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The Role of Social Capital, Farmers' Creativity, and Social Support in Enhancing Melon Farmers' Resilience in Gunungkidul Regency

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Abstract

In Indonesia, farmers in Gunungkidul Regency are facing water scarcity, thin soils, pests, and price volatility in melon farming on karst soil; therefore, farmer resilience is a must. This study explores the role of social capital, farmer creativity, and social support in farmers' resilience in the context of melon farming. Partial least squares structural equation modelling (PLS-SEM) was used in the analysis of a quantitative explanatory survey of 180 melon farmers sampled proportionately among the eight melon-producing subdistricts. The measurement model was composed of 17 indicators and met the criteria for convergent validity, reliability, and discriminant validity. The perceived resilience was very high (mean 4.32 out of 5), and most farmers relied on self-assembled drip irrigation, plastic mulching, organic and dolomite amendments, crop rotation, and high-value varieties. Farmer creativity was the only significant predictor of resilience ($\beta = 0.154$, $p = 0.041$, $f^2 = 0.023$), whereas social capital ($\beta = 0.093$, $p = 0.242$) and social support ($\beta = 0.118$, $p = 0.121$) were not significant. The model accounted for 7.4% of the variance in resilience, suggesting that the unmeasured structural factors (water access, liquid capital, and market linkages) are also important. The results indicated that bonding social capital and fragmented support do not buffer karst-based commercial melon farms, but technical innovation by farmers does. The study contributes to policies that can scale up water-saving innovations, build farmer groups as collective marketing and credit institutions, and link them up to formal buyers.

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***Keywords**: Farmer resilience, Social capital, Farmer creativity, Social support, Melon, Karst, PLS-SEM, Gunungkidul.*

Introduction

Agriculture continues to be a strategic sector of national development as it provides food security, subsistence livelihoods, and sustainable economic growth. The sector plays a significant role in the gross domestic product (GDP) of Indonesia, generates export revenue, and employs a high percentage of the country's workforce (Athukorala & Patunru, 2023; Salendu, 2021). In this sector, horticultural commodities of high economic value are an important way of diversifying incomes, especially for smallholders facing highly diversified ecological and economic conditions. The success or failure of the farmers' response to these conditions will determine the sustainability of horticulture's contribution to local and national economies. Gunungkidul

Regency in the Special Region of Yogyakarta is an example of this challenge. The regency has a high risk of drought occurrence during the dry season, especially in karst areas, characterized by shallow soils, rocky, and dry (Antriyandarti et al., 2024). Groundwater in this karst system often lies more than 100 m below the surface, which makes it costly to access, and only about 30% of the doline ponds that once supplied villages still hold water all year (Jiang et al., 2021). Despite these limitations, farmers cultivating land other than flat land have diversified from staple crops to vegetables, fruits, and other horticultural crops, and melon (Cucumis melo L.) has been grown on karst land with local adaptation (Azizah et al., 2025; Uda et al., 2020). Based on official statistics, the harvested area of melon has increased from 10.14 ha in 2022 to 22.09 ha in 2025 (Harwadi et al., 2026). This growth has not been predictable. Some subdistricts, such as Playen and Ngawen, experienced significant increases in production from 2024 to 2025, while Karangmojo experienced a decrease and Patuk ceased reporting production; Paliyan showed some fluctuations. This is also an indication of heterogeneity among farmers and the different production capabilities they have in the same extreme agro-ecological environment.

Melon is a high-value but demanding crop. It grows best in friable, organic soils that have sufficient water and are well supplied with nutrients, and is drought-sensitive and prone to environmental fluctuations, requiring intensive management. Growing on arid, calcareous soils is thus vulnerable to production risk, pest and disease challenges, escalating input costs, and fluctuating prices. The central question is therefore whether melon farmers can absorb these shocks, adapt, and continue producing. This capacity is described by the concept of 'resilience' as the ability of a system to keep functioning, even when disturbed, by being robust, adaptable, and transformative (Mayar et al., 2022). Farm resilience is not solely about production technologies but also about the interaction between biophysical conditions and the farmers, institutions, and markets that are part of the farming system (Nicolau et al., 2026). There are a number of social and behavioural resources that have been identified in the literature that can contribute to increased farmer resilience. Social capital is defined as networks, trust, and shared norms, which are associated with farmers' technology adoption, and for melon growers, the use of farmer networks and adoption of greenhouse technology (Hidayat et al., 2025). However, Arnott et al. (2021) note that bonding connections within a community are not the same as bridging and linking connections with external actors and institutions, and therefore the value of social capital varies, depending on its nature. Social support from family, farming organisations, communities, and formal institutions can buffer against stress, with evidence from Indonesian smallholders and other farming groups showing that both community-based and formal social support are important for coping with stress (Amandaria et al., 2025; Haryanto, 2026; Isnan et al., 2025). Farmer creativity is a key factor in determining farm resilience to climate change and drought (Tambo & Wünscher, 2017), and farmer-led innovation is now seen as an important ingredient in finding locally appropriate solutions. However, there is recent evidence from Indonesia that these resources do not equally impact the food security of households; bridging ties and community participation did, but bonding ties did not (T. W. Nugroho et al., 2022; Rusmawati et al., 2023b; Uwiringiyimana, 2025), and agricultural sustainability was differently related to bonding, bridging, and linking ties among Tengger highland farmers (Ambayoen et al., 2024). Nevertheless, there are still three gaps. First, these determinants have been mostly studied individually: social capital and social support have been associated with technology adoption in other studies, while creativity with innovation or psychological well-being has been explored in separate studies; and their relative contributions to farm-level resilience have rarely been estimated in a single explanatory model. Combined models, if available, link social or psychological resources with the innovation capability and/or adaptive capacity or performance, not with resilience. In China, smallholders' social capital impacted only innovation capability and technology adoption (Han et al., 2022; L. Li et al., 2024; Xie et al., 2024); in Central Java, smallholders' human, natural, physical, and social capital, but not financial capital, influenced rural adaptive capacity (Anggoro et al., 2025; Prayitno, Auliah, et al., 2025). Secondly, the majority of the evidence comes from European, North American, South Asian, and Chinese contexts; Indonesian research has not focused on commercial horticulture in marginal drylands

contexts, but rather on staple crops, livestock, or whole communities (Sudomo et al., 2023). Research conducted within the Gunungkidul karst is available to understand the reasons for drought and coping at the household level (Antriyandarti, Barokah, Rahayu, Asami, Laia, et al., 2024; Zamroni et al., 2025); however, none has quantified the factors behind resilience among farmers in a high-value water-intensive crop like melon. Third, the associations of structural models to the internal and external determinants of farm outcomes have been studied widely; however, the individual's creative capacity has rarely been tested in comparison to social capital/social support as factors influencing the capacity of farms to be resilient. The effect of a strong sense of togetherness, namely gotong royong in rural Gunungkidul, and whether it can actually help protect commercial melon production in karst regions is an empirical question that still needs to be answered.

To cover the gaps mentioned above, this study was conducted to understand the role of social capital, farmer creativity, and social support in the resilience of melon farmers in the Gunungkidul Regency. Relationships between constructs are tested using survey data from 180 melon farmers proportionally distributed across the producing subdistricts, with partial least squares structural equation modelling (PLS-SEM). The study is helpful in three ways. It provides an integrated approach where creativity is an internal factor and social capital and social support are external factors. It offers evidence from a valuable horticultural product under karst conditions, which is not well represented in the resilience literature. It also provides context-specific results for institutions and local governments to enhance farmers' adaptive capacity in the marginal drylands. This study is conducted with a practical and theoretical motivation. From the perspective of the farmers themselves, the expansion of melon in Gunungkidul has been spurred by farmers themselves, while the public drought response in the regency has been directed to emergency water supply and general assistance (Putri et al., 2024); recognizing what resource sustains melon farmers will determine whether the funding of public resources is directed to technical innovation by farmers, strengthening the farmers' group structure, or formal support programmes. Comparing internal and external resources should theoretically distinguish whether the typical high degree of community cohesion in rural Java is a resilience resource in commercial horticulture or whether it is primarily a resource for social and psychological security (Dewi, 2026). The rest of the paper is structured as follows: Literature is reviewed and hypotheses developed in Section 2, the research methodology is described in Section 3, research results are presented and discussed in Section 4, theoretical and managerial applications are presented in Section 5, and Section 6 concludes with limitations and directions for future research.

2. Literature Review

2.1 Farmer resilience in marginal dryland agriculture

Resilience in agriculture is defined as the ability of an agricultural system to function in the presence of economic, social, and environmental shocks. Ramezani (2026) defines this capacity in three dimensions: Robustness – resistance to disturbance; Adaptability – capability to adapt practices and strategies; Transformability – capability to transform the system when the current organization is no longer viable. Resilience of farms is not just about the farm, but about the social-ecological context in which the farm exists, the disturbance against which the resilience is being evaluated, and the perspective of the evaluator as well as the time horizon over which resilience is being judged (van der Lee et al., 2022). The idea is multidimensional, and for smallholders it is important to consider dimensions of household economic stability, social cohesion, and the integrity of the production base, which are not captured by yield or income alone (Diallo & Yılmaz, 2026). The concept of farmer resilience in this study is the capacity of an individual farmer to continue producing melons despite natural and socio-economic challenges through their economic, social, and ecological capabilities. Empirical studies conducted in drylands in Indonesia have, however, focused on the household or community level of resilience measurement. The result was that in the karst in Girisubo, Gunungkidul, 84% of the houses had a medium to high level of resilience index (Antriyandarti, Barokah, Rahayu, Asami, & Hagania,

2024), while studies in other parts of Java indicate that rural adaptive capacity is dependent on the combination of human, natural, physical, and social capital, not only individual assets (Azhari et al., 2025; Prayitno et al., 2026). The studies provide little insight into the farmer who has invested in a commercial water-intensive crop and relies on the sustainability of that enterprise to be resilient. Resilience in this study is thus considered a farmer's enterprise-specific capacity.

2.2 Social capital and farmer resilience

Social capital typically refers to the networks, trust, and norms that facilitate coordination and cooperation. In agriculture, it facilitates information and resource sharing, ensures joint management of common resources, and responds to changes in the environment and markets (Halewood et al., 2018). Empirical research has shown that social capital is associated with willingness to innovate with new technologies (Han et al., 2022) and the construction of resilient agricultural landscapes. Farmers' networks have been found to facilitate the dissemination of greenhouse technology among growers in the melon sector (Hidayat et al., 2025). However, the impact of social capital varies with its nature. In poor and marginal communities, Halstead et al. (2022) suggest that social capital may have strong bonding capabilities and weaker linking capabilities to formal institutions, thus constraining the potential outcomes it can achieve.

The literature reviewed suggests that the impact of social capital on resilience is contingent on what it provides access to when it is considered critically. Chen et al.(2025) demonstrated that farmers have both bonding, bridging, and linking ties in various types of support networks and that innovation is not related to the total amount of social capital, but to the composition of the ties, that is, the presence of one type or another. The bridging ties and community participation had a positive effect on the household food security situation in Indonesia, while bonding ties did not significantly affect the food security situation of the household (Prayitno, Zuhriyah, et al., 2025; Rusmawati et al., 2023a); and for the highland farmers of Tengger, the bridging ties and community participation improved the household food security situation, but bridging ties did not significantly affect the household food security situation (Matondo et al., 2026). Finally, structural models in the context of smallholder households in Indonesia and China also suggest that social capital frequently acts indirectly by influencing innovative behaviour and self-efficacy, instead of directly on household outcomes (K. Li et al., 2026; Matondo et al., 2026; Najid et al., 2025). However, most studies concluded that farmers who are integrated into extensive networks of trust and reciprocity are more capable of sharing labour, information, and inputs during times of shocks (McAllister & Wright, 2019; Yang et al., 2024). In Gunungkidul, a community where gotong royong and sambatan (reciprocal labour exchange) are still alive, this explanation results in the first hypothesis:

H1: *Social capital has a positive effect on the resilience of melon farmers.*

2.3 Farmer creativity and farmer resilience

Farmer creativity is the ability to think innovatively, adapt farming practices, and come up with viable answers to resource limitations and uncertainty. Farmers' ability to innovate and learn is often seen as an important determinant of farm resilience to climate change and drought (Silici et al., 2021; Teklu et al., 2023). Farmer-led innovation, which is a product of the challenges faced on the farm and the local knowledge of the farmers, is widely recognised as a source of appropriate and low-cost solutions, and extension and training can enhance the innovativeness of farmers (Audouin et al., 2023; Günther et al., 2025). Much of this literature sees creativity as a precursor to innovation or uptake (adoption), but not as a direct correlate to resilience, as this study explicitly tests. The value of resilience in creativity is the ability to transform limited local resources into viable solutions. Farmers who innovated on their own were more climate change resilient in northern Ghana (Guodaar et al., 2021), and climate-smart innovations enhanced the resilience of smallholders in the Ethiopian highlands (Asefa et al., 2025; Debie, 2025). The adaptation methods recommended by the experts in the Gunungkidul karst are mostly those that farmers need to adapt and develop themselves, including low-water crops, organic amendments, and conservation practices, which are also considered a form of small-scale water harvesting

(Diop et al., 2022). The findings on the mechanism are not consistent; in China, the performance of smallholders' social and psychological capitals was mediated by innovation capability (Liu et al., 2026), while in Indonesia, the role of innovation capability as a mechanism linking the social and psychological capitals of smallholders and their performance was less common than the role of extension (K. Li et al., 2026). Given that social resources are the most common measure of resilience, and that farmer creativity has rarely been examined as a direct predictor of resilience with these resources, the second hypothesis is:
H2: *Farmer creativity has a positive effect on the resilience of melon farmers.*

2.4 Social support and farmer resilience

Family, farmer groups, communities, and formal institutions provide social support for individuals, which helps buffer the impact of stress. Greater perceived support is associated with better psychological well-being, and membership in farming organisations can decrease social stress for farmers (Deegan & Dunne, 2022; Nye et al., 2023). In Indonesia, smallholders appreciate the government's support as well as community-based support, both of which have varying stability and flexibility (Isnan et al., 2025; Race et al., 2022). Support that is intermittent, seasonal, or inadequate for a crop, on the other hand, can help farmers psychologically, but not materially, in terms of their ability to adjust to production and financial shocks. The stress-buffering perspective of social support thus suggests a beneficial link with resilience, although findings are less consistent with respect to the protection offered beyond psychological outcomes. While formal support and community-based support are both valued by Indonesian smallholders, the latter may be less reliable and less suited to the needs of the farmers, and risk-sharing and informal governance have helped farming communities in Sulawesi to cope with floods and other shocks (Amandaria et al., 2025; Haryanto, 2026). Putri et al.(2024) suggest that adaptation through the provision of extension, training, and financial support needs to be based on the risks of drought that farmers are facing in Gunungkidul to be effective. The third hypothesis is that there is family, group, and institutional support that can help during production and price shocks, both emotionally and by providing inputs, information, and labour for production.
H3: *Social support has a positive effect on the resilience of melon farmers.*

2.5 Research gap and conceptual model

The literature indicates that resilience is related to both internal capacity (creativity) and external resources (social capital and social support), but rarely are the three aspects investigated together in a single structural model for horticultural farmers in a marginal dryland context (El Jarroudi et al., 2026; Kresna, 2021). There are only a handful of combined models that link social and psychological resources to innovation capacity, adaptive capacity, or performance, but not to resilience, and that are related to staple-crop, livestock, or mixed rural households (Sargani et al., 2025). The inclusion of internal resources (creativity) and external resources (social capital and social support) in the same model enables direct comparison between the contributions of the external and internal resources. The three hypotheses developed above are summarised in the conceptual model in Figure 1.

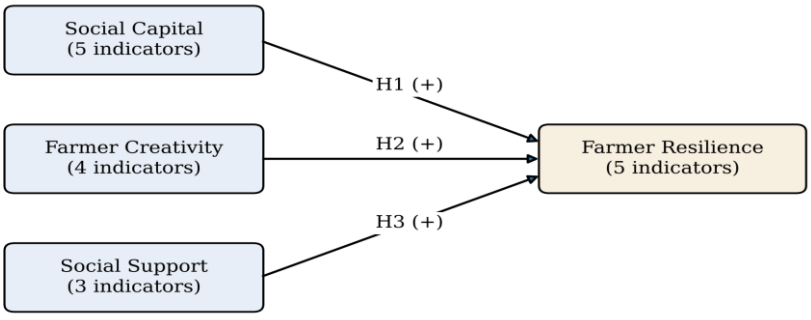


Figure 1. Conceptual Model and Hypotheses

3. Research Methods

A quantitative explanatory survey design was used to test the hypothesized relationships between four latent constructs: social capital, farmer creativity, social support, and farmer resilience. Gunungkidul Regency was purposively selected as a melon-producing region in the Special Region of Yogyakarta with marginal Karst land. Production information obtained from Badan Pusat Statistik (BPS) indicated that there were eight producing subdistricts, and sample villages were selected based on information from the local agricultural extension office. The population of this study comprised all melon farmers in the regency. The sample size (180) is based on the PLS-SEM recommended minimum of 5 respondents per indicator (Hair et al., 2019a). Specifically, the minimum was set at five respondents for each of the 36 indicators specified in the research design (36 × 5 = 180). This sample also exceeds the minimum implied by the ten-times rule (three structural paths point to resilience, giving 30 respondents) and the 77 respondents required by an a priori power analysis for detecting a medium effect ($f^2 = 0.15$) with three predictors, $\alpha = 0.05$ and a power of 0.80 (Carneiro et al., 2026). It is, however, smaller than the approximately 261 respondents that the inverse square root method requires to detect a path coefficient as small as 0.154 with 80% power (Kock & Hadaya, 2018), so the study had limited power to detect very small effects; this is acknowledged as a limitation. The respondents were randomly allocated to subdistricts according to the proportion of melon production in each subdistrict in 2025 (Table 1).

Table 1: Sample Allocation by Subdistrict

Subdistrict	Production 2025 (tons)	Share (%)	Respondents
Playen	9.20	41.65	75
Ngawen	8.10	36.67	66
Karangmojo	1.40	6.34	11
Semin	1.13	5.12	9
Paliyan	1.00	4.53	8
Semanu	0.61	2.76	5
Ponjong	0.35	1.58	3
Girisubo	0.30	1.36	3
Total	22.09	100.00	180

Source: *Calculated from BPS Gunungkidul Regency (2025).*

A structured questionnaire was used to gather data that relied on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) for the farmers' responses to each of the constructs. Data collection methods included open-ended questions for determining adaptation strategies, and non-participant observation and secondary documents from local agencies were used in addition to the survey. Resilience, social capital, creativity, and social support indicators were derived from the literature. The instrument was subjected to expert review and pre-tested with 30 melon farmers; those that did not meet the criteria for validity and reliability were dropped prior to the main survey. The initial instrument contained 70 items (14 for social capital, 18 for creativity, 14 for social support and 24 for resilience). In the pilot test, the AVE of every construct was below 0.50 (0.214–0.335) and several loadings were below 0.50 or negative, so 45 items were removed stepwise, leaving 25 items for the main survey. In the main sample (n = 180), eight further items were removed because their loadings were below 0.708 and kept the AVE of their construct below 0.50 (Hair et al., 2019b; Sarstedt et al., 2021), resulting in the 17 indicators reported in Table 5 and Figure 2. The data were analysed using the PLS-SEM approach, which suits prediction-oriented models with a number of latent constructs and moderate sample sizes (Demir & Uşak, 2025). All constructs were defined as being reflective. The outer loadings (target ≥ 0.708; indicators loading between 0.40 and 0.708 were retained only when the AVE and composite reliability of their construct already met the thresholds and their removal would have narrowed the content of the construct, whereas indicators below 0.40 were removed (Hair Jr et al., 2021) and the average variance extracted (AVE > 0.50) were used to evaluate the measurement model, as were Cronbach's alpha and composite reliability (both with a value of ≥ 0.70), the Fornell-

Larcker criterion (Purwanto & Sudargini, 2021), and the heterotrait-monotrait ratio (Hair et al., 2019a). Indicators that did not meet the criteria were eliminated in a step-by-step fashion. The success of the structural model was measured by inner variance inflation factors (VIF < 5), coefficient of determination (R^2), effect sizes (f^2), and good model fit (standardised root mean square residual (SRMR) and normed fit index (NFI) (Purwanto & Sudargini, 2021). The hypotheses were tested by bootstrapping using 5,000 subsamples with a 2-tailed t-test at a 5% significance level ($|t| \geq 1.96$). The descriptive statistics were given in five equal-width mean intervals (very low 1.00-1.80 to very high 4.21-5.00). Adaptation strategies were summarized as multiple responses, and then their frequencies were calculated.

4. Results and Discussion

Firstly, the characteristics of the 180 respondents are given in Table 2. The majority were male (81.6%), with nearly half aged over 50 years (49.4%), a mean age of 49.5 years, compared to only 5.0% under 30 years. Half (51.1%) had finished senior high school, and 12.2% had been to college. The land holdings were small: 75.0% of the farmers had less than 0.5ha. Approximately 42.2 % had 10 years or less of melon-farming experience, while 31.7 % had over 20 years of experience. The high education level of the farmers is a human-capital asset that will help them learn from extension and online information, whereas the ageing population presents a generational renewal challenge for the horticultural sector in the region. Melon was cultivated primarily in open fields (91.1% of the respondents), primarily rock melon and golden melon, with farmers using deep wells to water their crops, or buying piped water at a high price in water-stressed subdistricts like Semin and Girisubo.

Table 2: Characteristics of Respondents (n = 180)

Characteristic	Category	N	%
Gender	Male	147	81.6
	Female	33	18.4
Age	< 30 years	9	5.0
	30–50 years	82	45.6
	> 50 years	89	49.4
Education	Primary school or less	28	15.6
	Junior high school	38	21.1
	Senior high school	92	51.1
	College (diploma/bachelor)	22	12.2
Farm size	< 0.25 ha	52	28.9
	0.25–0.50 ha	83	46.1
	> 0.50 ha	45	25.0
Melon experience	≤ 10 years	76	42.2
	11–20 years	47	26.1
	21–40 years	47	26.1
	41–50 years	10	5.6

Source: *Primary data (2026).*

Secondly, farmers adopted a package of practices to manage production risk (Table 3). Almost all the farmers applied plastic mulching to conserve soil moisture (97.2%), organic manure and dolomite lime to enhance fertility of calcareous soil (93.3%), self-assembled drip irrigation from pipe and hose to reduce the use of pumped water (90.0%), and crop rotation with rice and secondary crops to reduce pest and disease cycles (85.6%). As a hedge against price risk, two-thirds of farmers (66.7%) planted high-value varieties for urban markets. These practices are congruent with those that are described as adaptation in agriculture under climate stress (Anwar et al., 2013) and indicate that farmer-driven adaptation is largely low-cost and built by farmers themselves rather than dependent on external technology. The same low-cost options, namely organic amendments, conservation practices, and small-scale water management, are recommended for drought adaptation in the Gunungkidul karst (H. Y. S. H. Nugroho et al., 2022).

Table 3: Adaptation Strategies of Melon Farmers (multiple responses, n = 180)

Adaptation dimension	Practice	N	%
Soil moisture conservation	Silver-black plastic mulch on open beds	175	97.2
Soil fertility	Organic manure and dolomite lime	168	93.3
Water management	Self-assembled drip irrigation	162	90.0
Pest and disease control	Crop rotation (melon–rice–secondary crops)	154	85.6
Economic and market risk	High-value varieties (rock melon, golden melon)	120	66.7

Source: *Primary data (2026).*

Thirdly, Table 4 shows that the means for all constructs were high. The highest mean value (4.316, very high) was given to Resilience, followed by Social capital (4.271), Social support (4.265), and Farmer creativity (4.135, high). Overall, the lower creativity mean indicates that local innovation (use of home-made drip systems, botanical pesticides, etc.) is still largely trial and error, and not yet a common way of doing things. Despite the high social scores, gotong royong and sambatan do not necessarily reduce the financial risks of melon farming, so the structural model was used to test whether these resources actually contribute to resilience.

Table 4: Descriptive Statistics of the Constructs (n = 180)

Construct	Indicators retained	Min	Max	Mean	SD	Category
Social support	3	2	5	4.265	0.626	Very high
Farmer creativity	4	2	5	4.135	0.612	High
Social capital	5	2	5	4.271	0.670	Very high
Farmer resilience	5	2	5	4.316	0.666	Very high

Source: *Primary data (2026). Interpretation intervals follow Sugiyono (2019).*

Fourthly, the iterative purification of the measurement model retained 17 indicators: five for resilience, five for social capital, four for creativity, and three for social support. The outer loadings ranged from 0.651 to 0.891, which is greater than the recommended minimum of 0.6; the AVE values were between 0.515 and 0.652, which is higher than the recommended minimum of 0.5; and the composite reliability values were from 0.809 to 0.848, which exceed the minimum of 0.70 (Table 5 & Figure 2). The Cronbach's alphas for all the scales ranged from 0.698 to 0.777, with creativity just under 0.70, but the composite reliability was good. Eight loadings were below 0.708 (RE1, RE5, MS4, MS5, MS7, KP2, KP4 and DS4; range 0.651–0.699). They were retained because each score was above 0.40, all of the construct's AVE and composite reliability scores met the thresholds, and those that were eliminated would have reduced the content validity; for instance, if KP2 and KP4 were deleted, creativity would have had only two indicators (Hair et al., 2021). AVE values for some constructs were just slightly above 0.50, so they should be considered satisfactory but not strong. The square root of each AVE (0.718–0.807) was larger than the highest correlation with other constructs in each construct's row (Table 6), and, as can be seen from Table 7, all HTMT ratios were at most 0.600, well below 0.85, indicating that the constructs were not heavily correlated. There was a higher value of HTMT between social capital and social support, which reflects their conceptual tangency in terms of being resources, but also suggests two different constructs. The inner VIF values (1.141 – 1.320) showed no collinearity.

Table 5: Measurement Model Results

Construct	Indicators	Loading range	Cronbach's α	CR	AVE
Farmer resilience	5	0.652–0.812	0.777	0.846	0.526
Social capital	5	0.651–0.810	0.769	0.844	0.521
Farmer creativity	4	0.686–0.754	0.698	0.809	0.515
Social support	3	0.695–0.891	0.743	0.848	0.652

Source: *SmartPLS output (2026). CR = composite reliability; AVE = average variance extracted.*

Table 6: Discriminant Validity: Fornell-Larcker Criterion

Construct	Social support	Farmer creativity	Social capital	Farmer resilience
Social support	0.807			
Farmer creativity	0.224	0.718		
Social capital	0.423	0.340	0.722	
Farmer resilience	0.192	0.213	0.196	0.725

Source: *SmartPLS output (2026). Diagonal values are the square root of AVE; off-diagonal values are inter-construct correlations.*

Table 7: Discriminant Validity: Heterotrait-Monotrait Ratio (HTMT)

Construct	Social support	Farmer creativity	Social capital
Social support			
Farmer creativity	0.332		
Social capital	0.600	0.490	
Farmer resilience	0.234	0.265	0.244

Source: *SmartPLS output (2026). Threshold: HTMT < 0.85 (conservative) and < 0.90 (Henseler et al., 2015).*

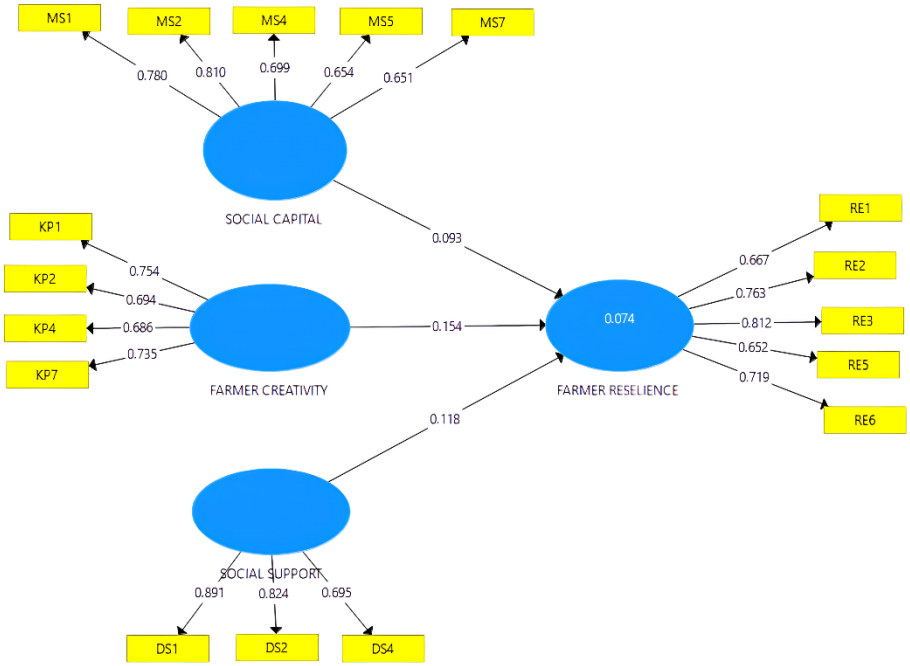


Figure 2. Path Diagram of the Final PLS-SEM Measurement Model

Note: *Arrows from constructs to indicators show outer loadings; arrows between constructs show path coefficients (β). * Significant at p < 0.05 (bootstrapping, 5,000 subsamples).*

Fifthly, the structural model accounted for 7.4% of the variance in farmer resilience (R^2 = 0.074; adjusted R^2 = 0.058), a low R^2 value by normal standards. In the classification criteria of Hair et al. (2019), an R2 of 0.074 is far below even the 0.25 threshold considered weak, indicating that over 90% of the variance in resilience is explained by factors not included in the paper, as discussed below. The fit in the global model was only marginal, with an SRMR of 0.105, slightly

above the conservative limit of 0.08 (Henseler et al., 2016), and an NFI of 0.537, which is well below the recommended value of 0.90. The PLS-SEM is prediction-oriented, and these fit indices are subject to debate and thus are reported for transparency but should be interpreted with care (Shmueli et al., 2019). The bootstrapping results are reported in Table 8. The positive and significant effect of farmer creativity on farmer resilience (β = 0.154, t = 2.052, p = 0.041) supported H2 with a small effect size (f^2 = 0.023). Social capital (β = 0.093, t = 1.170, p = 0.242) and social support (β = 0.118, t = 1.551, p = 0.121) were not significant, so H1 and H3 were rejected. Their effect sizes were below the 0.02 threshold (f^2 = 0.007 and 0.012).

Table 8: Hypothesis Testing Results

Hypothesis and path	B	SD	T	P	f^2	Decision
H1: Social capital → Resilience	0.093	0.080	1.170	0.242	0.007	Rejected
H2: Creativity → Resilience	0.154	0.075	2.052	0.041	0.023	Supported
H3: Social support → Resilience	0.118	0.076	1.551	0.121	0.012	Rejected

Source: *SmartPLS output (2026). Two-tailed test at α = 0.05.*

Turning to the interpretation of these results, creativity was the only construct with a significant effect on resilience (H2). For farmers, technical solutions – rather than external assistance – are of greater importance when water has to be pumped from deep wells, often with the use of diesel (McCarthy et al., 2020; Singh et al., 2022). The retained creativity indicators – modifying irrigation equipment, improvising pest & disease treatments, trying new techniques, choosing higher value varieties – map directly to the resilience indicators of coping with scarce water, coping with micro-climate anomalies, and keeping farming financially viable. This linkage can be seen in practices like home-made drip irrigation, botanical pesticides, application of manure and dolomite, and switching to rice or secondary crops, and is consistent with evidence that practical, farmer-led innovation is a key driver of farm resilience. The result agrees with agency-based understandings of social-ecological resilience in high-risk environments, but the effect is small (f^2 = 0.023) and therefore should not be overstated. This interpretation aligns with recent evidence that the ability of smallholders to innovate is the conduit through which their intangible assets are converted into performance gains (Stoeva et al., 2024), and with recommendations for drought adaptation in Gunungkidul to be based on locally adapted, low-cost farming methods (Basuki et al., 2026). The small scale of the effect also means that creativity is constrained by access to water and working capital – things that improvisation cannot solve. Social capital did not have a significant effect on resilience (H1). The main activities of gotong royong and reciprocity in Gunungkidul are related to the exchange of labour in land preparation and harvest. This reduces family labour costs without focusing on the constraints of the commercial melon farming industry on porous limestone: cash for inputs and pump fuel, and bargaining power at sale. Most farmers sell individually to traders, and farmer groups are more of a channel for aiding the farmers than they are a marketing or credit institution. This is in line with Soundararajan et al. (2024) work, which found that bonding ties are not enough without the linking ties to the market, banks, and formal institutions, and is similar to what has been observed in other studies that informal social capital does not automatically translate to economic benefits. It differs from the positive effects of social capital on resilience and adoption reported by Terzo (2021) and implies that the effect varies depending on the kind of social capital and the economic environment. Similarly, in Indonesia, bonding ties were not significant to food security in the national survey, while bridging ties and community participation were (T. W. Nugroho et al., 2022); and among the Tengger highland farmers, it was the bridging ties that indeed gave access to external resources and institutional support (Ambayoen et al., 2024). The model shows that the highest social capital indicators were active participation in the farmer group (MS2 = 0.810) and mutual trust among villagers (MS1 = 0.780) (Figure 2), meaning mostly bonding social capital. Moreover, social capital was moderately correlated with creativity (r = 0.340; Table 6), which suggests that its influence may be indirect, through the exchange of ideas that feeds farmers' technical improvisation, as reported in structural models in which social capital worked

through innovative behaviour or innovation capability. This indirect route was not included in the current model and needs to be evaluated in future studies.

Participants' social support was also not significant (H3). If farmers perceive that they have support from their family, neighbours, and groups, this is likely to provide psychological protection, as the literature on stress buffering suggests (Deegan & Dunne, 2022), while not affecting their ability to absorb production or financial shocks. Seasonal input support is mainly provided for staple crops, and extension services offer little support for high-value horticulture, leaving farmers to rely on informal exchange and online sources. The value of the support is only realized in the context of farmers' needs, and in this case, the most outstanding support indicators were not correlated with the most relevant indicators of the farmers' resilience in farming activities for karst melon (Zeydalinejad et al., 2023). The interpretation is supported by Figure 2, where the production-input assistance appeared in the highest position in terms of social support indicators, with DS1 = 0.891, and the technical extension in the second position, mostly oriented to staple crops (DS2 = 0.824). The same applies to the smallholders in Indonesia, who also report that formal and community-based support are not always reliable, nor do they meet the needs of farmers (Hendrawan et al., 2024); and the stress-buffering effect of support found among farmers (Deegan & Dunne, 2022) does not always lead to farmers having the material resources to recover from a failed harvest or a price collapse. Two qualifications apply. The model explains only 7.4% of the variation in resilience, suggesting that other factors, including well depths, fuel costs, working capital, price fluctuations, and credit access, have a much greater influence on the variation in resilience (Mbeule & Silwimba, 2026). The low explanatory power of the paper restricts the paper's contribution: This model is not able to explain melon farmers' resilience in general, only that among three socially oriented resources, this association is only detected for creativity, and is small ($f^2 = 0.023$). A similar level of explanatory power has been found for the adaptive capacity of rural people in Java with $R^2 = 0.184$ (Prayitno, Auliah, et al., 2025); in this case, natural and physical assets were important as well as social assets. Moreover, the study was not large enough to detect path coefficients lower than approximately 0.15; that is, the smaller, non-significant effects of social capital and social support should be interpreted as "small or absent," and not as an indication of lack of effect. The measurement model is satisfactory, not high quality; the SRMR is above the conservative level, and the data consist of cross-sectional self-reports and could include social desirability bias, particularly on the solidarity items. Therefore, the findings provide an indication of the relative importance, rather than a full picture of resilience within this model.

5. Theoretical and Managerial Applications

Table 8 presents the hypothesis tests, which have different uses in theory, and Figure 2 shows the measurement structure used for karst dryland melon farming actors. These are presented separately below.

5.1 Theoretical applications

First, this study provides evidence for an agency approach to resilience in marginal drylands. The only construct with a significant path to resilience (Table 8) was creativity ($\beta = 0.154$, $p = 0.041$), and the retained constructs for it (Figure 2) were all technical and on-farm. When the limitation is water and cash, it seems farmers' ability to re-combine limited resources is more important for their resilience than the amount of relational resources that they possess. This builds on existing farmer innovation and climate resilience research to a high-value horticultural crop cultivated on karst land. Secondly, the findings add to the existing agricultural resilience theory by clarifying the function of social capital. Secondly, the findings replenish the agricultural resilience theory by clarifying the role of social capital. Social capital shows the second-highest mean (4.271; Table 4); it has no direct effect ($\beta = 0.093$, $p = 0.242$; Table 8) and is correlated with creativity ($r = 0.340$; Table 6). The pattern suggests that the relationships among bonding, bridging, and linking ties, and the relationship between an aggregate social capital score and innovation should be differentiated from a direct relationship of the aggregate score to resilience (Kyne & Aldrich, 2020). Third, social support was most likely to be significant, despite its high mean (4.265; Table

4), when both the content and the perspective of the social support were considered (Table 8), which further implies that the stress-buffering view needs to be complemented by a corresponding perspective on social support as it relates to the stressor. The dominant support indicators (DS1 = 0.891 and DS2 = 0.824) are not related to water, credit, or markets, the real constraints facing melon farmers in Figure 2. Fourthly, the model has only modest explanatory power (R^2 = 0.074; Figure 2), and this indicates that farmer-level resilience in karst horticulture cannot be captured in the model solely using the social and cognitive resources variables. Theoretical models should incorporate natural, physical, and financial capital, including well depth, irrigation infrastructure, and working capital, as well as farmers' social and cognitive capital resources, as livelihood-asset models suggest (Amosah et al., 2026).

5.2 Managerial applications

Firstly, for farmers and farmer groups, the significant creativity path (Table 8) and the near-universal use of self-assembled drip irrigation (90.0%) and plastic mulch (97.2%) shown in Table 3 indicate that farmers' own innovations are the most valuable resource available locally. Farmer groups may help build capacity in creativity by documenting the successful low-cost drip kits, botanical pesticides and soil amendments, and by conducting farmer-to-farmer demonstrations and field days to share innovations. Secondly, farmer groups need to be made into economic organisations rather than a conduit for aid. The non-significant social capital route (Table 8) shows that the nature of reciprocity within the village is not sufficient to reduce cash and market risks facing farmers. Groups should therefore be encouraged to purchase their inputs collectively, establish emergency savings and loan associations, and introduce a staggered planting schedule to prevent price crashes, quality grading, and collective marketing to formal buyers, which create bonding ties to become bridging and linking ties. Thirdly, the non-significant social support path (Table 8) and the predominance of generic input and extension indicators (Figure 2) should be supported through specific actions in dryland horticulture: hands-on training in water-efficient melon production, co-financing of shared deep wells and water storage, access to credit and crop insurance for horticulture, and brokerage between farmer groups and urban buyers. As the model accounts for only 7.4% of the variance in resilience, a programme based on social mobilisation alone is not likely to be enough and should be coupled with investment in water infrastructure and working capital.

6. Conclusion

This study examined the relationships of social capital, farmer creativity, and social support with the resilience of melon farmers on karst land in Gunungkidul Regency. Farmers' resilience was very high, and they adopted a common package of low-cost adaptation strategies, such as mulching, using organic and dolomite amendments, self-built drip irrigation, crop rotation, and high-value varieties. Of the three factors, only farmer creativity was significantly positively associated with farmer resilience; social capital and social support were not. However, solidarity and moral support in the rural communities alone cannot save commercial melon farming from financial and resource limitations under marginal land. In numerical terms, creativity had a small but significant positive effect on resilience (β = 0.154, p = 0.041, f^2 = 0.023), whereas the effects of social capital (β = 0.093, p = 0.242) and social support (β = 0.118, p = 0.121) were not significant (Table 8), and the three constructs together explained only 7.4% of the variance in resilience. The study adds to the resilience literature by demonstrating for a high-value horticultural crop in a karst dryland that it is individual technical creativity that is more important than relational resources, and that bonding social capital must be coupled with linking social capital. The main practical message, elaborated in Section 5, is that support for melon farmers in karst drylands should build on farmer-led technical innovation, transform farmer groups into economic organisations, and tailor public support to water, credit and market constraints. In doing so, the study responds to calls for more context-specific evidence on smallholder resilience in marginal Indonesian landscapes.

There are some limitations of the study. The model accounts for a limited portion of the variance in resilience, and excludes structural factors like well depth and discharge, fuel costs, working capital, and price dynamics. The cross-sectional design makes it difficult to compare results with different seasons, as the conditions of drought and disease pressure fluctuate in varying ways with the seasons; the data are self-reported; and the results may not be generalisable across irrigated lowland or greenhouse systems to karst dryland environments. Future research should incorporate these biophysical and financial factors, explore bonding, bridging and linking social capital individually, and apply longitudinal data and in-depth interviews with farmers and traders to offer insight into the lack of a conversion of social capital into economic protection. In addition, the purification of the instrument removed a large share of the initial items, which may have narrowed the content of some constructs, and the sample of 180 farmers provided limited statistical power to detect very small effects. Future studies should also test indirect paths, for example from social capital to resilience through creativity, use larger samples or multi-group analysis to compare subdistricts with different water access, and combine survey data with farm records of yields, costs and prices.

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