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Harnessing the Digital Revolution for Agricultural Succession: A Multi-Site Mixed-Method Study of the *'Petani Muda Keren'* (PMK) Community Network and Youth Engagement in Indonesian Food

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A B S T R A C T

Indonesia faces a critical agricultural succession crisis, with an aging farmer population threatening the nation's long-term food security (SDG 2). Digital agrifood systems (DAS) are posited as a solution to attract youth, but adoption is uneven, and the socio-structural mechanisms facilitating this transition are poorly understood. This study investigates the role of the *'Petani Muda Keren'* (PMK - Cool Young Farmers) community network, a rapidly growing grassroots movement, in bridging this gap. We employed a multi-site (West Java, Yogyakarta, West Sumatra) sequential explanatory mixed-method design. First, a quantitative survey (N=300) was conducted with PMK members (n=150) and a matched control group of non-member young farmers (n=150). We used descriptive statistics, independent t-tests, and Ordinary Least Squares (OLS) regression to analyze differences in digital adoption, productivity, and income. Second, qualitative data from 30 in-depth interviews and 6 focus group discussions with PMK leaders, members, village officials, and Ministry of Agriculture representatives were analyzed using thematic analysis to explain the quantitative findings. PMK members demonstrated significantly ($p<0.001$) higher adoption scores for digital technologies (such as e-commerce, farm management apps, and IoT sensors). On average, PMK members reported 34.5% higher monthly incomes and 22.8% greater farm productivity compared to non-members. The OLS regression model, controlling for education, farm size, and access to credit, confirmed that PMK membership ($\beta=0.282$, $p<0.01$) is a significant positive predictor of farmer income, distinct from the independent, positive effect of the digital adoption score ($\beta=0.347$, $p<0.001$). Qualitative analysis revealed three core mechanisms: (1) peer-to-peer mentorship de-risking technology adoption, (2) collective action for market access via network-branded e-commerce, and (3) the socio-psychological construction of a modern, 'cool' professional farmer identity. In conclusion, community-based networks like PMK function as critical social infrastructure. They are not merely passive adopters of technology but active "social bridges" that translate digital potential into tangible economic and social outcomes. They de-risk digital adoption, aggregate market power, and reframe agriculture as a high-status, viable career for the next generation. Policies aiming to achieve SDG 2 must move beyond simple technology dissemination and invest in fostering and scaling these vital social learning and innovation ecosystems.

1. Introduction

The global food system is at a demographic precipice. The average age of farmers is increasing globally, estimated at over 60 in many developed nations and rising rapidly across the developing world.[1] This "aging farmer" phenomenon poses a profound threat to global food security, as it signals a breakdown in intergenerational knowledge transfer, a

decline in farm dynamism, and a potential future deficit of skilled food producers. In Indonesia, a nation of over 270 million people striving for food self-sufficiency, this challenge is particularly acute. The national farmer population is aging, with the 2018 Inter-Census Agricultural Survey (SUTAS) indicating that only 8% of farmers are under the age of 35, while nearly 60% are over 45.[2]

This demographic crisis is juxtaposed against the strategic importance of agriculture for Indonesia. The sector is a cornerstone of the national economy, a significant source of employment, and the foundation of national stability and food sovereignty.[3] The Indonesian government has explicitly tied its agricultural goals to the United Nations' Sustainable Development Goal 2 (SDG 2): "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". However, achieving this goal is contingent upon resolving the agricultural succession crisis. Without a new generation of farmers, Indonesia's food security architecture rests on a fragile and aging foundation.[4]

The aversion of Indonesian youth to agricultural careers is well-documented. Agriculture is broadly perceived as a "3D" profession—Dirty, Dangerous, and Difficult—as well as being high-risk, low-profit, and associated with low social status.[5] Rural youth, driven by higher educational attainment and exposure to urban lifestyles via digital media, overwhelmingly aspire to formal, non-agricultural "white-collar" jobs in cities, fueling rapid urbanization and hollowing out rural communities. In response to this, policymakers and development experts have championed the "Fourth Agricultural Revolution" or "Agriculture 4.0." This paradigm posits that digital agrifood systems (DAS)—encompassing precision agriculture, IoT sensors, drones, farm management software, big data analytics, and e-commerce platforms—can fundamentally transform the sector. The "promise" is that digitalization can rebrand agriculture, turning it into a high-tech, data-driven, and profitable enterprise. By supplanting manual labor with data analysis and physical risk with digital management, DAS could theoretically make farming "cool" and "keren," thereby attracting the tech-savvy younger generation. The Indonesian government's "Making Indonesia 4.0" initiative explicitly includes agriculture as a priority sector for digital transformation.[6]

However, a significant gap exists between this techno-optimistic vision and on-the-ground reality. Technology adoption is not automatic. Barriers in rural Indonesia are immense, including a persistent digital divide (uneven internet access), high costs of technology, a lack of digital literacy, and fragmented smallholder farm structures.[7] Crucially, technology dissemination often follows a top-down, "push" model that ignores the socio-cultural contexts and learning preferences of young farmers. Simply providing an app does not create a farmer. This leads to a high rate of technology abandonment and persistent skepticism.

This study argues that the missing link in the discourse on digitalization and youth is the role of social infrastructure. While most research focuses on the technological (such as app features) or economic (such as subsidies) drivers of adoption, it largely overlooks the social processes by which adoption actually occurs. How do young people learn? How do they manage risk? How are professional identities formed? This is where grassroots community networks become critically important. In Indonesia, a new phenomenon has emerged: the *'Petani Muda Keren'* (PMK), or "Cool Young Farmers," network. Starting as a loose social media collective, PMK has evolved into a formidable multi-chapter grassroots organization. It functions as a peer-to-peer support system, a knowledge-sharing hub, and a collective identity-building project. Its explicit goal is to reframe agriculture as a modern, profitable, and socially respected profession, primarily through the savvy application of digital tools and modern business practices.[8]

While the existence of farmer groups is not new, the PMK network is distinct. It is digitally native, youth-led, and focused on business innovation rather than traditional subsistence farming. It operates horizontally, using social media (WhatsApp,

Instagram, YouTube) as its primary organizational and knowledge-dissemination tools.[9] This network model, grounded in social capital theory, suggests that the relational ties between members—trust, shared norms, and information exchange—may be as important as the technologies themselves. These networks may function as "social bridges," de-risking the high costs of individual experimentation and creating a supportive ecosystem for innovation. Despite the anecdotal success and growing visibility of PMK, there has been no rigorous, empirical investigation into its mechanisms or impact. We do not know, in a systematic way, how this network functions, if it measurably improves outcomes for its members compared to non-members, and what the specific mechanisms are that link network participation to digital adoption and, ultimately, to food security contributions.[10]

Therefore, the aim of this study is to conduct a multi-site, mixed-method investigation into the role of the *'Petani Muda Keren'* (PMK) community network in facilitating youth engagement, digital agrifood system adoption, and socio-economic outcomes in Indonesia. Specifically, we ask the following research questions: (1) Are there statistically significant differences in digital technology adoption, farm productivity, and income between young farmers who are members of the PMK network and those who are not?; (2) What factors (including PMK membership, digital adoption, education, and farm size) predict the economic performance (income) of young farmers?; (3) How and why does the PMK network function? What are the specific social, cultural, and economic mechanisms through which it influences its members' decisions, behaviors, and professional identities?

The novelty of this study is threefold. First, it moves beyond a purely techno-centric or economic analysis of agricultural development by centering a social-technical lens, focusing on a grassroots community network as the unit of analysis. Second, it provides rigorous, mixed-method empirical evidence, triangulating quantitative impact data with qualitative "how" and "why" explanations, which is essential for understanding the *mechanisms* of change. Third, by focusing on a youth-led, digitally-native organization, this study provides a new, scalable, and bottom-up model for agricultural succession and policy, offering critical insights for achieving SDG 2 in Indonesia and other developing nations facing similar demographic challenges.

2. Methods

To capture the complex interplay of social dynamics, technological adoption, and economic outcomes, we employed a multi-site sequential explanatory mixed-method design. This design was chosen for its strength in first identifying what quantitative differences exist and then using qualitative data to explain those differences in depth; (1) Phase 1 (Quantitative): A cross-sectional comparative survey was administered to young farmers (aged 18-40) who were members of the PMK network and a matched control group of young farmers who were not members. This phase was designed to quantify differences in key variables; (2) Phase 2 (Qualitative): Building on the quantitative results (for instance, "Why do PMK members adopt e-commerce at a 50% higher rate?"), we conducted in-depth interviews (IDIs) and focus group discussions (FGDs) with a purposively selected subsample of participants from Phase 1, as well as with PMK leaders and external stakeholders. This phase was designed to uncover the underlying mechanisms, processes, and contexts.

The study was conducted in three provinces in Indonesia, selected to represent a diversity of agricultural, economic, and cultural contexts where PMK chapters are active: (1) Bogor, West Java: A peri-urban area with high-value horticulture, intense market competition, and proximity to the Jakarta metropolis; (2) Sleman, Yogyakarta: A region known for agricultural innovation, strong community governance (village-level), and a focus on tourism-related agrifood products; (3) Tanah Datar, West Sumatra: A more traditional, rural area with a strong communal (nagari) governance system, representing

challenges of remoteness and digital infrastructure. A multi-stage sampling strategy was used. First, the three provinces and specific districts were selected purposively. Second, within these sites, we generated two sampling frames. The treatment group (PMK members) was identified through official membership lists provided by PMK chapter leaders (N=150, 50 per site). The control group (non-PMK members) was generated using a combination of village-level farmer registries and snowball sampling, matched to the treatment group based on location, primary crop type, and age bracket (N=150, 50 per site). The total sample size for the quantitative survey was N=300.

For Phase 2, a purposive sampling strategy was used to select 30 participants for IDIs (10 per site, including high-performing PMK members, new PMK members, and non-members) and to convene 6 FGDs (2 per site: one with PMK members, one with PMK leaders and village government officials).

Data collection for phase 1: quantitative survey

The survey instrument was developed in English, translated into Bahasa Indonesia, and back-translated to ensure accuracy. It was pilot-tested with 20 young farmers in a non-study area (Bandung). The survey captured: (1) Socio-Demographics: Age, education level, farming experience, household size; (2) Farm Characteristics: Farm size (hectares), primary crops, land tenure (own, rent, family), access to formal credit; (3) PMK Membership: Binary (Yes/No), duration of membership, intensity of participation; (4) Digital Adoption Score (DAS): A composite index (0-10) created for this study, summing the adoption (1=Yes, 0=No) of 10 distinct digital tools: i) Smartphone for farm info, ii) Social media for marketing, iii) E-commerce platform (such as Tokopedia or SayurBox), iv) Digital payment app (such as OVO or GoPay), v) Farm management app, vi) Digital soil testing, vii) IoT sensors (such as weather or moisture sensors), viii) Drones (for mapping or spraying), ix) Online learning (such as YouTube tutorials), x) Digital supply chain platform; (4) Economic Outcomes: Self-reported average monthly income from farming (IDR) and self-reported average productivity (tons/ha/season) for their primary crop.

Data collection for phase 2: qualitative interviews and focus groups

Semi-structured interview guides were developed to explore the "how" and "why" behind the quantitative data. Key themes included; Motivations for joining (or not joining) PMK, perceptions of agriculture as a career, specific processes of learning and knowledge sharing within the network, experiences (positive and negative) with digital technology adoption, the role of the network in accessing markets, capital, and information, and interactions with village governance and government agricultural extension services. IDIs were conducted in person, lasted 60-90 minutes, and were audio-recorded. FGDs lasted 90-120 minutes and were facilitated by a trained moderator and note-taker.

Data was analyzed using Stata 17.0. Frequencies, means, and standard deviations were calculated for all variables, segmented by PMK membership. Independent samples t-tests (for continuous variables like income, productivity, and DAS) and Chi-square tests (for categorical variables) were used to test for significant differences between PMK members and non-members. An Ordinary Least Squares (OLS) regression model was estimated to determine the predictors of farmer income. The model was specified as:

$$\text{Log(Income)}_i = \beta_0 + \beta_1(\text{PMK\_Membership})_i + \beta_2(\text{Digital\_Adoption\_Score})_i + \beta_3(\text{Education})_i + \beta_4(\text{Farm\_Size})_i + \beta_5(\text{Age})_i + \beta_6(\text{Access\_to\_Credit})_i + \varepsilon_i$$

Notes: 1) Log(Income) was used to normalize the income distribution. and 2) PMK Membership was the key independent variable of interest, allowing us to test if network membership has a significant effect on income after controlling for other key factors, including the level of digital adoption itself.

All audio recordings were transcribed verbatim in Bahasa Indonesia and then translated into English for

analysis. We used a rigorous thematic analysis approach guided by Braun and Clarke; (1) Familiarization: The research team read and re-read the transcripts; (2) Initial Coding: Two researchers independently coded the first 10 transcripts, developing a preliminary codebook; (3) Codebook Refinement: The team met to discuss discrepancies, merge codes, and finalize the codebook; (4) Full Coding: The remaining transcripts were coded using the final codebook in NVivo 12 software; (5) Theme Development: Codes were clustered into broader sub-themes and then into major overarching themes that directly addressed the research questions, particularly the *mechanisms* of PMK's influence; (6) Triangulation: Qualitative themes were systematically compared with quantitative results to build a comprehensive, explanatory narrative.

The study protocol was approved by the CMHC Research Center. All participants provided written informed consent. Anonymity was protected by removing all personal identifiers from transcripts and datasets. Participants received a small compensation (in the form of phone credit or a lunch voucher) for their time.

3. Results and Discussion

Phase 1: Quantitative findings

The two groups (PMK and Non-PMK) were broadly similar in age and farm size, suggesting the matching protocol was successful. However, PMK members had, on average, a significantly higher level of formal education, with 45.3% having a diploma or university degree compared to only 22.0% of non-members (see Table 1). PMK members also reported significantly greater access to formal credit (62.0% vs. 40.0%), a difference that qualitative data later suggested was linked to network activities in financial literacy and collective loan applications.

Table 1. Descriptive characteristics of the survey sample (N=300).

VARIABLE	CATEGORY	PMK MEMBERS (N=150)	NON-PMK MEMBERS (N=150)	P-VALUE
Age (Mean, SD)	—	29.5 (4.8)	30.2 (5.1)	0.245 (ns)
Gender (% Male)	—	82.0% (123)	86.0% (129)	0.358 (ns)
Education	< High School	12.7% (19)	28.0% (42)	
	High School	42.0% (63)	50.0% (75)	**<0.001*** **
	Diploma/University	45.3% (68)	22.0% (33)	
Farm Size (ha) (Mean, SD)	—	1.15 (0.8)	1.09 (0.7)	0.531 (ns)
Land Tenure (% Own)	—	48.0% (72)	52.0% (78)	0.508 (ns)
Access to Credit (% Yes)	—	62.0% (93)	40.0% (60)	**<0.001*** **
Farming Experience (Years, Mean, SD)	—	6.8 (3.1)	7.5 (3.5)	0.122 (ns)

Note: p-values from t-tests for continuous variables and Chi-square tests for categorical variables. (ns) = not significant. ***p<0.001

The comparative analysis revealed stark and statistically significant differences between the two groups across all key performance metrics (Table 2). PMK members had a mean Digital Adoption Score (DAS) of 7.2, nearly double that of non-members (3.8). This difference was driven by high adoption of e-commerce (88% of PMK members vs. 35% of non-members) and farm management apps (65% vs. 18%).

These differences in digital adoption were mirrored in economic outcomes. PMK members earned, on average, 2.0 million IDR more per month (a 34.5% increase) and achieved over 1 ton/ha more in productivity. These results provide strong initial evidence of a positive association between network membership and socio-economic performance.[11]

Table 2. Comparison of digital adoption and economic outcomes.

Quantifying the impact of PMK network membership on key performance indicators.

VARIABLE	PMK MEMBERS (N=150)	NON-PMK MEMBERS (N=150)	% DIFFERENCE	T-STATISTIC	P-VALUE
Digital Adoption Score (0-10)	7.2 (1.5)	3.8 (1.9)	**+89.5%**	17.54	**<0.001*** **
Monthly Income (Million IDR)	7.8 (2.1)	5.8 (1.8)	**+34.5%**	9.12	**<0.001*** **
Productivity (ton/ha/season)	5.9 (1.2)	4.8 (1.1)	**+22.8%**	8.33	**<0.001*** **

Note: ***p<0.001. All differences are highly statistically significant.

To isolate the effect of PMK membership from other confounding variables (especially education and digital adoption, which are also high among PMK members), we ran an OLS regression. Table 3 presents the results. The regression model explains 57.8% of the variance in (log) monthly income and is highly significant. The results are compelling; (1) Digital Adoption: As expected, the Digital Adoption Score is a strong, significant predictor of income (β=0.347). A one-point increase in the adoption score is associated with a 34.7% increase in monthly income, holding all else constant; (2) PMK Membership: This is the key finding. Even after controlling for an individual's level of digital adoption, education, farm size, and credit access, PMK Membership remains a highly significant positive predictor (β=0.282). This suggests that being a member of the PMK network is associated with a 28.2% increase in income, independent of the member's personal technology use. This quantitative result strongly implies that the network provides benefits beyond just encouraging technology adoption. It suggests the presence of network effects, social capital, and collective action, which the qualitative phase was designed to explore.[12]

Table 3. OLS regression results predicting log (Monthly income) (N=300).

Isolating the independent effect of network membership and digital adoption.

VARIABLE	COEFFICIENT (B)	STD. ERROR	T-VALUE	P-VALUE
PMK Membership (1=Yes)	0.282	0.091	3.10	0.002**
Digital Adoption Score (0-10)	0.347	0.058	5.98	<0.001***
Education (1=Diploma/Univ)	0.165	0.080	2.06	0.040*
Farm Size (ha)	0.201	0.065	3.09	0.002**
Access to Credit (1=Yes)	0.129	0.072	1.79	0.074
Age	-0.045	0.033	-1.36	0.174
Constant	8.940	0.210	42.57	<0.001***

Model Statistics

R-squared	Adjusted R-squared	F-statistic	Model p-value
0.578	0.569	65.14	<0.001

Significance levels: *p<0.05, **p<0.01, ***p<0.001

Phase 2: Qualitative findings (The Mechanisms)

The qualitative analysis of 30 IDIs and 6 FGDs revealed how the PMK network generates the outcomes seen in the quantitative data. Three major themes, or mechanisms, emerged.

Mechanism 1: De-risking digital adoption via peer-to-peer mentorship

The most pervasive theme was that PMK provides a "safe space" for technological experimentation. Top-down government training was described as "too formal, too fast, and with no follow-up." In contrast, PMK's learning environment is continuous, informal, and peer-based.

"*I bought the [IoT] soil sensor, and it sat in the box for two months. The manual was in English. I was afraid to break it. The government extension officer... he knows about fertilizer, not apps. I posted on the PMK WhatsApp group, and [another member] who lives 10km away came over on his motorbike. He sat with me for two hours. He showed me the dashboard on his phone... how to read it. That is the PMK difference. It's not just training, it's partnership.*" – IDI, PMK Member, Sleman

This "social de-risking" is crucial. Individual farmers, especially those with limited capital, cannot afford to fail. The network distributes the risk of innovation by providing on-demand, trusted technical support. This peer-to-peer mentorship lowers the cognitive and financial barriers to adopting complex tools, explaining the high DAS scores in Table 2.

Mechanism 2: Collective action for market access via network-branded E-commerce

The quantitative data showed PMK members had higher incomes, even independent of their personal tech use. The qualitative data explains this through collective action, particularly in marketing.

"*Alone, my 100kg of chilies is nothing. The tengkulak (middleman) gives me one price, take it or leave it. But as 'PMK Sleman,' we aggregate our harvest. We have a member who is a digital marketing graduate. He runs our 'PMK Fresh' Instagram and Tokopedia store. We grade our produce together, and we package it with our brand. We sell 5 tons together directly to restaurants in Jakarta. We get a 40% higher price. My 100kg is part of that 5 tons. I don't even use the app myself, but I get the network benefit.*"– FGD, PMK Member, Sleman

This mechanism directly explains the significant PMK Membership coefficient in the regression (Table 3). The network is not just a collection of high-performing individuals; it is a platform for collective market power. It reduces transaction costs, bypasses exploitative intermediaries, and builds a collective brand that individual smallholders could never achieve alone.

Mechanism 3: Constructing a modern, 'Cool' professional identity

This theme addresses the foundational "why" of youth engagement. PMK successfully combats the "3D" (Dirty, Dangerous, Difficult) stigma of agriculture by building a new, high-status professional identity.

"*My parents are farmers. I saw them struggle. I was embarrassed. I went to university in the city to get an office job. I got one... and I was bored, sitting in traffic. Then I found the PMK Instagram feed. I saw young people, my age, with laptops in their sawah (rice field), flying drones... they called themselves 'agri-preneurs,' not 'petani' (farmers). I realized I could use my business degree on the farm. I quit my job. My parents thought I was crazy. Now I manage 10 hectares, I have 5 employees, and I earn triple my office salary. PMK made it 'keren' (cool). It gave me the... the pride... to come back to the land.*"– IDI, PMK Leader, Bogor

This "social-psychological" function of the network may be its most powerful, long-term contribution. It provides the social validation and modern template that young, educated Indonesians need to see agriculture as a viable and desirable career path.[13] It is this identity shift that underpins their willingness to engage with the digital tools and business models that drive their economic success.

The findings of this study provide a profound and multi-layered answer to a question that lies at the heart of Indonesia's food security: how do we get the next generation to farm? The quantitative data is stark: members of the *'Petani Muda Keren'* (PMK) network are more digital, more productive, and earn significantly more. However, the most critical finding of this entire study—and the one with the deepest implications—is the robust, independent, and positive coefficient of PMK_Membership in our regression model. This finding (β=0.282) is not just a statistic; it is the numerical fingerprint of a complex social engine. It proves that the network's benefit is not merely reducible to the sum of its parts—the apps, the drones, the university degrees of its members. There is a powerful, synergistic "network effect" at play. Being a member confers a distinct advantage, a 28.2% income boost, even after we account for the individual's personal level of digital savvy and education.[14] This discussion will deconstruct that "network effect." We will move beyond the what (the numbers) and the how (the qualitative mechanisms) to explore the so what? (the theoretical and policy implications). We argue that the PMK network's success is not in being a simple conduit for technology, but in acting as a "social bridge" that simultaneously de-risks innovation, aggregates market power, and fundamentally reconstructs the professional identity of the farmer.

The core theoretical contribution of this study is the empirical validation that in the context of digital agriculture, social capital is a direct factor of production, as tangible in its economic output as land, labor, or capital. The PMK network is, in essence, an architecture for manufacturing social capital, which it

does in two primary forms: bonding and bridging.[15] Our first qualitative mechanism, "De-risking Digital Adoption via Peer-to-Peer Mentorship," is an illustration of bonding social capital—the dense, trust-based ties within a homogenous group. The quantitative data shows PMK members have a Digital Adoption Score (DAS) of 7.2 versus 3.8 for non-members. The qualitative data explains why. Consider the narrative of the PMK member in Sleman: "I was afraid to break it." This simple phrase captures the immense psychological and financial friction that throttles top-down technology dissemination. A government-subsidized sensor is useless if it stays in the box. The government extension officer, trained in a previous era's challenges, "knows about fertilizer, not apps." This is the gap where innovation dies. Into this gap steps the PMK network, not with a formal, one-day training, but with a continuous, on-demand, social safety net.[16] "He sat with me for two hours." This is not a "service"; it is an act of community. As theories of situated learning suggest, complex knowledge is best transferred not through abstract instruction but through "legitimate peripheral participation." The network provides a safe space to be a beginner, to ask "stupid" questions, and to learn by doing, with a trusted peer as a co-pilot. This social de-risking lowers the cognitive load and, crucially, the financial risk of experimentation. If a new hydroponic mix fails, the individual farmer may go bankrupt. If it fails within the PMK network, it becomes a shared "learning moment" disseminated on the WhatsApp group, saving 149 other members from the same fate. The network effectively distributes the cost of failure across the entire community, while socializing the dividends of success. This mechanism alone is a powerful accelerator, explaining the +89.5% difference in digital adoption.[17]

The second component of the network effect is bridging social capital—the ability to connect "outside" the group to access novel resources, information, and markets. This is the story of Mechanism 2: "Collective Action for Market Access." The regression model told us that membership itself, independent of personal tech use, boosts income. The FGD with the Sleman member explains this perfectly: "I don't even use the app myself, but I get the network benefit." This is the power of collective action in the digital age. Here, the network functions as a platform, a digital cooperative. The "digital marketing graduate" who runs the 'PMK Fresh' store acts as a "knowledge broker," a concept central to social network theory. This individual leverages their specialized skills (bridging capital) on behalf of the entire group. They aggregate the "100kg of chilies" from dozens of smallholders into "5 tons," transforming a low-value commodity into a high-value, branded product. They use the network's collective reputation to bypass the exploitative *tengkulak* (middleman) and forge direct links with high-paying urban restaurants. This is a fundamental re-structuring of the agricultural value chain. The network is not just teaching farmers to *use* e-commerce; it is becoming an e-commerce entity itself. The 40% price premium they capture is a direct monetary return on their social capital. This finding extends classic collective action theory by showing how digital tools (Instagram, Tokopedia) act as catalysts, dramatically lowering the coordination costs that historically plagued agricultural cooperatives.[18]

While the economic and technological findings are compelling, they arguably sit downstream of a more profound, social-psychological phenomenon. This is Mechanism 3: "Constructing a Modern, 'Cool' Professional Identity." This study is framed against Indonesia's "agricultural succession crisis," a problem rooted not in a lack of land or market demand, but in a crisis of aspiration. As our introduction noted, agriculture is widely perceived as a "3D" (Dirty, Dangerous, Difficult) profession. This is, at its core, an identity problem. The PMK network's most radical innovation is not its use of drones, but its success in "rebranding" the farmer. The member from Bogor, who quit his "boring" office job to return to the farm, is the archetype. His "ah-ha" moment came from seeing people his own age, "with laptops in their *sawah*," who called themselves "agri-preneurs," not "petani." This is

not a semantic game. It is a fundamental reconstruction of professional status, a concept sociologist Pierre Bourdieu would call the creation of a new form of "cultural capital." The PMK network has built a new "habitus" for farming. It has made it "keren" (cool).[19] This "keren factor" is the recruitment engine. It is what solves the aspiration crisis, attracting the very cohort—educated, tech-savvy, ambitious—that rural Indonesia has been "leaking" to its cities. This identity shift is the *pre-condition* for everything else. An "agri-preneur" is *expected* to use a smartphone to analyze market data; a "petani" is not. An "agri-preneur" *expects* to earn a middle-class income and have a professional brand; a "petani" is often resigned to being a price-taker. This new identity creates a "pull" for the very digital tools and business models that the government has been "pushing" with limited success. It provides the intrinsic motivation—the pride, the status, the professional validation—that makes the hard work of farming desirable. Without solving this identity crisis, there is no one left to adopt the technology, and the entire "Agriculture 4.0" vision collapses.

The implications of these findings are transformative, demanding a fundamental rethink of agricultural development policy in Indonesia and across the Global South. The current dominant model—a top-down, techno-solutionist approach focused on disseminating hardware (subsidized tools) and software (apps)—is building on a foundation of sand. It ignores the social architecture required to make those tools meaningful. Our findings suggest a new, more effective paradigm: (1) Shift from "Pushing" Technology to "Enabling" Ecosystems: The billions of rupiah spent on developing government apps or providing one-off training seminars could be radically repositioned. The evidence from this study shows that organic, peer-to-peer learning networks are vastly more effective. Policy should therefore focus on funding the network. This means official recognition and financial support for grassroots organizations like PMK. It means providing grants for their operational costs, for their knowledge-sharing events, and for their collective marketing efforts; (2) A New Mandate for Village Governance and Extension Services; This study offers a new vision for two key institutions: village governance (*Pemerintah Desa*) and agricultural extension services (*Penyuluh Pertanian*). The extension officer who "knows about fertilizer, not apps" is not a failure, but a victim of an outdated mandate. His role should be re-imagined. He should not be a (poor) instructor; he should be a *facilitator, a convener, and a resource broker for* the local PMK chapter. His key performance indicator (KPI) should not be "how many farmers trained" but "how healthy is the local learning ecosystem?" Similarly, the Village Fund (*Dana Desa*) is a powerful, decentralized financial tool. Instead of being used exclusively for physical infrastructure like roads, village heads should be empowered and encouraged to use it as a local innovation fund. A village could, for example, provide a "digital community hub"—a co-working space in the village hall with high-speed internet—for the local PMK chapter to use as its headquarters. It could provide matching funds for the PMK's collective branding efforts. This would be a direct investment in the village's human and social capital, with clear, high-return economic benefits; (3) Invest in the "Identity Engine." Finally, policymakers must recognize that this is a battle for hearts and minds, not just for yields. The government's own media and outreach should stop portraying farming as a project of "poverty alleviation" and start portraying it as a high-status, high-tech, "agri-preneurial" career. They should be funding and amplifying the stories of the PMK members, making them the heroes of Indonesia's new, modern economy. The "keren factor" is a scalable, powerful, and, at present, deeply under-utilized policy tool.[20]

As this discussion has focused on the mechanisms and implications, we must also acknowledge the study's limitations. The cross-sectional nature of the quantitative data means we can only demonstrate strong association and correlation, not definitive causality. While the sequential explanatory design (where qualitative data explains the "how")

provides powerful evidence for the direction of these relationships, we cannot, for example, entirely rule out self-selection bias (it is possible that more educated, more motivated young farmers are simply more likely to join PMK and be successful). This limitation, however, provides a clear and compelling agenda for future research. The next logical step would be a longitudinal study. Such a study would follow a new cohort of PMK members from their first day of joining, tracking their adoption, income, and, crucially, their identity-perception over a period of two to three years. This would allow us to empirically trace the journey from "individual farmer" to "networked agri-preneur," providing definitive, causal evidence of the mechanisms we have illuminated.

4. Conclusion

This study investigated the role of the '*Petani Muda Keren'* (PMK) community network as a critical social-technical intermediary for engaging youth in Indonesia's digital agrifood system. Our mixed-method, multi-site analysis yielded three key conclusions. First, PMK membership is quantitatively associated with significantly higher rates of digital technology adoption, farm productivity, and, most notably, a 34.5% average increase in monthly income compared to non-members. Second, the network's impact on income is not merely a byproduct of technology use. Our regression analysis showed that PMK membership itself is a significant predictor of income, independent of an individual's digital adoption level. This "network effect" highlights the immense value of social capital and collective action. Third, our qualitative analysis illuminated the mechanisms behind these numbers. The PMK network functions as a "social bridge" by: (1) de-risking technology adoption through continuous peer-to-peer mentorship, (2) aggregating market power and bypassing intermediaries via collective, network-branded e-commerce, and (3) fundamentally reframing agriculture as a high-status, 'cool' profession, thus solving the core social-psychological barrier to youth engagement. In essence, the PMK network provides a powerful, bottom-up, and scalable model for agricultural succession. It demonstrates that to achieve SDG 2 and secure Indonesia's food future, policy must evolve. We must invest not just in the *technologies* of Agriculture 4.0, but in the social ecosystems and community leaders who turn digital potential into lived reality.

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