included the development of community greenhouses, increased cultivation knowledge, shared institutional roles, and adequate infrastructure support.

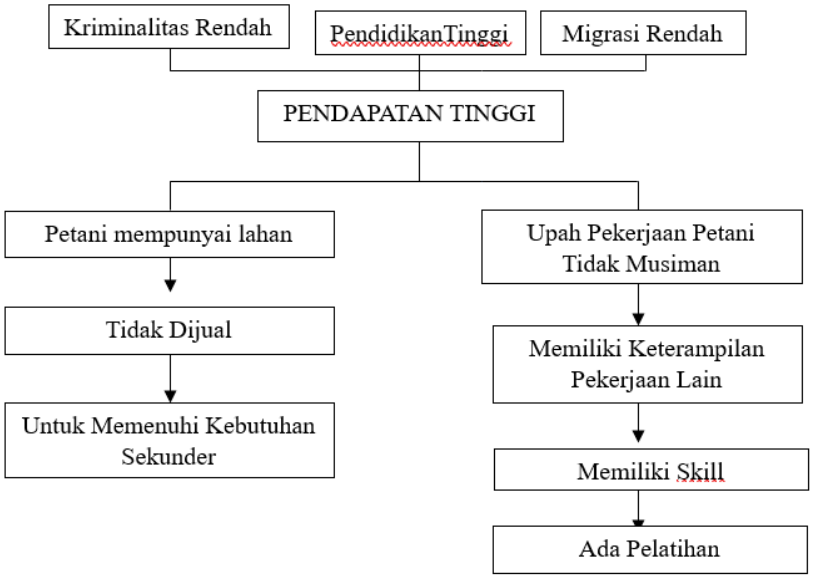

Figure 7. Hope Tree Analysis

The hope tree indicates the consistent direction of change desired by the community: strengthening food production close to homes, increasing community control over food sources, and building collective governance. This strengthens the viability of the greenhouse intervention as a strategy aligned with the community's aspirations.

To map the actors and inter-institutional relationships involved, a Venn diagram was used. This analysis identified key institutions, such as RT, women's groups/PKK, TPQ, the village government, youth groups, and village leaders, as central actors in managing and sustaining the greenhouse. The size of the circles and the degree of overlap indicate the influence, proximity, and potential for collaboration among actors.

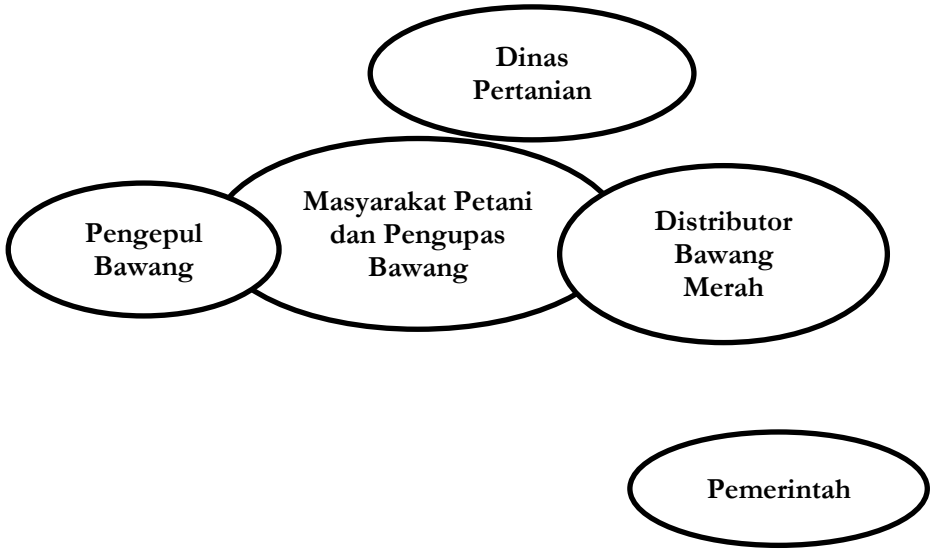

Figure 8. Venn Diagram

The Venn diagram highlights that the success of the intervention depends on collaboration between community-based institutions (RT, PKK, TPQ) and the village government. Involvement from TPQ and other religious organizations strengthens religious social capital, which has been shown to enhance participation and compliance in joint activities.

This analysis places the baseline of Krajan 1, characterized by dependence on seasonal labor, low income, limited infrastructure, and imbalanced market relationships, in a context that empirically supports the priority intervention of strengthening community food production. Through the problem tree, hope tree, and Venn diagram analysis, it is clear that the greenhouse intervention is not only rooted in tangible needs but also has strong institutional support and a shared community vision, thus opening opportunities for improving food security indicators in terms of availability, access, and stability at the household level.

Strengthening Community Institutions and Community Greenhouse Transformation

The strengthening of community institutions in Dusun Krajan 1 and the transformation of the community greenhouse were built through the Participatory Action Research (PAR) approach, using a repetitive cycle of deliberation–action–reflection. A series of Focus Group Discussions (FGDs) resulted in a collective agreement that the construction of a community greenhouse was the most relevant

intervention to address daily food needs, while also strengthening the role of women's groups (PKK), RT/RW structures, and religious institution networks (TPQ/prayer gatherings).

During the implementation phase, the greenhouse was built through mutual aid at the end of January 2025 on village land in RT 3, specifically on the east side of the village head's house, ensuring neutral and open access for all residents. The facilitator team and women's groups agreed on the distribution of materials and roles: the team served as technical facilitators, while the women played the main role in the construction and planting process.

The greenhouse structure used bamboo frames and paranet for protection and ventilation, equipped with tiered racks to optimize space and reduce deterioration during watering, while also minimizing the risk of plants being eaten by chickens, which are commonly raised by the residents. All plants were cultivated in polibags to facilitate rotation, media control, and reorganization as needed. This configuration aligns with the recommendation for low-tech greenhouses in resource-limited contexts, emphasizing the optimization of temperature, relative humidity, and vapor pressure deficit (VPD) to ensure year-round harvest continuity.[21]

Figure 9. Greenhouse Construction

[21] Shamshiri et al., "Review of Optimum Temperature, Humidity, And Vapour Pressure Deficit For Microclimate Evaluation And Control In Greenhouse Cultivation Of Tomato: A Review."

The governance of the greenhouse was formulated participatorily through a clear role distribution and usage rules. PKK is responsible for watering, light fertilization, and seed replacement; RT/RW coordinates schedules, structural maintenance, and communication across RTs; village officials provide infrastructure support; and religious leaders strengthen collective discipline and adherence to common rules.

The daily/weekly duty system was documented through a simple logbook containing attendance, maintenance activities, and records of pests or damage, which also functioned as a monitoring and evaluation instrument to prevent the return of previous collective responsibility failures. The take–replant rule stipulates that residents who use the harvest for household consumption must replant or contribute replacement seeds, while surplus harvest is managed for local sales, and the proceeds are allocated to maintenance and facility improvements.

The plant portfolio focused on approximately 70 commodities directly related to kitchen needs, particularly chili, eggplant, tomato, celery, as well as herbs like turmeric, ginger, and galangal, with criteria based on high consumption frequency, ease of maintenance, and relatively quick harvest cycles. The harvest was prioritized for household consumption around the greenhouse, while surplus production could be used as a source of funds for maintenance or additional seedlings. Residents responded positively to this initiative, interpreting it as an effort to minimize kitchen expenses. The village head emphasized that this community greenhouse is the starting point for Desa Clarak's food security system, as it is the first greenhouse facility in the region.

After the intensive facilitation ended, the community agreed that the maintenance of the greenhouse would continue to be managed by the PKK and local residents, with the obligation to ensure seed security and adhere to the take–replant rule. This arrangement is consistent with findings that women's groups play a key role in household food practices and the sustainability of community-based innovations.[22]

The integration of religious social capital proved crucial in ensuring the sustainability of this new institution. The intensity of activities at TPQ, yasinan, rotibul

[22] Antriyandarti et al., "The Dual Role of Women in Food Security and Agriculture in Responding to Climate Change: Empirical Evidence From Rural Java."

haddad, and istighatsah created a network of trust, mutual cooperation norms, and coordination capacity, which facilitated volunteer recruitment, enforcement of rules, and adherence to duty schedules.

This social capital functioned as the "institutional glue" that maintained the rhythm of greenhouse maintenance, expedited the resolution of technical issues such as pest infestations or structural damage, and strengthened residents' sense of ownership. This local configuration aligns with international evidence on community-based participatory interventions in food security and systematic reviews of community gardens, which show significant contributions to fresh food access, social cohesion, and community resilience.[23] Within this framework, the Krajan 1 community greenhouse can be understood as a new institution that emerged from a combination of appropriate technical design and institutional architecture based on social-religious capital, rather than merely a short-term physical project.[24]

Initial Impact, Replication, and Pathway to Strengthening Sustainability

Reflections on the implementation of the intervention in Dusun Krajan 1 show that the community greenhouse program emerged from a unique socio-economic context: the majority of residents work as farmers, farm laborers, livestock keepers, or factory workers, with their livelihoods heavily dependent on environmental conditions and basic infrastructure, while income levels remain relatively low. Despite this, social cohesion and community solidarity are relatively strong. The problem mapping conducted with the community revealed various issues related to education, economy, and infrastructure, but the ranking process emphasized that economic issues, particularly household expenditures, were the primary concern that needed immediate response.

In the FGD, the community agreed that the most realistic strategy was to minimize kitchen expenditures, rather than merely pursuing short-term income increases. The facilitator team then acted as a link between the residents, village

[23] Yusriadi and Cahaya, "Food Security Systems in Rural Communities: A Qualitative Study."
[24] Hume et al., "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Cutcomes: A Systematic Review."

officials, and women's groups to jointly formulate solutions, leading to the development of a community greenhouse as an instrument to strengthen household food security based on participation. This approach aligns with participatory food security research frameworks, which emphasize collective identification of root causes, the selection of enhancement strategies, and testing and adapting solutions throughout the rural food value chain.[25]

The initial impact identified in terms of food access shows that residents find it "easier to obtain fresh food" from the community greenhouse without being fully reliant on the market. Reflection notes highlight the direct benefits, including the availability of vegetables and herbs for daily consumption, as well as increased community awareness of more sustainable cultivation practices.

Indications of reduced kitchen expenditures began to emerge when several commodities previously purchased could now be sourced from their own harvest, resulting in a reduction in some food expenditure categories. During periods of surplus, small business opportunities emerged through limited local sales. This pattern is consistent with systematic reviews of community gardens, which show increased consumption of fruits and vegetables, improvements in psychosocial and community indicators, and contributions to food security and local resilience, although the quality of evidence varies.[26]

From the perspective of social capital, the program's dynamics demonstrate the strengthening of solidarity and collaborative practices. Joint planting and harvesting activities, rotating maintenance duties, and monthly evaluation forums created a collective routine, documented in daily watering schedules, weekly fertilization, pest checks, and evaluation meetings. Established religious networks such as TPQ, yasinan, and rotibul haddad accelerated the adoption of collective behaviors, including compliance with duty schedules, the implementation of the "take–replant" rule, and the responsibility of guarding the greenhouse against seed theft.

[25] F. Graef et al., "Framework for Participatory Food Security Research in Rural Food Value Chains," *Global Food Security* 3, no. 1 (February 2014): 8–15, https://doi.org/10.1016/j.gfs.2014.01.001.
[26] Hume et al., "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Cutcomes: A Systematic Review."

These findings align with quantitative evidence from Indonesia, which shows that both bonding and bridging social capital dimensions significantly impact household food security, and that social capital plays a key role in strengthening the four pillars of food security.[27] The integration of religious social capital functions as an institutional lever, enhancing the effectiveness of participatory approaches at the village level.[28]

For sustainability, the community and village government have outlined three key levers. First, a community cost-sharing scheme that combines labor contributions, seed or fertilizer dues, and community work for structural repairs to maintain daily greenhouse operations. Second, the development of Standard Operating Procedures (SOPs) for maintenance and monitoring–evaluation mechanisms through activity logbooks, duty schedules, and monthly evaluations, emphasizing the importance of recording productivity, household harvest utilization, and economic benefits. Third, strengthening village support by placing the greenhouse on neutral and easily accessible village land in RT 3, with plans for the expansion of new units if success indicators are met in line with a rural governance framework that emphasizes decentralization, participation, and strengthening local institutions for sustainable development.[29]

---

[27] Clare Hume et al., "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Outcomes: A Systematic Review," *BMC Public Health* 22, no. 1 (June 23, 2022): 1247, https://doi.org/10.1186/s12889-022-13591-1; Estiana Rusmawati, Djoni Hartono, and Adiwan Fahlan Aritenang, "Food Security in Indonesia: The Role of Social Capital," *Development Studies Research* 10, no. 1 (December 31, 2023), https://doi.org/10.1080/21665095.2023.2169732; Estiana Rusmawati and Djoni Hartono, "Food Security: The Role of Social Capital in Indonesia Rural Area," *Economics Development Analysis Journal* 10, no. 3 (August 25, 2021): 324–37, https://doi.org/10.15294/edaj.v10i3.48442.

[28] Septia Hana Fauziah et al., "The Relationship Between Social Capital and Food Security in Farmer Households (Case Study: Sedayulawas Village, Lamongan Regency – Indonesia)," *Region: Jurnal Pembangunan Wilayah Dan Perencanaan Partisipatif* 18, no. 2 (July 31, 2023): 517, https://doi.org/10.20961/region.v18i2.67435.

[29] Robert Saputra and Tomáš Havlíček, "Strengthening Rural Governance for Rural Development Through Collaborative Strategy: The Application of Soft System Methodology and Textual Network Analysis," *Systemic Practice and Action Research* 37, no. 6 (December 21, 2024): 1175–93, https://doi.org/10.1007/s11213-024-09696-w; Robert Saputra and Tomas Havlicek, "Building Competitive Rural Enterprises through Collaborative Governance: A Model for Strengthening BUMDes in Indonesia," *International Journal of Economics, Business, and Entrepreneurship* 8, no. 2 (September 3, 2025): 120–49, https://doi.org/10.23960/ijebe.v8i2.334; Chatzichristos Georgios and Hennebry Barraí, "Social Innovation in Rural Governance: A Comparative Case Study Across the Marginalised Rural EU," *Journal of Rural Studies* 99 (April 2023): 193–203, https://doi.org/10.1016/j.jrurstud.2021.06.004.

From a technical perspective, the low-tech design, based on bamboo frames, paranet, open ventilation, tiered racks, and polibags, supports continuous harvesting because microclimate parameters (temperature, relative humidity, VPD) can be managed within suitable ranges for horticultural crops, as demonstrated in reviews of greenhouse designs and microclimate control in resource-limited contexts.[30]

From a replication perspective, the documentation of implementation and reflection emphasizes the need for practical modules, including SOPs for planting–replanting duty schedules, expenditure and harvest log formats, and short training curricula for residents; early involvement of village officials; and adaptation of commodities and planting cycles to local agro-ecological conditions.

This framework aligns with rural development studies that emphasize the importance of scaling out community-based innovations through participatory governance and adaptation to local capacities, with adequate policy support. The initial impact in Krajan 1 shows a reduction in kitchen expenditures, increased access to fresh food, and strengthened community solidarity through participatory governance; the integration of religious social capital accelerates adoption and compliance, while the maintenance cost-sharing scheme, regular monitoring and evaluation, and village government support for greenhouse expansion provide a solid foundation for replication potential in other villages with similar social and agro-ecological characteristics.

Conclusion

The community greenhouse development program in Dusun Krajan 1 emerged from the context of a "kitchen emergency," characterized by a combination of seasonal income, high dependence on the market, limited basic infrastructure, and an imbalanced market structure based on intermediaries (juragan). Through the

[30] Noureddine Choab et al., "Review on Greenhouse Microclimate and Application: Design Parameters, Thermal Modeling and Simulation, Climate Controlling Technologies," *Solar Energy* 191 (October 2019): 109–37, https://doi.org/10.1016/j.solener.2019.08.042; Olivera Ećim-Đurić et al., "Prediction of Greenhouse Microclimatic Parameters Using Building Transient Simulation and Artificial Neural Networks," *Agronomy* 14, no. 6 (May 27, 2024): 1147, https://doi.org/10.3390/agronomy14061147; Y. Ivanova et al., "Application of Modern Means and Technologies for Monitoring The Microclimate in Greenhouses," *Agricultural Science and Technology* 16, no. 4 (December 2024): 117–21, https://doi.org/10.15547/ast.2024.04.047.

Participatory Action Research (PAR) approach, supported by socio-economic mapping tools, problem–hope trees, and Venn diagrams, the community and researchers successfully crystallized the core issues, formulated collective aspirations, and mapped key actors, which then formed the basis for designing the intervention in the form of a bamboo–paranet community-scale greenhouse.

The implementation of the greenhouse on village land in RT 3, with tiered racks and daily vegetable–herb commodities, managed through the "take–replant" rule and a women's group duty roster system, showed positive initial impacts. Residents reported increased availability of fresh food, easier access without full reliance on the market, and indications of reduced kitchen expenditures. At the institutional level, the roles of women's groups, RT/RW, and religious networks (TPQ, yasinan, rotibul haddad) contributed to strengthening collective governance and adherence to joint rules, while confirming the importance of religious social capital as a lever for the sustainability of the intervention.

These findings confirm that low-tech community greenhouses can serve as a low-cost/high-impact intervention to improve the dimensions of food availability, access, and stability at the household level, as long as they are supported by participatory institutional designs based on local social capital. Moving forward, strengthening quantitative monitoring and evaluation systems, as well as developing SOPs and replication modules, will be essential prerequisites for expanding the intervention to other hamlets or villages with similar social and agro-ecological characteristics.

References

'Azhima, M. Fauzan, Shannaz Mutiara Deniar, Tubagus Chaeru Nugraha, and Salahudin Salahudin. "Sic Pillars of Global Food Security in Indonesia: A Systemic Literature Review." *Sosiohumaniora*. vol. 25, no. 3, (November 1, 2023): 419–29. https://doi.org/10.24198/sosiohumaniora.v25i3.43549.

Abdallah, Marwa Ben, Maria Fekete-Farkas, and Zoltan Lakner. "Exploring the Link between Food Security and Food Price Dynamics: A Bibliometric Analysis." *Agriculture*. vol. 11, no. 3, (March 19, 2021): 263. https://doi.org/10.3390/agriculture11030263.

Antriyandarti, Ernoiz, Dewi Nawang Suprihatin, Anggityas Werdining Pangesti, and

Palupi Lindiasari Samputra. "The Dual Role of Women in Food Security and Agriculture in Responding to Climate Change: Empirical Evidence From Rural Java." *Environmental Challenges*. vol. 14 (January 2024): 100852. https://doi.org/10.1016/j.envc.2024.100852.

Calloway, Eric E., Leah R. Carpenter, Tony Gargano, Julia L. Sharp, and Amy L. Yaroch. "New Measures To Assess The 'Other' Three Pillars Of Food Security–Availability, Utilization, and Stability." *International Journal of Behavioral Nutrition and Physical Activity*. vol. 20, no. 1, (April 26, 2023): 51. https://doi.org/10.1186/s12966-023-01451-z.

Choab, Noureddine, Amine Allouhi, Anas El Maakoul, Tarik Kousksou, Said Saadeddine, and Abdelmajid Jamil. "Review on Greenhouse Microclimate and Application: Design Parameters, Thermal Modeling and Simulation, Climate Controlling Technologies." *Solar Energy*. vol. 191 (October 2019): 109–37. https://doi.org/10.1016/j.solener.2019.08.042.

Clapp, Jennifer, William G. Moseley, Barbara Burlingame, and Paola Termine. "Viewpoint: The Case For A Six-Dimensional Food Security Framework." *Food Policy*. vol. 106 (January 2022). https://doi.org/10.1016/j.foodpol.2021.102164.

Congreves, Kate A. "Urban Horticulture for Sustainable Food Systems." *Frontiers in Sustainable Food Systems*. vol. 6 (August 19, 2022). https://doi.org/10.3389/fsufs.2022.974146.

Ećim-Đurić, Olivera, Mihailo Milanović, Aleksandra Dimitrijević-Petrović, Zoran Mileusnić, Aleksandra Dragičević, and Rajko Miodragović. "Prediction of Greenhouse Microclimatic Parameters Using Building Transient Simulation and Artificial Neural Networks." *Agronomy*. vol. 14, no. 6, (May 27, 2024): 1147. https://doi.org/10.3390/agronomy14061147.

Fauziah, Septia Hana, Gunawan Prayitno, Dian Dinanti, and Izatul Ihsansi Hidayana. "The Relationship Between Social Capital and Food Security in Farmer Households (Case Study: Sedayulawas Village, Lamongan Regency – Indonesia)." *Region: Jurnal Pembangunan Wilayah Dan Perencanaan Partisipatif*. vol. 18, no. 2, (July 31, 2023): 517. https://doi.org/10.20961/region.v18i2.67435.

Georgios, Chatzichristos, and Hennebry Barraí. "Social Innovation in Rural Governance: A Comparative Case Study Across the Marginalised Rural EU." *Journal of Rural Studies*. vol. 99 (April 2023): 193–203. https://doi.org/10.1016/j.jrurstud.2021.06.004.

Graef, F., S. Sieber, K. Mutabazi, F. Asch, H.K. Biesalski, J. Bitegeko, W. Bokelmann, et al. "Framework for Participatory Food Security Research in Rural Food Value Chains." *Global Food Security*. vol. 3, no. 1, (February 2014): 8–15. https://doi.org/10.1016/j.gfs.2014.01.001.

Hanani AR, Nuhfil, Moh Shadiqur Rahman, Hery Toiba, Fitria Dina Riana, Fahriyah Fahriyah, Mohammad Ilyas Shaleh, Mohammad Wahyu Firdaus, Mahfudlotul 'Ula, Dwi Retnoningsih, and Wiwit Widyawati. "Does The Greenhouse

Adoption Improve Farmers' Welfare? Evidence from Melon Farmers in Indonesia." *AGRARIS: Journal of Agribusiness and Rural Development Research*. vol. 10, no. 2, (December 20, 2024): 198–214. https://doi.org/10.18196/agraris.v10i2.416.

Hume, Clare, Jessica A. Grieger, Anna Kalamkarian, Katina D'Onise, and Lisa G. Smithers. "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Cutcomes: A Systematic Review." *BMC Public Health*. vol. 22, no. 1, (June 23, 2022): 1247. https://doi.org/10.1186/s12889-022-13591-1.

———. "Community Gardens and Their Effects on Diet, Health, Psychosocial and Community Outcomes: A Systematic Review." *BMC Public Health*. vol. 22, no. 1, (June 23, 2022): 1247. https://doi.org/10.1186/s12889-022-13591-1.

Huq, Ferdous Farhana, and Leith Deacon. "A Systematic Review of Community Gardens and Their Role in Urban Food Security and Resilience." *Discover Sustainability*. vol. 6, no. 1, (July 25, 2025). https://doi.org/10.1007/s43621-025-01628-5.

Ivanova, Y., S. Ivanov, K. Peychev, and I. Belovski. "Application of Modern Means and Technologies for Monitoring The Microclimate in Greenhouses." *Agricultural Science and Technology*. vol. 16, no. 4, (December 2024): 117–21. https://doi.org/10.15547/ast.2024.04.047.

Kullman, Sasha M., and Anna M. Chudyk. "Participatory Member Checking: A Novel Approach for Engaging Participants in Co-Creating Qualitative Findings." *International Journal of Qualitative Methods*. vol. 24 (December 14, 2025). https://doi.org/10.1177/16094069251321211.

Lubis, Ahmad Hafidz, and Ahmad Ihwanul Muttaqin. "Pendampingan Masyarakat Desa Sidomulyo Dusun Krajan Dalam Meningkatkan Kemampuan Publik Speaking Untuk Menjadikan Sektor Wisata Tumpak Sewu Sebagai Wisata Internasional." *Khidmatuna: Jurnal Pengabdian Masyarakat*. vol. 4, no. 1, (November 15, 2023): 44–54. https://doi.org/10.54471/khidmatuna.v4i1.2925.

McKim, Courtney. "Meaningful Member-Checking: A Structured Approach to Member-Checking." *American Journal of Qualitative Research*. vol. 7, no. 2, (2023): 31–52. https://doi.org/10.29333/ajqr/12973.

Mudatsir, Rasdiana, and Sumarni. "Penguatan Kelompok Wanita Tani Dalam Mendukung Ketahanan Pangan Rumah Tangga Di Kabupaten Jeneponto." *Journal Galung Tropika*. vol. 14, no. 1, (April 30, 2025): 62–72. https://doi.org/10.31850/jgt.v14i1.1291.

Oktiani, Erlisa, and Khoirunurrofik Khoirunurrofik. "Role of Roads and Irrigation on Food Security in Indonesia." *Economics Development Analysis Journal*. vol. 13, no. 2, (August 7, 2024): 259–74. https://doi.org/10.15294/edaj.v13i2.78981.

Probolinggo, BPS Kabupaten. "Kecamatan Leces Dalam Angka 2024." Probolinggo,

2024.

Putri, Stefany Anindya, Wardani Umi Maesyaroh, Arifah Arifah, Restina Lestari, and Widhi Handayani. "The Role of Farmers and Middlemen in The Perspective of Actor Network Theory: Study of Actors on Agricultural Product Distribution Chain in Kaponan Village, Magelang Regency, Central Java." *Agrisocionomics: Jurnal Sosial Ekonomi Pertanian*. vol. 7, no. 1, (March 31, 2023): 1–15. https://doi.org/10.14710/agrisocionomics.v7i1.14484.

Rusmawati, Estiana, and Djoni Hartono. "Food Security: The Role of Social Capital in Indonesia Rural Area." *Economics Development Analysis Journal*. vol. 10, no. 3, (August 25, 2021): 324–37. https://doi.org/10.15294/edaj.v10i3.48442.

Rusmawati, Estiana, Djoni Hartono, and Adiwan Fahlan Aritenang. "Food Security in Indonesia: The Role of Social Capital." *Development Studies Research*. vol. 10, no. 1, (December 31, 2023). https://doi.org/10.1080/21665095.2023.2169732.

Saputra, Robert, and Tomas Havlicek. "Building Competitive Rural Enterprises through Collaborative Governance: A Model for Strengthening BUMDes in Indonesia." *International Journal of Economics, Business, and Entrepreneurship*. vol. 8, no. 2, (September 3, 2025): 120–49. https://doi.org/10.23960/ijebe.v8i2.334.

Saputra, Robert, and Tomáš Havlíček. "Strengthening Rural Governance for Rural Development Through Collaborative Strategy: The Application of Soft System Methodology and Textual Network Analysis." *Systemic Practice and Action Research*. vol. 37, no. 6, (December 21, 2024): 1175–93. https://doi.org/10.1007/s11213-024-09696-w.

Security, Committe On World Food. "Food Security and Nutrition: Building a Global Narrative Towards 2030." Rome, 2020.

———. "Global Strategic Framework for Food Security & Nutrition (GSF)." Food and Agriculture Organization of the United Nations, 2021. https://www.fao.org/cfs/policy-products/onlinegsf/en/.

Shamshiri, Ramin, Fatemeh Kalantari, K. C. Ting, Kelly R. Thorp, Ibrahim A. Hameed, Cornelia Weltzien, Desa Ahmad, and Zahra Mojgan Shad. "Advances in Greenhouse Automation and Controlled Environment Agriculture: A Transition to Plant Factories and Urban Agriculture." *IJABE: International Journal of Agricultural and Biological Engineering*. vol. 11, no. 1, (2018): 1–22.

Shamshiri, Redmond Ramin, James W. Jones, Kelly R. Thorp, Desa Ahmad, Hasfalina Che Man, and Sima Taheri. "Review of Optimum Temperature, Humidity, And Vapour Pressure Deficit For Microclimate Evaluation And Control In Greenhouse Cultivation Of Tomato: A Review." *International Agrophysics*. vol. 32, no. 2, (April 1, 2018): 287–302. https://doi.org/10.1515/intag-2017-0005.

Sutomo, Sutomo, Aries Musnandar, Diaya Uddeen Deab Mahmoud Alzitawi, and Sutrisno Sutrisno. "Religious-Sociocultural Networks and Social Capital Enhancement in Pesantren." *Jurnal Pendidikan Islam*. vol. 10, no. 1, (June 25,

2024): 137–48. https://doi.org/10.15575/jpi.v10i1.19997.

Vivek, Ramakrishnan, Yogarajah Nanthagopan, and Sarmatha Piriyatharshan. "Beyond Methods: Theoretical Underpinnings of Triangulation in Qualitative and Multi-Method Studies"." *SEEU Review*. vol. 18, no. 2, (December 1, 2023): 105–22. https://doi.org/10.2478/seeur-2023-0088.

Widunyah, Oryza Maulida, Alia Fibrianingtyas, and Dwi Retnoningsih. "The Influence of Rural Road Infrastructure on Rice Crop Productivity in Indonesia." *Journal of Tropical Rural Development*. vol. 1, no. 1, (2024): 1–9.

Wossen, Tesfamicheal, Thomas Berger, Mekbib G. Haile, and Christian Troost. "Impacts of Climate Variability and Food Price Volatility on Household Income and Food Security of Farm Households in East and West Africa." *Agricultural Systems*. vol. 163 (June 2018): 7–15. https://doi.org/10.1016/j.agsy.2017.02.006.

Yusriadi, Yusriadi, and Andi Cahaya. "Food Security Systems in Rural Communities: A Qualitative Study." *Frontiers in Sustainable Food Systems*. vol. 6 (September 20, 2022). https://doi.org/10.3389/fsufs.2022.987853.

Zuhri, Muchamad Syaifuddin, and Lailul Mursyidah. "The Role of PKK in Sustainable Community Empowerment: Peran PKK Dalam Pemberdayaan Masyarakat Berkelanjutan." *Indonesian Journal of Cultural and Community Development*. vol. 15, no. 3, (2024). https://doi.org/10.21070/ijccd.v15i3.1092.