An analysis of the effect of knowledge systems on empowerment levels and food security

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ABSTRACT

The existing link between knowledge systems, empowerment, and food security of farmers has been proven in many studies. However, the measurement of their empowerment level focusing on the psychological dimension of their participation in these knowledge systems is limited in the agricultural sector. These knowledge systems empower farmers to access intangible and tangible resources that are valuable for farmers' decision-making and performance. Thus, it was crucial for the study to investigate the levels of psychological empowerment outcomes attained by smallholder farmers, to evaluate the progress made by knowledge systems that were initiated and activated to empower farmers and improve their food security. A purposive sampling technique was used to select 219 smallholder farmers who are actively linked to the KwaZulu-Natal Department of Agriculture. Applying empowerment theory and previous studies, five psychological empowerment outcomes were identified. The principal component analysis method (PCA) was employed to generate the principal component (PC) of the perceived farmers' psychological empowerment level and the Household Food Insecurity Access Scale (HFIAS) to measure household food security. The results showed that smallholder farmers were moderately and highly competent, had a sense of self-efficacy, had a sense of control, had agricultural knowledge, and were food secure. These systems not only empowered the farmers with tangible assets but also intangible outcomes as shown in the results of the study. These knowledge systems should be highly tapped into especially in this period of COVID-19 lockdowns accompanied by

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movement restrictions to ensure the sustainability of agricultural systems and inclusive empowerment of intangible and tangible skills for farmers. These knowledge systems could be used to comply with COVID-19 policies and legislations that are sensitive to physical contact and platforms for farmers to engage in knowledge transformation and empowerment.

Keywords: Knowledge systems, Psychological empowerment, Food security, Smallholder farmers

1. INTRODUCTION

The Covid-19 pandemic rapidly brought changes worldwide and significantly affected various sectors including agricultural production sectors in terms of labour workers, job loss by employees, etc. Farmers before the COVID-19 pandemic have long been facing agricultural-related problems and this issue became worsen during the period when all aspects of households' livelihoods were affected and movement restrictions to observe the COVID-19 regulations. Smallholder farmers play a very important role in agriculture, especially in food production and contribution to their countries' economies (FAO, 2017). In farming communities, knowledge is a social construct informed by overlapping paradigms that are continually evolving. The restrictions and lockdowns significantly shook information and knowledge platforms from a traditional approach to online and limited physical interactions. This has negatively challenged the farmers, especially smallholder farmers who rely on physical engagement for learning and sharing soft and technical farming skills.

Various existing knowledge systems contribute to smallholder farmers' sustainable and resilient farming through new ways of practising, organising, and gaining farming knowledge. According to Hornidge et al. (2016) knowledge systems are networks of linked actors, organizations, and objects that perform several knowledge-related functions that link knowledge and know-how with action. Therefore, relevant and effective knowledge systems are crucial to the achievement of farmers' empowerment and food security. These knowledge systems are essential to building up the capacity of farmers to improve their production, identify problems, and search for possible solutions suitable to their farming enterprises (Beaman & Dillon, 2018). Thus, the study highlights

that the knowledge systems' strengths and weaknesses are dynamic and valuable, especially in delivering transformative knowledge to improve farmers' food security.

Moreover, Chiu and Chen (2016) argue that farmers engage in knowledge systems with the motive of developing their ability to make critical and informed decisions that improve their productivity, carry out resilient farming, and be empowered. According to Kabeer (2001), empowerment is the capacity of a group or an individual to make effective choices (i.e., make choices that lead to desired actions and outcomes). Kabeer concludes that an individual's ability to make choices consists of three interrelated elements, namely resources (as conditions), organisation (as process), and performance (as results). Furthermore, it emphasises that the empowering process for individuals includes learning decision-making skills, managing resources, and working with others (Van Grinsven and Visser, 2011).

These intangible skills are crucial for the human capital involved in physical farming and empowerment in an agricultural context. Murugani and Thamaga-Chitja (2019) criticises those agricultural interventions that tend to focus on farmers' tangible assets and overlook the intangible ones such as knowledge.

This study focuses on psychological empowerment as one of the intangible outcomes of farmers' participation in knowledge systems, arguing that when farmers engage in empowering systems enriched with knowledge and skills, farmers become independent and gain confidence in decision-making. Indeed, Ibrahim and Alkire (2007) have argued that the empowerment of farmers not only depends on the quality of knowledge and skills they possess but also on their mental capacity, which enhances their human capital and influences their decisions regarding farming. Farmers have motives and values that are logical, and ethical, as well as emotional and social factors that direct them in choosing which information to obtain, the sources they pursue, and the learning methods they follow (Tenkasi & Chesmore, 2003; Sligo & Massey, 2007; Teilmann, 2012). If a farmer has no such experience, gaining and integrating new information properly will be difficult and empowerment could remain beyond their reach. Farmers exist in communities with social and

cultural linkages; thus, their decision-making is, therefore, a social process, formed by social group dynamics that include and influence other fellow farmers.

Literature emphasises the importance of empowerment (Kabeer, 2001; Ibrahim & Ilkire, 2007; Murugani & Thamaga-Chitja, 2019); however, the psychological dimensions have not been adequately explored in the analysis of the process of the empowerment of farmers. The study described in this paper was based on the premise that knowledge systems are expected to empower farmers. In other words, the creation and integration of knowledge systems provide farmers with relevant agricultural knowledge and empowerment. However, available studies argue that psychological empowerment is necessary for all other dimensions of empowerment to take place (Landini *et al.*, 2014; Batool & Ahmed, 2019). Thus, it is crucial to unpack the psychological level of empowerment and the transformation of farmers after the empowerment initiatives.

Small-scale farmers perform a key role in agricultural production by contributing to food production and increasing food security (DAFF, 2011; Murugani & Thamaga-Chitja, 2019). Access to education is one of the basic preconditions of poverty alleviation. For households and individuals, the quality, adequate supply, accessibility, and proper use of food are correlated with food security (FAO, 2017). Poor households are dependent on social connections to mobilise the resources needed to access food (Faure, 2015). It is, therefore, essential to understand how people use their networks to access resources and knowledge. Agricultural production can be increased by relevant knowledge systems that provide relevant, accurate, and useful information and knowledge (Goulet, 2013), and the functions of agricultural information and knowledge systems, therefore, need to be understood.

2.   CONCEPTUAL FRAMEWORK FOR THE STUDY

2.1   Knowledge Systems

Hoffman et al. (2015) suggest that the knowledge system supports three learning pathways, namely, social learning, experiential learning, and technical learning. An agricultural knowledge system (AKS) is a collection of actors such as researchers, advisors, and educators working primarily in agricultural knowledge institutes (Demiryurek et al., 2008). This knowledge is then

transferred to the agricultural sector through agricultural extension services and education programmes (Suksod et al., 2019). In South Africa, both government and non-government organisations are involved in the provision of agricultural knowledge to farmers. Farmers have various agricultural knowledge needs that are relevant to their day-to-day work and they receive this knowledge from a variety of sources external to their organisation. Farmers are supported in their farm management by advisors from various professions who often form a network of advisors.

Buntu (1986) identified five elements of AKS: the existing stock of knowledge; the means of increasing knowledge; the means of testing and developing knowledge; the practical application of knowledge and the dissemination of knowledge (educational training and extension). Farmers have honed their farming skills over time, and they know how to best deal with local challenges using indigenous knowledge and natural resource management ability. Their experiences and knowledge are essential for their resilience to common shocks and hazards and these abilities can enable them to adapt to the climate change effects. Farmers in the study area have formed groups in their respective wards to tackle the challenges they face in agricultural production because being in groups enhanced their ability to access services and inputs which could have not been accessed individually. These smallholder farmers engage in multiple informative networks which are both formal and informal knowledge systems.

The South African Government has set up Farmers Field School (FFS) projects, Farmers Group (FG), self-help groups, and cooperatives to develop awareness and enhance farmers' knowledge platforms and empower the farmers (DAFF, 2011). These heterogeneous networks expose farmers to diverse agricultural knowledge and key actors. Such channels for knowledge and learning are embedded largely in farmers' self-organised and locally originating social structures (Lwoga et al., 2013). Agricultural information structures have resulted in cooperation between peasants, local administration, and academics (FAO, 2017; DAFF, 2011). The application of information at the individual level is therefore complex. The association between the various actors of knowledge and the generation of common knowledge is expanding and to assess their effect on the

empowerment and food security of farmers, it is important to categorise the information structures that are accessible to farmers through their social capital.

2.2 Farmer empowerment

The theory of empowerment includes both the process and outcomes of empowerment (Kabeer, 2001; Van Grinsven & Visser, 2011; Avelino *et al.,* 2019). In agricultural contexts, this means that farmers' activities and agricultural programmes facilitate the empowering process. Thus, the results of these processes are the outcomes that can be measured according to the farmers' level of empowerment (Kabeer, 2001; Ibrahim & Alkire, 2007). According to Ginige et al. (2020), the psychological empowerment outcomes that are close to power include knowledge, skill, strength, control, and self-efficacy. The psychological empowerment of farmers is defined and measured as the individual's belief that they can influence others (i.e., through a leadership role and having a significant impact on the farming community). The study was based on the argument that psychological empowerment positively influences farmers' decisions and performance.

Avelino et al. (2019) stress the importance of understanding the systems that build empowerment. Furthermore, the study argued that these systems provide access to resources and inputs and shift the role of power to collective actions and vice versa. Similarly, Kabeer (2001) argues that the psychological dimensions of empowerment are experienced at an individual level, but it is established through the collective action and practice of farmers.

Suksod et al. (2019) emphasise that the learning and training provided by Agriculture Knowledge Systems allow farmers to build up their skills for their intrinsic value and increase their self-esteem. Thus, evaluating empowerment outcomes is crucial for the systems designed to empower farmers to continue evolving effectively. The study was based on the argument that it is important not only to understand the economic and agrarian implications of the knowledge systems used by the farmers but also their effect on farmers' personal lives. Hence, the study investigated levels of the psychological empowerment of farmers. Therefore, to understand how farmers feel about themselves because of participating in these knowledge systems, it is important to evaluate the categories of effective and empowering knowledge systems. This study aimed to investigate the

levels of empowerment demonstrated by the farmers who participated in the study. Furthermore, it aimed to explore the impact of these levels of empowerment on the farmers' food security status. The knowledge systems used by the smallholder farmers in KwaZulu-Natal (DAFF, 2011), who were the focus of the study described in this paper, provided useful information and helped these farmers to improve the knowledge and skills that met their farming needs. Moreover, the hypothesis is that they were psychologically empowered through and after they participated in these knowledge systems. In other words, this study was based on the argument that all the intangible assets brought about by psychological empowerment are useful for farmers' decision-making and performance in improving their food and nutrition security. Thus, it was crucial to investigate the levels of empowerment outcomes of the smallholder farmers who participated in the study, as a way of evaluating and monitoring the progress made by knowledge systems in empowering them in their farming communities and food security.

2.3   Overview of the KwaZulu-Natal Smallholder Farmer Knowledge System

Thamaga-Chitja and Morojele (2014) argue that South African smallholder farmers (SHF) are those who live in rural communities; they are considered to be poor with little or no educational background, and operate with basic farm infrastructure that locates them on the far margin. Farmers in the KwaZulu-Natal Province have connections with people and organisations ranging from group members and merchants to family, neighbours, Non-Governmental Organisations (NGOs), and the government. Government and private agencies work together to provide farmers with knowledge and information (DAFF, 2011). Research institutions help to solve specific scientific challenges and inform politicians of methods and tools to assist in developing policy.

Private sector agents, such as multinational and national agribusiness firms and small and medium enterprises, are important in agricultural knowledge systems. Matthewson (2014) posits that these actors are directly involved in the delivery of agricultural knowledge, while others have a role in policy formulation and link the private sector with farmers and agricultural production processes. NGOs, associations, and groups are important actors in providing agricultural knowledge to small-scale farmers (Mkenda et al., 2017). NGOs have been at the forefront of supplying inputs and

advisory services to farmers and empowering them to undertake collaborative activities such as analysing problems, sharing information, and making decisions jointly.

In South Africa, the government and non-governmental development agencies have focused on empowering rural farmers and communities through collective action institutions by recognising such institutions as essential agricultural development partnership networks. These interactions and learning systems of farmers build social knowledge networks with multiple heterogeneous communities of knowledge producers. Furthermore, this led farmers to develop their distinctive learning pools and social knowledge systems within and outside their communities. The findings of studies conducted by the FAO (2017) indicate that rural development policies have established mechanisms to assist in organising farmers into cooperatives, associations, and groups. This framework was designed to ensure targeted delivery services and collective actions to access inputs, group training, and knowledge.

3.   RESEARCH METHODOLOGY

3.1   Study Site

The study was conducted in two districts: the *uMtshwathi* Municipality and the *Ukhahlamba* Municipality which are situated in the province of Kwa-Zulu Natal. A purposive sampling technique was used in the selection of smallholder farmers who were linked to the KwaZulu-Natal Department of Agriculture and Rural Development (DARD) and participating in agricultural knowledge systems, thereby ensuring rich data collection from selected participants. Farmers at Appelsbosch are engaged in different types of social groups to sustain their livelihoods. The smallholder farmers of the Okhahlamba Local Municipality (OLM) mainly engage in maize/vegetable production, and livestock production occupies the marginal areas of the Bergville area. Agriculture is the area's biggest employer with commercial agriculture occupying 70% of the municipal land area. Thus, smallholder farming is significant in KwaZulu-Natal, as it is the backbone of its rural households. These social capital types include farmers' groups, burial societies, and grocery/money savings clubs (stokvel). These social groups have both economic and social benefits for households. The economic benefit of the social group includes the promotion of income security while the social benefit includes social support. All these social groups

contribute to household livelihood. Data were collected between November 2019 and March 2020 from a sample of 219 smallholder farmers. A pre-tested structured questionnaire was used to investigate these farmers' perceptions of knowledge systems, socio-economic factors, food security measures, and psychological empowerment measures.

3.2 Measuring Food Security

Food security information was collected using a Household Food Security Scale (HFIAS), which captures the occurrence of food insecurity and its frequency of occurrence. The HFIAS uses nine occurrence questions that ask whether a condition related to the experience of food insecurity has happened during the past four weeks or 30 days, with responses coded as 1=yes and 0= no (USAID, 2007). For this paper, based on the respondent's answer to each question, the HFIAS score was calculated. A total score of 27 represents the most food-insecure household whereas a lower score represents a more food-secure household. Finally, each household was classified into one of four categories: food secure, and mildly, moderately, or severely food insecure.

3.3 Empowerment level analysis

To design and measure empowerment, we considered empowerment outcomes. Applying empowerment theory and previous studies (Spreitzer, 1996; Khushk et al., 2016; Ani et al., 2018) to our scenarios, five empowerment outcomes (i.e., decision-making, increased self-efficacy, increased knowledge, leadership, and competence) were identified and assessed. With the data collected, each farmer responded by rating their level using the five-point Likert scale (1 to 5: strongly disagree to strongly agree). The expected range of scores on the variable was from '10' to '50'. Each dimension was added up and divided by the number of questions in each empowerment dimension (Spreitzer, 1996; Spreitzer & Qunn, 2001). Higher scores indicated higher self-esteem and vice versa. Scores ranging from 0 to 1 were described as low levels of each psychological empowerment dimension, 2 to 3 as moderate levels, and 4 and above as high levels.

3.4 The empirical analysis

3.4.1 Principle component analysis (PCA)

The principal component analysis (PCA) method was employed to generate the principal component (PC) of the perceived farmers' psychological empowerment level (competence, sense of control (decisions), self-efficacy, agricultural knowledge, and leadership). PCA is a multivariate data analysis and a statistical approach used to reduce the number of variables into a reduced number of dimensions, without losing the information (Yobe et al., 2019). The Likert scale with 5 categories was used to capture the farmers' perceptions regarding their empowerment. A description of all the psychological empowerment dimensions' explanatory variables was used in the PCA, which is the empirical model shown in table 1.

4.   RESULTS

The study demonstrated that smallholder farmers operate and interact with multiple networks which function within AKSs. These networks consist of individuals and/or organisations operating in local, scientific, and/or technical knowledge systems. The local knowledge systems of smallholder farmers were found to consist of savings clubs; farmers' groups and unions; cooperatives; farmers' labour associations; middlemen (intermediaries); and fellow farmers operating within the community in Table 1 below. Such knowledge systems also consist of institutional communication channels, such as the DARD; radio programmes; and fellow farmers.

Table 1: Knowledge systems used by the smallholder farmers

	N=219	%	Knowledge Forms
Farmers group associations	218	99.5	Local knowledge
Fellow farmers	189	86.3	Local knowledge
Cooperatives	106	48.4	Local knowledge
Trade business	51	23.3	Local knowledge
Labour organization	14	6.4	Local knowledge
Local committee	45	20.5	Local knowledge
Financial credits clubs	11	5.0	Local knowledge

Field visits	215	98.2	Technical knowledge
TV/Radio	72	32.9	Technical knowledge
Agricultural Exhibitions	97	44.3	Technical knowledge
Booklets	141	64.4	Technical knowledge
Educational groups/Institutions	53	24.2	Scientific knowledge
Health Programme	47	21.5	Scientific knowledge
DAFF Training/workshops	130	59.4	Scientific knowledge
NGO's	41	18.7	Scientific knowledge

A Kaiser-Meyer-Olkin (KMO) and Bartlett's test of Sphericity for the different sub-dimensions of empowerment was tested. The Kaiser Meyer Olkin (KMO) test was about 89.2%, which indicated that the PCA was appropriate for the analysis. Bartlett's test of Sphericity was significant at 1% (p-value (0.000), def. =55, $\chi 2$=81,012.90) in table 2 below. Thus, the PCA was appropriate for measuring empowerment.

The application of the PCA to the empowerment dimension variables produced results that had Eigenvalues greater than the one using the Kaiser Criterion test. The total variance explained by the PCA was observed. The first component explained about 49.7% of the total variance, while the second component explained 10.7%. The third and fourth components explained 7.2% and 5.3%. Lastly, the fifth component explained 5.2% of the total variance of the empowerment of the smallholder farmers. The principal components were labelled. To achieve labelling, the PC pattern matrix was conducted. The variables with high values were the most important factors, and the negative and positive signs indicated the direction of their impact on the components.

The first PC best described agricultural knowledge and the competence empowerment dimension. This indicated that competence in agricultural knowledge was the most important factor in smallholder farmers' empowerment. This PC accounted for 49.7% of the total variation.

Based on the dominant component loaded, the second PC best described the leadership and decision-making (sense of control) dimensions. This PC showed that farmers could use their

experience to make decisions and could give agricultural information to others. This represented the leadership and decision-making (sense of control) dimensions. This PC was explained by 10.7% with estimated coefficients above 0.3. Leadership is a very important skill for farmers to have when building up their resilience, empowering themselves, and engaging in transformative agriculture. Studies argue that there is a need to develop farmers who can first lead themselves, then lead others to practise resilient agriculture and achieve food security.

The third PC was the highest concerning farmers sharing information with a circle of friends and the ability to negotiate with others. This PC was explained by 7.2%. This best represented the empowerment of smallholder farmers regarding self-efficacy. The fourth PC was the highest about increased harvest and storage knowledge; the farmers' ability to use their experience and make decisions; and their confidence in their agricultural knowledge. This PC revealed the farmers' empowerment of agricultural knowledge and competence. The last PC was the highest regarding farmers being regarded as good knowledge sources by their fellow farmers. This indicated the farmers' empowerment about agricultural knowledge and information. This PC was explained by 5.2%.

Table 2: A principal component of farmers' empowerment

	Components				
	Competence	Leadership & decision making	Self-efficacy	Competence & agricultural knowledge	Agricultural knowledge &information
Indicators	PC1	PC2	PC3	PC4	PC5
Can provide agricultural awareness	**.854**	.003	-.058	-.174	-.072
Can Influence decisions	**.844**	-.098	.012	-.298	.064
Know who to go to for advice	**.841**	.247	-.212	-.146	.075
Identify and determine problems	**.821**	.310	-.244	.031	.055
Confidence in my agricultural knowledge	**.813**	-.144	-.060	**-.409**	-.053
Participate Crop max	.806	.287	-.214	-.076	.048

Increased Competence	.804	.286	-.275	.126	.059
Increased knowledge of herbicides and pesticides	.770	-.141	.001	-.470	.064
Increased market Information	.749	.289	-.244	.237	.034
Increased seed variety	.736	-.424	.024	.009	.004
Increase harvest and storage knowledge	.735	.106	.117	**.367**	-.230
Can use experience & make Decision	.726	-.003	-.212	**.350**	.087
Can decision on prices	.666	-.598	.123	.130	-.054
I have good leadership qualities	.553	.328	.237	.222	-.170
Can work with other People	.537	.374	.415	.087	-.212
Can giving agricultural Information	.618	**-.624**	.082	.255	.112
Can use my experience to decide and influence others	.593	**-.616**	.072	.174	.121
Can share information with a circle of friends	.458	.107	**.693**	-.129	-.110
Can Negotiate with others	.469	.268	**.541**	-.026	.154
I'm regarded as Good Source	-.038	.195	.235	.077	**.902**
Summary indicators					
Eigenvalues	9.745	2.141	1.436	1.057	1.045
% of Variance	48.723	10.705	7.178	5.287	5.227
Cumulative %	48.723	59.428	66.605	71.893	77.120
Kaiser-Meyer-Olkin	**.892**				
Bartlett's Test of Sphericity	**.000**				
Cronbach's alpha	**.965**				

Source: field survey 2020

The Chi-square test results in table 3 indicate a statistically significant relationship between farmers' household food security and the level of participation in local knowledge systems of

farmers (p<0.03). Farmers explained that local knowledge is based on the practical skills and experience of the farmers. The Chi-square test further showed a statistically significant relationship between household food security and the level of participation in technical knowledge systems of farmers (p<0.000). Farmers state that the technical knowledge received during training and demonstration helps them to improve their skills in conducting and performing field activities which improves their crop production. The results also reveal a statistically significant relationship between household food security and the level of participation in scientific knowledge systems by farmers. Scientific knowledge systems provide farmers with new information and soft skills.

Table 3: The participation of farmers in knowledge systems and food security

Knowledge system participation of farmers	Category of the participation level of farmers	Food Secure		Food Insecure		N (219)	P-value
		Food secure (n=65) %	*Mildly-food secure (n=39) %*	*Moderately food insecure (n=64) %*	*Severely food insure (n=51) %*		
Local knowledge participation level	Low High	0 29.7	0 27.8	0.5 28.7	0 23.3	1 218	**
Technical knowledge participation level	Low High	0.5 29.2	5.9 11.8	8.2 21.1	7.8 15.5	49 170	***
Scientific knowledge participation level	Low High	24.2 5.5	16.4 1.4	23.7 5.5	15.5 7.8	175 44	**

*Note: *** and ** means significant at 1% and 5% levels of significance, respectively. Source: Study Household Survey (2020)*

4.1 Psychological empowerment level and food security of smallholder farmers

A descriptive analysis of the variables of food insecurity and levels of psychological empowerment is summarised in Table 4 below. The farmers' household food security was measured, and the results showed that a larger proportion of farmers were food secure 29.7%, 17.8% of the farmers' households were mildly food insecure, 29.2% of the farmers' households were moderately food insecure, and 23.3% of severely food insecure. A Chi-square test was used to analyse the levels of psychological empowerment level in relation to the food security of the farmers' households. In determining the levels of the components of the farmers' empowerment, responses fell into low, moderate, and high levels.

4.2 Competence

The results show a statistical relationship between food security and the competence level of farmers at ($p<0.01$). From the 34.2% moderately competent proportion of farmers, 11.9% were food secure, 9.6% were mildly food secure, 8.2% were moderately food insecure, and 4.6 % were severely food insecure. This shows a positive trend whereby most farmers fell into the food secure proportion and only small groups were moderate and severely food insecure. However, of the 65.8% of highly competent farmers, 17.8% were food secure, 8.2% were mildly food secure, a surprising 21% were moderately food secure and 18.7% were severely food insecure. This implied that even though these farmers regarded themselves as highly competent in terms of psychological empowerment, there was room for improvement in reducing the number of severely food-insecure farmers.

4.3 Self-efficacy

A similar pattern was shown by the results regarding the farmers' level of self-efficacy. The results were statistically significant with $p<0.01$ between the self-efficacy and food security variables. The results of the study revealed that out of the 2.3% of the farmers who demonstrated a low level of competence, 0.9% were mildly food secure and 1.4% were moderately food insecure. Moreover, the results revealed that out of the 33.8% of the farmers who indicated a moderate level of self-efficacy, 12.8% were food secure, 8.7% were mildly food secure, 7.3% were moderately food insecure, and 5% were severely food insecure. This showed a positive trend, whereby many

farmers fell into the food secure group and a small number fell into the moderate and severely food insecure group. However, out of the 63.9% of the farmers demonstrating a high level of self-efficacy, 16.9% were food secure, 8.2% were mildly food secure, 20.5% were moderately food insecure and 18.3% were severely food insecure. This study concluded that many farmers were moderately and highly self-efficacious as well as food secure. However, we cannot ignore the significant number of severely food insecure farmers (23.3%) who regarded themselves as moderately and highly self-efficacious. This suggested that improvement is needed to reduce the number of food-insecure farmers.

4.4 Sense of control

There was a significant relationship between the farmers' food security and their sense of control ($p<0.01$). The results also revealed that, of the 2.3% of the farmers who demonstrated a low level of sense of control, 0.9% were mildly food secure and 1.4% were moderately food insecure. Out of the 35.2% of the farmers who demonstrated a moderate level of sense of control, 13.3% were food secure, 7.6% were mildly food secure, 7.3% were moderately food insecure and 5% were severely food insecure. This revealed a positive trend, whereby many of the farmers fell into the food secure group and a small number were moderately and severely food insecure. However, of the 62.5% of the farmers who demonstrated a high level of self-efficacy, 16.4% were food secure, 7.3% were mildly food secure, 20.5% were moderately food insecure and 18.3% were severely food insecure. This revealed that there is a need to focus on the large proportion of farmers (23.3%) who were severely food insecure and demonstrated moderate and high levels of sense of control.

4.5 Agricultural knowledge

A similar pattern was shown by the results regarding the levels of the farmers' agricultural knowledge. The study showed a statistical significance at ($p<0.01$) between increased agricultural knowledge/information and the farmers' food security status. Moreover, the results revealed that of the 2.7% of farmers with a low level of agricultural knowledge and information, 0.9% were mildly food secure and 1.8% were moderately food insecure. However, of the 34.3% of farmers with a moderate level of agricultural knowledge and information, 13.3% were food secure, 9.1% were mildly food secure, 6.9% were moderately food insecure and 5% were severely food insecure.

This revealed a positive pattern, whereby many farmers fell into the food secure group and a small number were moderately and severely food insecure. However, out of the 63% of farmers with high self-efficacy, 16.4% were food secure, 7.8% were mildly food secure, 20.5% were moderately food insecure and 18.3% were severely food insecure. This revealed a need to focus on many farmers (23.3%) who were severely food insecure but demonstrated moderate and high increased levels of agricultural knowledge and information.

4.6 Leadership

The Chi-square results indicated a statistically significant relationship between the farmers' food security and their level of leadership ($p<0.05$). Furthermore, the results showed of the 36.1% of farmers with low leadership skills, 12.8% were mildly food secure, 9.6% were mildly food secure, 1.8% were moderately food insecure and 5.1% were severely food insecure. This shows a positive pattern, whereby many farmers fell into the food secure group and a small number were moderately and severely food insecure. Out of the 55.7% of farmers who demonstrated a moderate level of leadership empowerment, 15.1% were food secure, 7.3% were mildly food secure, 16.3% were moderately food insecure and 16.4% were severely food insecure. However, of the 8.2% of farmers with high leadership skills, 1.8% were food secure, 0.9% were mildly food secure, 3.7% were moderately food insecure and 1.8% were severely food insecure. These results revealed a need to focus on the large proportion of farmers (23.3%) who were severely food insecure but fell into moderate and high levels of leadership skills. Even though many farmers showed moderate to high levels of empowerment regarding competence, self-efficacy, a sense of control, and agricultural knowledge, many of these farmers felt moderately proficient in leadership skills.

Table 4: Food security profile and empowerment level of farmers

Variables		Food secure		Food insecure		
	N (219)	Food-Secure (%)	Mildly food secure (%)	Moderately food insecure (%)	Severely food insecure (%)	X^2
Competence						***
low	0	0	0	0	0	
moderate	75 (34.2%)	11.9	9.6	8.2	4.6	

high	144(65.8%)	17,8	8.2	21	18.7	
Total%		**29.7**	**17.8**	**29.2**	**23.3**	
Self-Efficacy						***
low	5(2.3%)	0	0.9	1.4	0	
moderate	74(33.8%)	12.8	8.7	7.3	5	
high	140(63.9%)	16.9	8.2	20.5	18.3	
Total%		**29.7**	**17.8**	**29.2**	**23.3**	
Sense of control						***
low	5(2.3%)	0	0.9	1.4	0	
moderate	77(35.2%)	13.3	9.6	7.3	5	
high	137(62.5%)	16.4	7.3	20.5	18.3	
Total%		**29.7**	**17.8**	**29.2**	**23.3**	
Agricultural knowledge						***
low	6(2.7%)	0	0.9	1.8	0	
moderate	75(34.3%)	13.3	9.1	6.9	5	
high	138(63%)	16.4	7.8	20.5	18.3	
Total%		**29.6**	**17.8**	**29.2**	**23.3**	
Leadership						**
low	79(36.1%)	12.8	9.6	8.7	5.1	
moderate	122(55.7%)	15.1	7.3	16.8	16.4	
high	18(8.2%)	1.8	0.9	3.7	1.8	
Total%		**29.7**	**17.8**	**29.2**	**23.3**	

5. SUMMARY AND CONCLUSIONS

The knowledge of the farmers who participated in this study was the result of their interaction with public and private knowledge systems that were initiated to improve their productivity and empower them. The results showed that smallholder farmers who demonstrated moderate and high levels of competence, self-efficacy, sense of control, and agricultural knowledge were food secure. However, there was a lack of empowerment in leadership skills amongst the farmers of the study, as the majority felt moderately proficient in leadership skills. These findings suggest the need to improve the empowerment of these farmers in leadership skills. Moreover, we cannot ignore the significant number of farmers who were severely food insecure and who regarded themselves as

moderately and highly self-efficacious. This indicates the need to focus on working to reduce the number who indicated that they experienced food insecurity. Therefore, the KwaZulu-Natal Department of Agriculture and Rural Development (DARD), as well as various NGOs, need to have continuous access to these network systems which are actively used by smallholder farmers to significantly empower farmers in a manner that continue to build resilient food production. These knowledge systems should be tapped into, especially in this period of COVID-19 lockdowns that are accompanied by movement restrictions to ensure the sustainability of agricultural systems and inclusive empowerment of intangible and tangible skills for farmers. These knowledge systems could be used to comply with COVID-19 policies and legislations that are sensitive to physical contact and platforms for farmers to engage in knowledge transformation and empowerment.

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