International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 37 No. 2 March 2023, pp. 494-508

Social Relations and Knowledge Sharing in the Virtual Community of Practice among Farmers in Brebes District, Central Java, Indonesia

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Abstract—Due to the aggregation of common interests and concerns, digital information and communication technology (ICT) applications used by farmers can build virtual communities of practice (VCoP). This study aims to identify farmers' level of access to digital ICT applications, social capital (SC), social power relations (SPR), and knowledge sharing (KS) in the VCoP. It will also examine the causal relationship between exogenous and endogenous constructs. This study involved the participation of 221 farmers as smartphone users in Brebes District, Central Java Province, Indonesia. It used survey methods with questionnaire instruments and multistage clustered random sampling techniques. It assessed causal relationship models between constructs using SmartPLS 3 software. The study identified disparities in the level of access to digital ICT applications. The farmers who perceived SC and SPR at moderate and high levels were more than 75 per cent and 85 per cent, consecutively. Other farmers perceived KS in VCoP at low levels (average 29 per cent) and moderate levels (average 48 per cent). Path analysis shows that concerning access to digital ICT applications, the effects are significant and positive on SC and SPR; SC affects KS in VCoP significantly and positively; access to digital ICT applications significantly and positively influences KS in VCoP. However, despite the direction being positive, the effects of SPR on the KS in VCoP are not significant. Variations in values in the latent variables' access to digital ICT applications, SC, and SPR can *explain the variation in the latent variable knowledge sharing by 36 per cent.*

Keywords— access, capital, ICTs, power, smartphones.

I. Introduction

The application of digital information and communication technology (ICT) in agriculture is often called e-Agriculture—serves as a catalyst for institutions and individuals in agriculture and rural development to share knowledge, learn from others, and improve decision making about the vital role of ICTs in facilitating sustainable agricultural productivity and ensuring food security [1]. E-Agriculture is developing in scope as a new ICT application and used in the agricultural sector, for example, e-agriculture community of practice. The extensions of using smartphones among farmers to access various digital ICT applications [2] can definitely build a virtual community of practice (VCoP). VCoP is an online community that uses the internet to connect people who share similar interests or concerns and provide a platform for sharing and increasing knowledge [3]. So, farmers involved in VCoP can interact in social networks and build social relationships to create social capital (SC) and practice social power relations (SPR) to share knowledge.

Relationships in social networks among farmers on VCoP have the potential to produce SC stated by Reference [4] that SC consists of relationships that people build among themselves. In the long run, social relationships created by people who share a common interest in achieving a common goal will be a source of SC for them [5]. These social relationships are resources embedded in social structures (e.g. organizations, communities, or workplaces) that facilitate individual actions within them [6]. SC influences community strength and social base in solving emerging problems [7], mediates KS levels [8], and supports attitudes toward KS [9].

When farmers and agricultural stakeholders with the same goal come together as a VCoP, they can pool their resources, collaborate at the community level, and build strong networks in their social capital. However, very little social capital is explored in the literature, especially in utilizing various digital ICT applications among farmers to share knowledge for farmer capacity development. Indeed, many studies on business model and intellectual capital in the value creation of firms ([10], [11]). The characteristics of social relationships and the networks they generate can influence the ability to access, transfer, absorb and apply knowledge [12]. According to Reference [13], this social network can be considered a knowledge network where different nodes search for each other, transmit and create knowledge. Social relationships among these nodes permit or restrict the nodes' efforts to acquire, transfer, and generate knowledge [14].

Furthermore, the structure of a coherent relational network in a social system (e.g. VCoP) is likely a domain for SPR dynamics. In this matter, a person's attitudes and actions get influenced due to some subjects, objects, circumstances, information and activities. The power construction in other forms of social practice is collectively through a complex series of interactions and various discourses [15]. Reference [16] found that power relations and social practices strongly influence each other, and the relationship between the two variables promotes or limits empowerment opportunities. Power relations affect the process of knowledge sharing [17]. For example, Reference [18] provide empirical examples in professional and institutional contexts of how practitioners operate in the complex power/knowledge relationships that shape knowledge-sharing practices.

Similarly, Reference [19] complained that practitioners and academics were too quick to reject the problem of power being included in the knowledge-sharing process even though knowledge is power and knowledge shared is a greater power. Knowledge flow is fundamentally within power relations due to the close relationship between social structure caused by power dynamics and knowledge flow within an organization or institution. Reference [20] also believe virtual communities are not free from internal hierarchies, norms, and power relations that can repeat hierarchies and stratifications in modern institutions. However, few empirical studies include social power relations in the knowledge-sharing process [21] and directly discuss the relationship between power relations and VCoP [22].

Based on this background, this study aims to identify the level of access to digital ICT applications, SC, SPR, and KS in VCoP; Furthermore, it will predict the causal relationship of access to digital ICT applications to SC and SPR in facilitating KS in VCoP among farmers in Brebes District, Central Java Province, Indonesia. It is expected the findings of this research provide academic contributions and inputs to the formulation of pro-small farmer policies, especially in Indonesia, and become a decisive novelty in the context of agricultural transformation from input-intensive agriculture to knowledge-intensive agriculture because the benefits of the green revolution conflict with limited natural resources [23].

II. THEORETICAL FRAMEWORKS

The ICT capabilities in constructing new realities – namely, virtual public spaces and VCoP – are one of the decisive themes in this study. VCoP is a self-defined interactive communication network and a group of people or business partners collaborating based on common goals, interests, needs, or other activities [24]. Therefore, VCoP is described and justified as an effective way to share knowledge and collective learning in shared farming activities.

This study assumes that there is SC due to the utilization of digital ICT applications, especially those that facilitate the process of interactivity. SC is attached to the relationships between individual VCoP members that form the structure of the relational network. The SC theory is directly related to relationships as a resource to ensure collaboration among individuals [25]. The central proposition of the SC theory is that communication networks serve as a cost-effective means of achieving social goals, provide participants with available modes of cooperation, and serve as a "credential" in various linguistic contexts [26].

Reference [27] classified SC into three dimensions: structural, relational, and cognitive. The structural dimension is related to the quality of the network, the relational one relates to the quality of the relationship, and the cognitive one refers to shared representations and interpretations. In measuring the level of SC, Reference [8] operationalized structural, relational and cognitive dimensions. The structural one measured bond strength, network stability, and friction level. The relational one measured the level of confidence, and the cognitive one measured the level of mutual understanding.

Furthermore, SPR can take various forms of powers which are power over (domination relationship) derived from social power bases, power to (empowerment), and power with (collaboration or partnership) ([28], [29]). The viewpoint of power over is essentially the same as the approach of power as an entity and is often labelled as dominating power that refers to the power bases. This approach assumes the power bases as a source/object that people have and can be used to change the behavior of others [17]. In a broad sense, the definition of power as an entity is the ability of one party to make a change or control the behavior, attitudes, opinions, goals, needs, and values of another [30]. Individuals can have power over others for various reasons, such as gender, social class, and ethnicity [31].

To analyze social power, Reference [32] defines social influence as a change in a person's beliefs, attitudes, or behavior (target of influence) resulting from the actions of others (influencing agents). The definition of social power is the potential for such influence, the ability of an agent or figure of power to bring about such a change using the resources available to him. These resources represented in six bases of power are coercive power, reward power, legitimate power, expert power, referent power, and informational power [33].

Reference [34] emphasizes the importance of the knowledge-sharing process in virtual communities of practice to create, participate, or acquire innovative ideas. When community members generate new knowledge, they renew themselves [35]. This research operationalizes knowledge sharing among the farmers in the VCoP environment in three dimensions. Firstly, KS behavior (among others, [8], [36]), is operationalized in the study as the intensity of knowledge acquisition and knowledge donation. Secondly, KS as knowledge conversion process. Reference [37] uses Polanyi's concept of implicit and explicit knowledge, further introducing the concept of knowledge representation and assuming it as a continuum—the extent to which expressing the knowledge can be in a kind of verbal, symbolic or written form. This study operationalizes this dimension as the knowledge conversion in the knowledge-sharing process. Thirdly, perceived quality of shared knowledge. The KS quality is one of the main dimensions of the KS model [38]. This dimension is measured based on perceived quality of shared knowledge, and this includes six criteria of knowledge quality suggested by Reference [39], namely (1) relevance, (2) ease of understanding, (3) accuracy, (4) completeness, (5) reliability, and (6) timeliness.

Furthermore, as presented in Figure 1 on the Research Model and to answer the objectives of this study, we propose five main hypothesis: (H1) access to digital ICT applications facilitates SC and (H2) SPR, then (H3) SC and (H4) SPR that appear will have an influence on KS in VCoP, in addition to (H5) direct access effects to digital ICT applications on KS in VCoP.

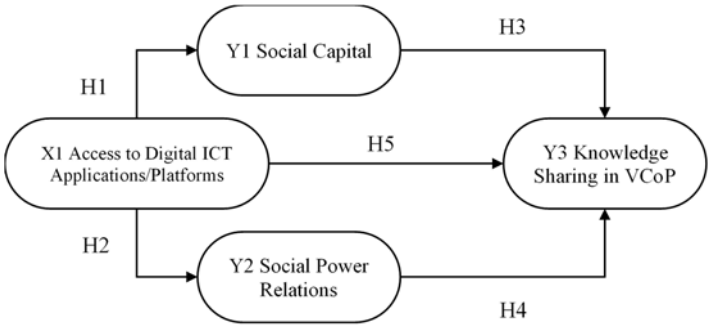

Fig. 1. Research Model and Hypothesis

III. METHODOLOGY

This study used a quantitative approach with survey methods and questionnaire instruments. Data collection carried out based multistage clustered random sampling. A total of 221 farmers using smartphones from Brebes District participated in this study, including those from Losari Sub-District (50 respondents), Ketanggungan Sub-District (50 respondents), Bumiayu Sub-District (50 respondents), and Wanasari and Brebes Sub-District (71 respondents).

The profile of farmer respondents consisted of 93 per cent men and 7 per cent women, aged up to 30 years as much as 21 per cent, 31 to 40 years as much as 22 per cent, 41 to 50 years as much as 39 per cent, 51 to 60 years as much as 15 per cent, and over 61 years as much as 4 per cent. The education level of the farmers mostly amounts to high school graduates (49 per cent) and junior high school (23 per cent). Moreover, some farmers study in universities (Diploma and Bachelor Programs) for as much as 16 per cent. However, 12 per cent of respondents were only elementary education. The characteristics of farmer households have narrow agricultural land areas, most (59 per cent) of respondents work on less than 0.5 hectares of land, 28 per cent of respondents work on 0.5 to 1.0 hectares of land, and only 13 per cent of respondents work on more than 1.0 hectares of land. Farming income is mostly low. About 39 per cent of the respondents earned less than IDR1.0 million per month, 34 per cent of respondents earned between IDR 1.0 million to IDR 2.0 million per month, 15 per cent earned IDR 2.0 to IDR 3.0 million per month, and only 13 per cent of respondents earned above IDR 3.0 million per month. (Note: Bank Indonesia's exchange rate on 10th March 2023 for USD1.00 was IDR 15,515.19 (selling rate) and IDR 15,360.81 (buying rate). Based on these characteristics, the study classifies most respondents were farmers smallholders.

This study performed the quantitative descriptive analysis with IBM SPSS Statistics Version 26. Moreover, PLS-SEM was used to assess the fitness of both outer (measurement) model and inner (structural) model. Partial Least Square (PLS) is a component-based or variant-based Structural Equation Modeling (SEM) and aims to assess the theoretical framework from a predictive model perspective [40]. SmartPLS 3 software is used to assess both the measurement and structural model, combined. In a SEM analysis, the measurement model is the part of the model that describes the relationships among the latent variables and their indicators, and the structural model is the part of the model that describes the relationships among the latent variables that make up the model. The weights and loadings are outer model parameter estimates, while the path coefficients are inner model parameter estimates.

Four latent variables, including indicators, are as follows: (1) X1 Access to digital ICT applications with indicators X1_1 access to android farming applications, X1_2 Access to FB group for farmer community, X1_3 Access to WAG for farmer groups, X1_4 Access to Internet/Google/Websites, and X1_5 Access to YouTube Channels to meet agricultural information needs and knowledge sharing among farmers; (2) Y1 Social Capital consists of indicators Y1_1 Structural, Y1_2 Relational, Y1_3 Cognitive dimensions of social capital; (3) Y2 Social power relations consists of indicators Y2_1 Power "Over", or power base, Y2_2 Power "To", or empowerment, and (3) Y2_3 Power "With", or partnership or collaboration; and (4) Y3 Knowledge Sharing in the virtual community of practice (KS in VCoP) among farmers consists of indicators Y3_1 KS Behavior, Y3_2 Knowledge conversions in KS, and Y3_3 Perceived quality of shared knowledge.

IV. Result and Discussions

A. Access to Digital ICT Applications among Farmers in Brebes District

The ultimate goal of digital ICT access is various types of use [41]. To meet the needs for information and social interaction, farmers use smartphones to access a variety of digital ICT applications, including android-based farming applications (farming apps) installed from the Google Play Store, Facebook (FB) groups of farmer communities, WhatsApp Groups (WAG) of farmer groups, Internet/Google information sources, and YouTube channels. Table I shows the disparity in the intensity of utilizing digital ICT applications/platforms among farmers. This inequality potentially creates disparity in SC and SPR.

TABLE I. Access to Digital ICT Applications/Platforms among Farmers

Usage Intensity	Digital ICT Applications/Platforms									
	Farming Apps Features		FB Groups of Farmer Community		WAG of Farmer Groups		Internet/ Google Information Sources		YouTube Channels	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
(1) Never	173	78%	93	42%	96	43%	62	28%	54	24%
(2) Rarely	17	8%	56	25%	53	24%	63	29%	70	32%
(3) Sometimes	25	11%	40	18%	41	19%	43	20%	47	21%
(4) Often	6	3%	28	13%	27	12%	44	20%	38	17%
(5) Very Often	0	0%	4	2%	4	2%	9	4%	12	5%

Source: IBM SPSS 26 output, primary data (2022), *N = 221*

B. Social Capital among Farmers Using Digital ICT Applications in Brebes Distric

Table II describes SC among farmers using digital ICT applications/platforms. Descriptive statistical analysis shows most farmers (more than 86 per cent) perceived structural, relational, and cognitive dimensions of SC at moderate to high levels. Moreover, a low percentage of the farmers (less than 10 per cent) perceived SC as relatively high, and a small percentage of other farmers (less than 5 per cent) perceived SC at very low to low levels.

In this study, the structural dimensions of SC consist of tie strength, network stability, and the level of friction that occurs when the farmers interact through Android smartphone-based agricultural applications, FB groups of farmer community, WAGs of farmer groups, and/or Internet/Google and YouTube channels. The tie strength reflects the characteristics of farmers in maintaining good relationships with several members of the farming community, getting to know some members personally, and communicating privately with some members in VCoP. Network stability reflects the characteristics of farmers in maintaining long-term relationships with members and changes in members of the farming community in VCoP. Furthermore, the level of attrition reflects the farmers' characteristics of having difficulty staying in touch with some farming community members in VCoP environment.

TABLE II. Degree of Social Capital among Farmers Using Digital ICT Applications/Platforms

Social Capital (SC) Dimensions	Degree of Social Capital (SC)									
	Very Low		Low		Moderate		High		Very High	
	(1)		(2)		(3)		(4)		(5)	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
Structural Dimension	1	1%	8	4%	96	43%	108	49%	8	4%
Relational Dimension	1	1%	7	3%	87	39%	104	47%	22	10%
Cognitive Dimension	3	1%	7	3%	94	43%	104	47%	13	6%

Source: IBM SPSS 26 output, primary data (2022), $N = 221$

Social interaction is one of the structural dimensions of SC [42]. In highly interactive conversations, shared experiences, and activities, sharing of tacit knowledge usually occurs [43]. Therefore, interaction means that individuals actively support each other in KS process, and individuals must be closely connected and frequently interact. During this interaction process, individuals can gain tacit knowledge by observing, imitating and interacting with others.

Trust reflects the relational dimension of SC among farming community members in Android-based agricultural application media, FB groups of farmer communities, WAGs of farmer groups, and or other community media. The trust level reaches from medium to high levels. Moreover, relational capital in the trust aspect reflects the degree of trust that members of the farming community provides a reliable picture of cultivation and or farming problems, information on the cost and availability of production inputs (e.g. seeds, fertilizers, medicines, pesticides and or agricultural machinery tools), decisive up-to-date agricultural commodity price information, reliable solutions to overcome cultivation and farming problems, and trust each other in mutually beneficial cooperation.

Trust-based relationships allow the exchange of knowledge among different agents. Trust makes people more willing to offer beneficial knowledge and more willing to listen and absorb others' knowledge [44]. In addition, trust is fundamental to improving approachability and communication and increasing knowledge sharing [45]. Trust can reduce perceived uncertainty, facilitate risk-taking behavior and foster constructive orientation that increases individuals' willingness to share tacit knowledge with their partners [46].

The cognitive dimension of SC refers to the shared understanding of individual farmers and other farming community members about the problems and challenges in farming activities, the importance of the farmers in the digital age, and the attention to sustainable farming activities. Cognitive proximity can influence knowledge transfer by changing how each party perceive what is relevant and what is not. People who share similar mental models about their work are more likely to share information regularly than people with different mental models [47] and are more likely to have high-quality relationships and interact with each other [48].

C. Social Power Relations among Farmers Using Digital ICT Applications in Brebes Distrit

Table III presents social power relations rationalized as respondents' degree of confirmation of social power bases (social power as an entity), power relations for empowerment or as empowerment strategies, and partnership power relations. Thus, social power relations in these three aspects are mostly from moderate to high degrees.

TABLE III. Degree of Social Power Relations Perceived by Farmers Using Digital ICT Applications in Brebes

Social Power Relations (SPR) Aspects	Degree of Social Power Relations (SPR)									
	Very Low (1)		Low (2)		Moderate (3)		High (4)		Very High (5)	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
SPR-Power Base	4	1.8%	11	5%	128	58%	74	34%	4	2%
SPR-Empowerment	3	1%	6	3%	62	28%	126	57%	24	11%
SPR- Partnership	3	1%	6	3%	78	35%	117	53%	17	8%

Source: IBM SPSS 26 output, primary data (2022), $N = 221$

When interacting through android smartphone-based agricultural applications, FB groups for farmer communities, WAGs' farmer groups, internet/Google, and or YouTube channels, social power relations over social power bases/entities appear in the form of reward power, coercive power, legitimate power, referent power, expert power, informational power sourced from community members, and or extension workers and or experts. It is often referred to as person "A" doing something to person "B", which causes "B" to do something they shouldn't be doing [21]. Reference [49] explains that with the power of information, the target (in this matter, the individual farmers) accepts, understands, and internalizes change independently, without further reference to the influencing agent. With coercive power and reward power, change is socially dependent on targets that continuously link change to influencing agents and thus requires continuous monitoring that aims to influence agents to sustain change. Conversely, the changes that occur through the power of legitimacy, expertise, and referral are also socially dependent. However, it is not necessary to carry out continued supervision.

Power relations for empowerment reflect the degree of perception of the individual farmers. Individual farmers (1) have the empowerment opportunity to be more productive; (2) they feel they can improve their cultivation and or farming skills; (3) they feel involved in the farming community is increasing. Furthermore, partnership power relations reflect the degree of perception of individual farmers in terms of the extent to which they have the opportunity to develop good relationships or cooperation: (1) with fellow farmers, with extension workers and or agricultural experts; (2) with suppliers of seeds, fertilizers, medicines, pesticides, agricultural machinery tools, and others; (3) with suppliers of seeds, fertilizers, medicines, pesticides, agricultural machinery tools, and others; (4) with market participants; (5) with sources of financing or access to agricultural business credit. Social power is a crucial driver of knowledge sharing [50].

D. Knowlwdge Sharing in the Virtual Community of Practice among Farmers in Brebes District

Descriptive statistical analysis of KS in VCoP among farmers are presented in Table IV. A substantial finding showed that it recorded KS behavior in VCoP at moderate levels (42 per cent) and low levels (39 per cent). The KS behavior level among the farmers reflects knowledge collection (KC) and knowledge donation (KD) activities. KC occurs when individual farmers ask for advice to obtain intellectual capital, and KD refers to the motivation of individuals to share their intellectual capital.

TABLE IV. Degree of Knowledge Sharing in VCoP among Farmers

Knowledge Sharing (KS) Aspects	Degree of Knowledge Sharing									
	Very Low (1)		Low (2)		Moderate (3)		High (4)		Very High (5)	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
KS Behavior	24	11%	85	39%	93	42%	18	8%	1	1%
Knowledge Conversion	36	16%	98	44%	63	29%	22	10%	2	1%
Perceived Quality of Shared Knowledge	14	6%	32	15%	145	66%	28	13%	2	1%

Source: IBM SPSS 26 output, primary data (2022), $N = 221$

KC and KD in this study include solutions to cultivation and farming problems, factors that affect crop cultivation and productivity; improvement of good agronomic practices (e.g., use of biofertilizers and decomposers and or organic fertilizers); knowledge-based cultivation techniques (e.g. vermicomposting, transplantation, water management and irrigation, the "jajar legowo" cropping systems, planting high-yielding and high-value varietal crops, and or land conservation techniques); determination of planting and harvesting calendars, budgeting, and or farm business planning; price information and suppliers of seeds, fertilizers, medicines, and or agricultural machinery tools; control of plant nuisance organisms, such as weeds, pests, and plant diseases; price information for commodities in the sector; market and marketing opportunities; opportunities for agricultural cooperation; materials to improve communication, negotiation, critical thinking, decision-making, and or farm management skills; weather forecast information and climate-smart agriculture solutions; information about disasters, early warning and or mitigation actions; information on sources of farm business funding (farm business credit); information on crop failure insurance services, and; information about government policies in the agricultural sector.

Farmers perceive knowledge conversion at a low level (44 per cent) and a moderate level (29 per cent). The rate of knowledge conversion in the KS among farmers reflects the individual perceptions of farmers when using android-based framing apps, FB groups of farmer communities, WAGs of farmer groups or other online media for tacit to explicit knowledge conversion and explicit knowledge sharing. These include the following activities: (1) sharing success stories and failures of farming; (2) sharing knowledge and skills gained from work experience; (3) sharing farming business knowledge gained from newspapers, magazines, radio, television, and or online media; (4) sharing expertise gained from education and training; (5) sharing agricultural knowledge obtained from published research results; and (6) sharing business proposals and farming models for the digital era 4.0.

The degree of quality of knowledge shared among the farmers in this study reflects the perception or assessment of individual farmers on five dimensions of knowledge quality consist of accuracy, reliability, relevance, comprehensiveness (completeness), and timeliness on the following themes: (1) information and knowledge shared by individual farmers to the farming community; (2) information and knowledge shared by fellow members of the farming community; and (3) information and knowledge shared by Admins, extension workers, and or agricultural experts through the media of android phone-based farming apps, FB groups of farmer communities, WAGs of farmer groups or other online media. The study identified perceived quality of shared knowledge mostly at a moderate level (66 per cent).

The findings of this study confirm the role of ICTs in facilitating the process of agricultural knowledge sharing and acquiring agricultural knowledge from the experts [51], seeking answers to specific planting problems, innovations and modern agricultural practices, meeting relevant agricultural information needs [52], accessing the agricultural techniques of vermicomposting, transplanting, growing high-value crops with low volumes, post-harvest management, water management, and agricultural systems [53], and exchange of time-sensitive information [54].

E. The Relational Model of Access to Digital ICT Applications, Social Capital, Social Power Relations, and Knowledge Sharing in the VCoP

PLS-SEM consists of two models called the measurement model (or outer) and the structural inner model [55]. The outer model deals with "how do you measure your latent variables (construct)". The measurement model specification requires the consideration of the nature of the relationship between constructs and measures. The structural model contains the relationship between the latent variables (constructs), which has to be derived from theoretical frameworks.

Reference [56] suggest that the assessment procedure of the reflective measurement model estimated by PLS-SEM includes reliability and validity by assessing (1) the indicator reliability, (2) the internal consistency reliability, (3) the convergent validity, and (4) the discriminant validity. The first step in reflective measurement model assessment involves examining how much of each indicator's variance is explained by its construct, which is indicative of indicator reliability. The indicator reliability indicates the communality of an indicator. Table V shows indicator loadings above 0.708 are recommended, since they indicate that the construct explains more than 50 percent of the indicator's variance, thus providing acceptable indicator reliability. This study eliminated three indicators with indicator loadings below 0.708, included X1_1, X1_4, and X1_5. These indicators did not reflect their latent variable of access to digital ICT applications.

TABLE V. Construct Reliability and Validity

Latent Variables	Indicators	Indicator Loadings	Composite Reliability	Average Variance Extracted (AVE)
X1 Access to Digital ICT Applications	X1_2	**0.796**	**0.791**	**0.655**
	X1_3	**0.822**		
Y1 Social Capital	Y1_1	**0.740**	**0.903**	**0.757**
	Y1_2	**0.884**		
	Y1_3	**0.878**		
Y2 Social Power Relations	Y2_1	**0.858**	**0.874**	**0.700**
	Y2_2	**0.866**		
	Y2_3	**0.877**		
Y3 Knowledge Sharing in VCoP	Y3_1	**0.896**	**0.901**	**0.751**
	Y3_2	**0.870**		
	Y3_3	**0.843**		

Source: SmartPLS Report, Primary data (2022), $N = 221$

Internal consistency reliability is the extent to which indicators measuring the same construct are associated with each other [56]. One of the primary measures used in PLS-SEM is composite reliability. Higher values indicate higher levels of reliability, with a minimum acceptable value of 0.6. The internal consistency reliability for all latent variables indicated values of above 0.7 (see Table V), in which reliability values between 0.60 and 0.70 are considered "acceptable in exploratory research," whereas values between 0.70 and 0.90 range from "satisfactory to good."

Convergent validity is the extent to which the construct converges in order to explain the variance of its indicators [56]. The metric used for evaluating a construct's convergent validity is the average variance extracted (AVE) for all indicators on each construct. The AVE is defined as the grand mean value of the squared loadings of the indicators associated with the construct (i.e., the sum of the squared loadings divided by the number of indicators). Therefore, the AVE is equivalent to the communality of a construct. As indicated in Table V, the AVE of all latent variables are higher than 0.5, whereas the minimum acceptable AVE is 0.50. An AVE of 0.50 or higher indicates the construct explains 50 percent or more of the indicators' variance that make up the construct.

The discriminant validity measures the degree to which a construct empirically differs from other constructs in structural models [56]. The Fornell and Larcker criterion is the traditional metric and suggested that each construct's Square root of AVE (squared variance within) should be compared to the inter-construct correlation (as a measure of shared variance between constructs) of that same construct and all other reflectively measured constructs in the structural model. The shared variance between all model constructs should not be larger than their AVEs. Assessment with the Forner-Larcker criterion shows a higher square root of AVE of a construct when compared to the correlation of that construct with all the other constructs in the study, so that establishes discriminant validity (see Table VI).

TABLE VI. Discriminant Validity/Fornell-Larcker Criterion

	Access to Digital ICT Applications	Knowledge Sharing in VCoP	Social Capital	Social Power Relations
Access to Digital ICT Applications	**0.809**			
Knowledge Sharing in VCoP	0.486	**0.870**		
Social Capital	0.277	0.466	**0.837**	
Social Power Relations	0.217	0.381	0.680	**0.867**

Source: SmartPLS Report, Primary Data (2022), $N = 221$

Once the assessment of reliability and validity of the measurement model has been established and met the required minimum values, the research model can be tested further [56]. Several steps need to be taken to evaluate the hypothesized relationships within the inner model [57]. The inner model (structural model) has two types of latent variables (constructs). Constructs are considered either exogenous or endogenous, whereas exogenous constructs act as independent variables and do not have an arrow pointing at them, endogenous constructs are explained by other constructs. While often considered as the dependent variable within the relationship, endogenous constructs can also act as independent variables when they are placed between two constructs [57]. The path coefficients represent the hypothesized relationships linking the constructs. Path coefficient values are standardized on a range from -1 to +1, with coefficients closer to +1 representing strong positive relationships and coefficients closer to -1 indicating strong negative relationships.

Moreover, the study conducted test of the structural model with bootstrapping method on SmartPLS 3.0 to obtain path coefficients and T-statistic values in order to verifying whether the relationships are significant. The relationship between the constructs of the model is measured in the structural model. Consequently, it helps in the determination of relationships between exogenous and endogenous constructs of the model. Hypothesis testing for the significance of the relationship of each path in the research model based on significant values of less than 0.05 ($p<0.05$) with statistical T values exceeding 1.96, then hypothesis is supported (the null hypothesis is rejected) [58]. The significance values of the paths in the combined model can be seen in Table VII and reflected in Figure 2. Based on statistical T values and P values, the relationship of exogenous and endogenous construct in all paths are significant, then hypothesis (H1, H2, H3, and H5) are supported, except the relationship of Social Power Relations with Knowledge Sharing in VCoP (H4) is insignificant, then the hypothesis is not supported.

TABLE VII. Final Results of Path Coefficients of the Research Model

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Access to Digital ICT Applications → Knowledge Sharing in VCoP (H5)	0.384	0.386	0.058	6.662	**0.000**
Access to Digital ICT Applications → Social Capital (H1)	0.277	0.282	0.058	4.803	**0.000**
Access to Digital ICT Applications → Social Power Relations (H2)	0.217	0.225	0.068	3.189	**0.001**
Social Capital → Knowledge Sharing in VCoP (H3)	0.292	0.296	0.087	3.361	**0.001**
Social Power Relations → Knowledge Sharing in VCoP (H4)	0.099	0.095	0.101	0.976	**0.329**

Source: SmartPLS Report [59], Primary Data (2022), $N = 221$

Significant at level 0.05 if the T >1.96

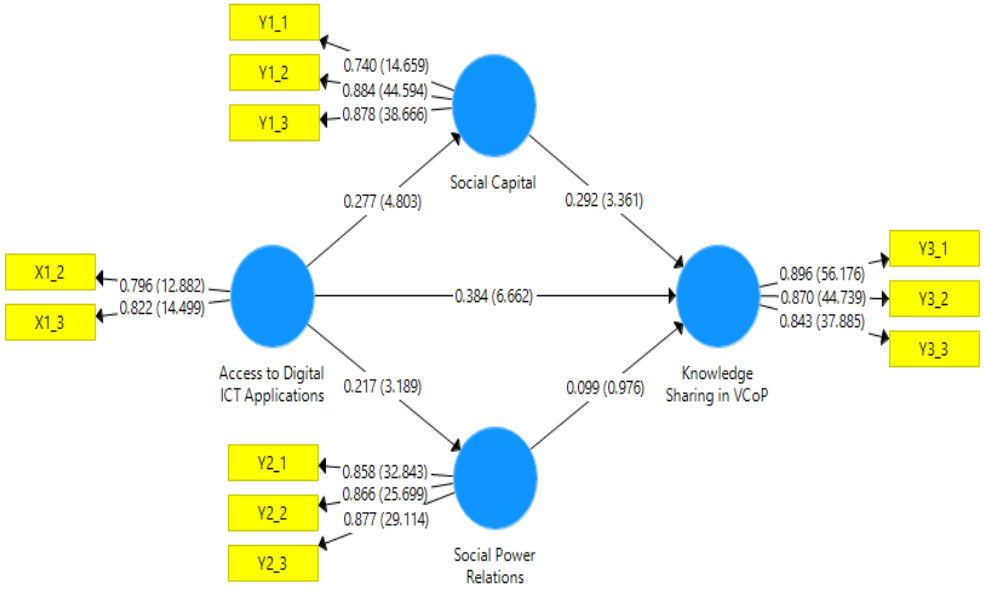

Fig. 2. Causal relationship model of access to digital ICT applications, social capital, social power relations, and knowledge sharing in the VCoP

The study uses the R-Square value to assess the power to explain (explanatory power) the effect of exogenous latent variables on endogenous latent variables. In the causal models, the study differs between exogenous and endogenous variables. Exogenous variables are variables whose associated variability is due to outside the model. Moreover, endogenous variables are variables whose variations are in the explanation of exogenous and endogenous variables in the system.

According to Reference [58], the most common measure used to evaluate structural models is the coefficient of determination (R2 value). This coefficient is a measure of the prediction accuracy of the model. The study calculated the quadratic correlation between the actual value and the prediction of a particular endogenous construct. The coefficient represents the combined effect of the exogenous latent variable on the endogenous latent variable. R2 values range from 0 to 1. The higher levels indicate a higher degree of prediction accuracy. R2 values of 0.75, 0.50, or 0.25 for endogenous latent variables can, as a rough rule of thumb, be described as substantial, moderate, or weak, respectively. The empirical results from testing the research model in Table VIII show that the variable access to digital ICT applications can explain changes in latent social capital variables (7.7 per cent). Other variables can explain the remaining 64.3 per cent. The latent variable of access to digital ICT applications can analyze the latent variable of social power relations (4.7 per cent). Other variables can reveal the remaining 95.3 per cent. Finally, the latent variables of access to digital ICT applications, social capital, and social power relations can explain the variation in the latent variable of knowledge sharing by 36.0 per cent. In this matter, other variables can describe the remaining 64.0 per cent.

TABLE VIII. R Square

Latent Variables	**R Square**	**Category**
Knowledge Sharing in VCoP	0.360	Moderate
Social Capital	0.077	Weak
Social Power Relations	0.047	Weak

Source: SmartPLS Report [59], Primary Data (2022), $N = 221$

V. CONCLUSION

Most of the farmers who participated in the study included small-holder farmers. They use smartphones to access various applications or digital ICT platforms. Furthermore, the study concludes and provides novelties as follows:

Firstly, the number of farmers accessing digital ICT applications varies. As many as 22 per cent of farmers access android-based farming apps, 58 per cent of farmers access FB groups of farmer communities, 57 per cent of farmers access WAG of farmers, groups, 72 per cent of farmers access Internet/Google information resources, and 76 per cent of farmers access YouTube Channels. The level of farmer access to digital ICT applications also varies from rare, moderate, to very frequent, depending on the digital ICT applications accessed. Secondly, social capital built from various social relationships among farmers who use digital ICT applications is perceived by most farmers (more than 75 per cent) at moderate and high levels, either in structural, relational, or cognitive dimensions. Thirdly, social power relations that arise among farmers using digital ICT applications are perceived by the majority of farmers (more than 85 per cent) at moderate to high levels, either in the aspects of social power base, empowerment, and partnership or collaboration.

Fourthly, it is believed that the farmers' continued use of smartphones to access digital ICT applications creates a public space for knowledge sharing among farmers. Substantially, some farmers perceive KS behavior at low (39 per cent) and moderate levels (49 per cent), knowledge conversion as low (44 per cent) and moderate levels (29 per cent), and perceived quality of knowledge shared at low (15 per cent) and moderate level (66 per cent). The disparity at the KS level in VCoP is believed to be due to the direct effects of access to digital ICT applications and the indirect effects of social capital and social power relations.

Fifthly, this study confirms the significant and positive influence of the level of access to digital ICT applications on the level of social capital, the level of access to digital ICT applications on the level of social power relations, the level of social capital on the level of KS in VCoP, and the level of access to digital ICT applications on KS. However, the effect of the level of social power relations on KS in VCoP is not significant at the level of 0.5. The latent variables of access to digital ICT applications, social capital and social power relations can explain the variation in the latent variable of knowledge sharing, as much as 36.0 per cent (moderate), whereas the remaining balance of 64.0 per cent explained by the other variables. This novelty is substantial for formulating strategies to support the transformation of agriculture from input-intensive to knowledge-intensive.

VI. RECOMMENDATIONS

Strengthening and sustaining the practice of digital ICT applications requires stakeholder involvements. For these purposes, we suggest (1) increasing cooperation between the government, application developers, and agricultural extension workers to develop smartphone-based digital ICT applications to provide accessible services with content relevant to local specific conditions (2) increasing the active role of administrators' farmer groups to motivate the use of digital ICT applications for farmer group members (3) improving the quality of android-based agricultural application services (4) increasing the active role of agricultural extension workers to be involved in the knowledge-sharing process using various digital ICT applications available (5) farmers' active involvement in the practices of digital ICT applications for various knowledge for their capacity building.

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