

<https://doi.org/10.5191/jiaee.2021.28314>

Do Smallholder Farmers Need Nutrition Education? A Case Study from KwaZulu Natal, South Africa

Sarahi Morales
Zomorano University

Abdukladir A. Egal
Vaal University of Technology

Wilna Oldewage-Theron
Texas Tech University/University of Free State

Abstract

South Africa (SA) is considered as the second largest economies in Africa with well-developed agricultural food production system. But food security is still a challenge at household level. Currently, in Africa, smallholder agriculture is recognized to contribute food security at household level. This study investigates the prevalence of food insecurity and nutritional knowledge of 78 local smallholder farmers in KwaZulu Natal (KZN) province of South Africa. The results from this study indicated that nutrition knowledge was poor and food insecurity was prevalent at >40% at the household level. It is therefore recommended that future agricultural training should include nutrition education based on FBDG (Food Based Dietary Guidelines) in their respective programs so as to attain a balanced diet for healthy and productive smallholder farmer communities.

Keywords: smallholder farmers, food security, nutrition knowledge, South Africa.

Funding: Funding for this project described in this study was funded by Oilseeds Advisory Committee in South Africa under Grant (M20/142).

Introduction

South Africa (SA) has the second largest economy on the African continent. It is thus regarded as a food secure nation - a country that reportedly produces enough staples as well as import the necessary additional food products to meet the nutritional needs of its population (Statistics South Africa, 2019; Republic of South Africa [RSA], 2015; Shisana et al., 2013). However, this is not necessarily the case at household level. In 2017 it was estimated that about 20% of all South African households' experienced hunger and 22% had inadequate to severely inadequate access to food (Statistics South Africa, 2019).

Food security, in many countries across the world, is strongly supported by smallholder farmers. Traditionally, the agricultural sector has been divided by subsistence farmers and large-scale commercial farmers. The concept of smallholder or small-scale farming has been usually regarded as "non-productive, non-commercial, subsistence farming... [which] contributes very little to the economy as a whole and the to the welfare and livelihoods of rural dwellers" (Kirsten & van Zyl 1998). But, studies have demonstrated that small-scale farming can be profitable and viable (Ngqangweni et al., 2001). Smallholder farmers are classified as subsistence farmers and emerging farmers. Subsistence farmers are those whose agricultural production is intended only for food consumption. Emerging farmers are those inclined to produce commercially and/or producing a surplus that reaches markets. The proportion of farmers classified under the category of emerging are reported to be a minority (Pienaar, 2013).

The government of SA has recognized the value of smallholder farming as a mechanism to minimize food insecurity and poverty (Baiphethi & Jacobs, 2009). Smallholders contribute to the nations' food supplies in terms of quantity and quality of the food demand. In addition, this type of farming represents a safety net in many rural economies worldwide (High Level Panel of Experts [HLPE], 2013). It is estimated 80% of African farmers are smallholders (HLPE, 2013). In the specific case of SA, approximately 20% of the households are involved in the agricultural sector and 65% are considered to be subsistence farmers (RSA, 2015). This is approximately four million people (Statistics South Africa, 2012). Now, smallholders are considered important contributors to nations' economies, environment, and cultural and social structures, especially in developing countries such as SA (High Level Panel of Experts [HLPE], 2013).

Unfortunately, smallholder farmers are characterized as living in poverty and experience food insecurity throughout their lives despite producing food supplies. They often have limited food production and/or lack purchasing power to meet their food needs (HPL, 2013). Previous studies in SA explored the food insecurity experience of households in rural and urban areas. While, authors indicated male-headed households in urban areas were more likely to be food secure than female-headed households, both male- and female-headed households are more prone to experience food insecurity in rural areas. Considering most Africans in rural areas are involved in the agricultural sector, it is likely they have experienced hunger at some point in their lives (Tibesigwa & Visser, 2015). In the KwaZulu Natal province of South Africa, an estimated 20% of the households are involved in agricultural activities as additional sources of income and food. Coincidentally, 19% of households in the province are classified as having an inadequate access to food and 5% with severely inadequate access to food (Statistics South Africa, 2019). Several studies have been conducted in SA to determine the prevalence of food insecurity, determinants of food insecurity, and coping strategies, among others (Walsh & van Rooyen, 2015; Frayne et al., 2009; Kepe & Tessaro 2014; Kruger et al., 2006; Lemke, 2005; Lemke et al., 2000). But there are limited studies investigating smallholders' food security. The existing

literature has found many smallholder farmers in the country are food insecure (Maziya, et al., 2017; Altman et al., 2009).

Conceptual Framework

Food insecurity is often associated with malnutrition and both have important consequences for individuals' health and well-being (Walsh & Rooyen, 2015). According to the UNICEF conceptual framework for malnutrition, households experiencing food insecurity immediately experience an inadequate dietary intake and diversity leading to hunger and undernutrition. The issues of malnutrition and hunger can result in mortality, morbidity, and disability and it has important long-term implications for nations, such as hindering citizens' cognitive abilities, economic productivity, reproductive performance, and increasing the prevalence's of metabolic and cardiovascular diseases (Herforth et al., 2012; UNICEF, 2013). A lack of nutritional knowledge of food insecure and undernourished people has been considered as one of the potential factors that hinders individuals' ability to choose the most appropriate foods and beverages to have an adequate diet that meets their nutritional needs to lead a healthy and active life (Vorster et al., 2013).

Purpose and Objectives

The context provided and the paucity of information about food insecurity and nutrition knowledge of smallholder farmers in SA, guided the purpose of this study, to investigate smallholder/subsistence farmers' basic nutrition knowledge and their household's food insecurity access. The objectives of this study were to:

1. Describe the food access of farmers from the KwaZulu Natal (KZN) province based on HFIAS classification.
2. Determine the basic nutritional knowledge of smallholder farmers from KwaZulu Natal (KZN).
3. Ascertain farmers' nutritional knowledge based upon their household food security prevalence.

Methods

Study Design and Sampling

This study was descriptive in nature. Data used in this study come from a survey conducted among a convenience sample of 78 black smallholder farmers, who attended the Grain SA Farmer days during the winter season of 2017, was used. Farmers indicated their willingness to participate by signing an informed consent form after the study objectives were explained. The study protocol was approved by the Vaal University of Technology and the Institutional Research Board at Texas Tech University.

Data Collection

During the survey, a structured questionnaire was completed with the assistance of a trained fieldworker, where needed. The questionnaire had two main sections: food security and general nutritional knowledge. The food security part of the questionnaire was the Household Food Insecurity Access Scale (HFIAS) to measure food security and coping strategies. The instrument allows identifying anxiety related to food access, perceptions of quantity, quality, and reduction of food intake, as well as consequences or actions of reduced access to food (Coates et

al., 2007). The instrument has nine dichotomous questions where households were asked to indicate whether they have experienced any of the food insecurity conditions or applied any of the coping strategies (0 = no, 1 = yes). It also has nine follow-up questions for each of the original questions respectively. Households were asked to indicate if they have experienced a condition related to food insecurity and hunger and the frequency in which they experience the condition (1 = rarely, once or twice; 2 = sometimes, three to ten times; 3 = often, more than ten times). Participants were asked to answer the questions considering their experience in a time frame of the last four weeks. These questions allow the researchers to identify the household's food insecurity access prevalence, the severity of the condition, and the coping strategies used to compensate the reduced food consumption (Coates et al., 2007). The instrument has been validated and it is widely used to assess food insecurity prevalence across the world (Deitchler et al., 2010).

The basic nutrition knowledge section included questions asking farmers their perceived nutritional knowledge, and knowledge of food functions, recommended servings, and the SA Food-Based Dietary Guidelines (FBDGs). The instrument used in this study was a modified version of an instrument used previously by the authors (Oldewage-Theron & Egal, 2012) with face and content validity, and internal consistency ($\alpha = .73$) determined as acceptable (Nunnally & Bernstein, 1994). An overall basic knowledge of nutrition was determined based upon a set of 33 questions instead of 59 questions from the original instrument due to the nature of the study characteristics. Farmers were asked initially to indicate their perceived level of nutritional knowledge in a Likert-type scale ranging from excellent to poor/bad responses (excellent = 6 to poor/bad = 1). Farmers were asked to select the correct answer among the possible options. Knowledge results were then recorded as correct or incorrect answers with a binary code of 1 and 0, respectively. The sum of correct answers resulted in an overall basic knowledge of nutrition with a maximum possible score of 33 points. An initial question asked farmers to indicate their perceived level of nutritional knowledge. The internal consistency of the reduced instrument was found to be similar to the original instrument and therefore deemed acceptable for analysis ($\alpha = .77$).

Data Analysis

All the data were captured and a complete dataset of 78 farmers was used for analysis (100% response rate). Data were analyzed using IBM SPSS®, version 25. Descriptive statistics of central tendency and variability were used to describe the farmers in terms of the food security and basic nutritional knowledge. Food security prevalence was determined following the scoring parameters established by the authors (Coates et al., 2007) and the adjusted classification parameters made by Chakona and Shackleton (2018) at a recent study in South Africa. The estimation of the parameters by the authors (Coates et al., 2007) is determined by an if-then process depending upon the affirmative responses to certain items in the scale by each category. While the adjusted parameter is based on a classification by the obtained score. Both classifications suggest that a higher score indicates a more severe food insecurity state. Individual/Household food insecurity levels were analyzed and grouped according to four ordinal categories; 1 = Food Secure, 2 = Mildly Food Insecure Access, 3 = Moderately Food Insecure Access, 4 = Severely Food Insecure Access (Coates et al., 2007). Frequencies were further calculated to indicate prevalence of the various food security levels. A further dichotomous food secure (group 1) and food insecure (groups 2, 3 and 4) was done. Knowledge

scores were calculated by adding all the correctly answered questions (1 = correct answer, 0 = wrong answer).

An independent t-test and Analysis of Variance (ANOVA) were conducted to ascertain farmers' nutritional knowledge based upon their household food security prevalence. An independent t-test was conducted to compare farmers' nutritional knowledge scores based upon their food security status (secure or insecure). The null hypothesis states, food secure farmers' nutritional knowledge is not significantly different than food insecure farmers' nutritional knowledge. A one-way ANOVA was used to compare the mean scores of food insecure farmers' nutritional knowledge based upon the severity of their food insecurity: mild, moderate, and severe. The null hypothesis stated: food insecure farmers' nutritional knowledge is not significantly different based upon the severity of the food insecurity status. An alpha level of .05 was established *a priori* for both statistical analyses.

Results

Prevalence of Food Insecurity and Coping Strategies

The prevalence of food insecurity was assessed using the Household Food Insecurity Access Scale (HFIAS). The results were evaluated using the parameters established by the authors of the scale (Coates et al., 2007) and the adjusted classification criteria made by Chakona and Shackleton (2018) in South Africa. Based on the authors criteria, 55.1% of farmers' households were classified as having adequate food access (food secure). The remaining 44.9% were classified as food insecure at different levels of severity, namely moderately food insecure (19.2%), mildly food insecure (14.1%), and severely food insecure (11.6%). Based on the adjusted classification criteria, and slightly higher amount of stallholder farmers were classified as food secure (56.4%) and a slightly less were classified as food insecure (43.6%). The classification at different levels of severity also varied: 20.5% were classified as mildly food insecure and, 15.4% and 7.7% were classified as moderately and severely food insecure, respectively (Chakona & Shackleton 2018). Table 1 shows the classification of the farmers households food security condition using the HFIAS measurement and the scoring criteria established by the authors and the adjusted criteria for South Africa.

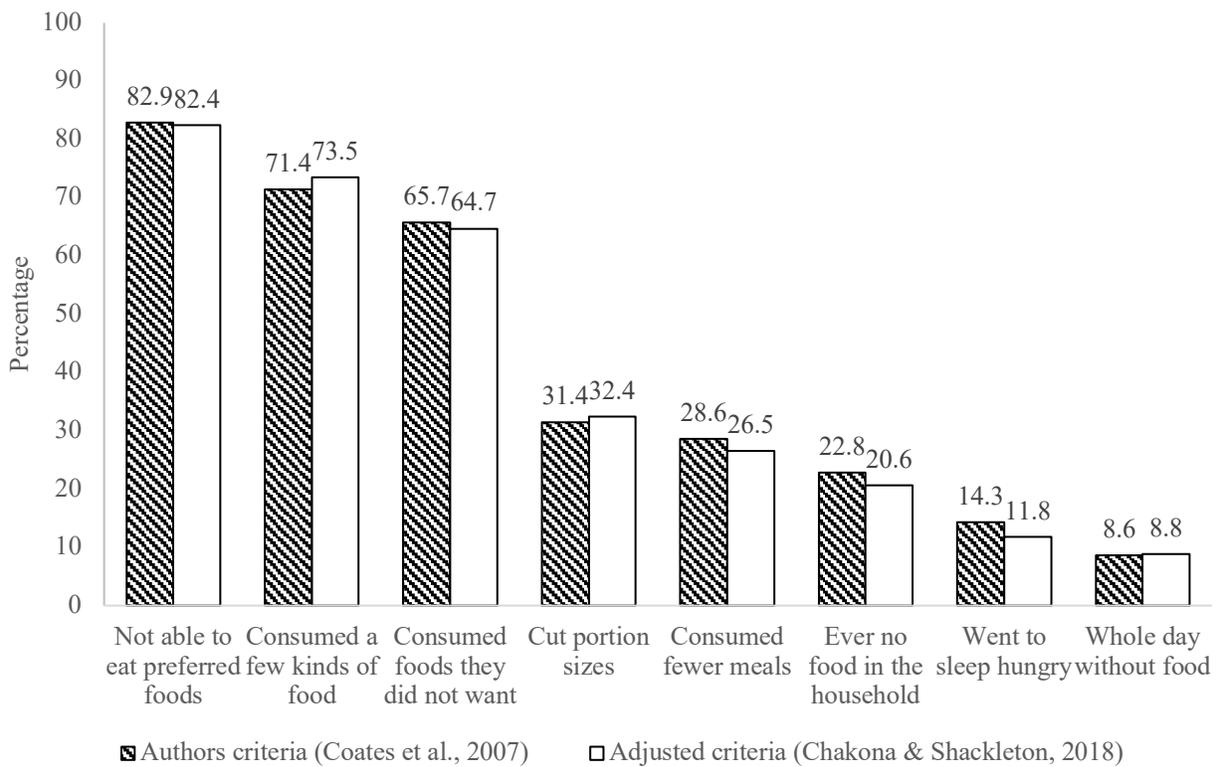
Table 1

Classification of farmers households' food security based on the criteria of the HFIAS measurement (N = 78) by the authors and adjusted for South Africa

Classification	Authors criteria (Coates et al., 2007)		Adjusted criteria (Chakona & Shackleton, 2018)	
	<i>n</i>	%	<i>n</i>	%
Food Secure	43	55.1	44	56.4
Food Insecure	35	44.9	34	43.6
Severity level of food insecure households				
Mildly food insecure	11	14.1	16	20.5
Moderately food insecure	15	19.2	12	15.4
Severely food insecure	9	11.6	6	7.7

Food insecure households, at any level of severity (mild, moderate or severe), reported the use of coping strategies while food secure farmers did not use any coping strategies in their households. Figure 1 shows the frequency percentage of coping strategies employed by the food insecure farmers and their households within the timeframe of the study. Both classification criteria, Coates et al. (2007) and Chakona and Shackleton (2018) reported, similarly, to most frequently use the coping strategies of not being able to eat preferred foods (82.9% and 82.4%, respectively), consuming fewer kinds of foods (71.4% and 73.5%, respectively), and consuming foods they did not really want (65.7% and 64.7%, respectively) due to limited resources. They also reported cutting portion sizes (31.4% and 32.4%, respectively), consuming fewer meals (28.6% and 26.5%, respectively), and going to sleep hungry (14.3% and 11.8%, respectively), and a whole day without food (8.6% and 8.8%, , respectively) due to lack of food available in the household. Almost a quarter of the farmers reported that they did not have food available in the household (22.9%; 20.6%) at some point due to lack of resources to purchase food (Figure 1).

Figure 1
Coping strategies reported by smallholder farmers at their households.



Note. Comparison based on the HFIAS classification criteria of authors (Coates et al., 2007) and adjusted for South Africa (Chakona & Shackleton, 2018).

Nutrition Knowledge

Farmers were asked initially to indicate their perceived level of nutritional knowledge in a Likert-type scale of excellent to poor/bad. The majority of the farmers perceived themselves to have a good (48.0%), very good (14.7%) or excellent (18.7%) nutritional knowledge. While

14.6% considered having fair nutritional knowledge, and only 4.0% believed they have poor nutritional knowledge (Table 2).

Table 2

Farmers' perceived nutritional knowledge (N = 75)

Items	F	%
Excellent	14	18.7
Very good	11	14.7
Good	36	48.0
Fair	11	14.6
Poor/bad	3	4.0

Farmers' nutritional knowledge was determined by the sum of correct answers. Overall, the farmers had a moderate basic nutritional knowledge with a mean score of 14.3 ($SD = 4.6$) out of a maximum score of 33. This represents an average knowledge of 43.4%. Results of questions regarding farmers' basic nutritional knowledge varied by topic: nutrition, identification of fortification on food products, hygienic preparation of foods, meaning of malnutrition, and the South African Food Based Dietary Guidelines (FBDG), as seen in Table 3. The majority of farmers (71.8%) correctly identified breakfast as the most important meal of the day. Only 17.9% could describe malnutrition correctly and knowledge of nutrients were poor. Only 2.6% and 6.4% of the farmers could identify nutrients and functions of nutrients in the body, respectively. The fortification logo was unknown to the majority of farmers (80.8%) and only two indicated they had seen it on bread, and three on maize meal. Similarly, knowledge of the FBDGs was poor overall. Only 9.0% of the farmers indicating that they have heard about the FBDGs before.

Table 3

Nutrition knowledge results (N = 78)

Knowledge topics	Respondents with zero correct answers		Respondents with 100% correct answers	
	n	%	n	%
Breakfast is the most important meal of the day ^e	-	-	56	71.8
Nutrients				
Classification of nutrients as macro- and micronutrients ^b	3	3.8	2	2.6
Functions of nutrients ^c	15	19.2	5	6.4
Fortification				
Have you seen the logo before? ^e	-	-	15	19.2

Food items on which the logo appears? ^e	-	-	5	6.4
Meaning of the logo ^c	74	94.9	4	5.1
Malnutrition				
Meaning of malnutrition ^c	64	82.1	14	17.9
FBDGs				
Heard about the FBDGS? ^c	71	91.0	7	9.0
Different FBDGs ^a	2	2.6	3	3.8
Hygiene				
Preparation of food ^d	5	6.4	50	64.1

Note. ^a number of questions asked = 11; ^b number of questions asked = 7; ^c number of questions asked = 6; ^d number of questions asked = 3; ^e number of questions asked = 1.

Farmers' Nutritional Knowledge by HFIA Prevalence

The classification criteria set by Coates et al. (2007) was used for these analyses. The farmers who were food secure had a knowledge mean score of 14.9 ($SD = 5.2$) while farmers who were food insecure had a mean score of 13.6 ($SD = 3.9$). An independent *t*-test was conducted to compare farmers' nutritional knowledge scores based upon their food security status (secure or insecure). The null hypothesis states, food secure farmers' nutritional knowledge is not significantly different than food insecure farmers' nutritional knowledge. An alpha level of .05 was established *a priori*. The assumptions of parametric tests were met. Based on the results, the *t*-test was found to be non-significant, $t = -1.24$, $p = .22$. Therefore, food secure farmers' knowledge was not significantly different than food insecure farmers' knowledge.

A one-way Analysis of Variance (ANOVA) was used to compare the mean scores of food insecure farmers' nutritional knowledge based upon the severity of their food insecurity: mild, moderate, and severe. Farmers households classified as mildly food insecure had a knowledge mean score of 14.7 ($SD = 4.65$), while moderate and severe households had a mean score of 12.87 ($SD = 3.48$) and 13.56 ($SD = 1.88$), respectively. The null hypothesis stated, food insecure farmers' nutritional knowledge is not significantly different based upon the severity of the food insecurity status. An alpha level of .05 was established *a priori*. The assumptions of parametric tests were met. Based on the results, the ANOVA was significant, $F(2, 32) = .85$; $p = .44$. Therefore, the null hypothesis is failed to reject in favor of the alternative hypothesis. No significant differences in nutrition knowledge were observed between the mildly, moderately and severely food insecure groups.

Conclusions, Implications and Recommendations

Smallholder farmers are mainly located in the poorest rural areas of SA where persistent chronic food insecurity and malnutrition is evident (Gwebu & Matthews, 2018; Oyo et al., 2018; Sibhatu & Qaim, 2017). The smallholder farming sector is thus a good entry point for improving food security and nutrition (Sibhatu & Qaim, 2017). There is a paucity of data about the food security level of smallholder farmers in SA and this study aimed to investigate rural

smallholder/subsistence farmers from a district in KZN's basic nutrition knowledge and their household's food insecurity access.

It is assumed that because farmers produce food, they would be food secure. The findings of this study showed that almost half of the smallholder/subsistence farmers were food insecure, showing a lower prevalence compared to rural households in the District of iLembe in KZN (Drysdale et al., 2019), but a higher prevalence than smallholder farmers in Tongaat (Khumalo & Sibanda, 2019) and Msinga (Maziya et al., 2017), as well as the national and KZN prevalence of 21.3% and 23.4% respectively (Statistics South Africa, 2019). Various reversible and irreversible coping strategies were employed by the food insecure groups that could worsen the impact on food insecurity in the short and long term (Ngidi & Hendricks, 2014). Worrying about not having enough food in the household was experienced by a large percentage (40.0 %) of the farmers. The majority of the food insecure farmers consumed only a few kinds of foods, were not able to consume the preferred foods and consumed foods they did not really want. These findings were consistent with other studies undertaken in the iLembe District (Drysdale et al., 2019) and Msinga (Maziya et al., 2017) in KZN. These coping strategies can be reversed as soon as resources become available.

The prevalence of food insecurity among the smallholder farmers in this study was higher than the national prevalence (23.9%) for black headed households (Statistics South Africa, 2019). This may partially be explained by the fact that the SA measurement did not include the two questions about going to bed hungry and not having had any food in the household that was included in this study. However, this large food insecurity prevalence indicates a serious problem amongst smallholder farmers in particular with 11.6% being severely food insecure, meaning that, they were not only employing reversible coping strategies like cutting meal sizes and the number of meals in a day, but they also experienced times when they would have no food available in the house and going a whole day without food (Coates et al., 2007). Although only 8.6% of the farmers indicated going without food for a whole day, which was consistent with the households in iLembe District (Drysdale et al., 2019) and Tongaat (Khumalo & Sibanda 2019), however, this is a worrisome finding as these "irreversible strategies" can have serious consequences if used on a regular basis (Drysdale et al., 2019).

Farmers are the backbone of the agriculture industry throughout the world. Small landholding farmers have been especially recognized in SA for the last decade as instrumental to minimize poverty and food insecurity (Baiphethi & Jacobs, 2009). These views are reinforced by the United Nations in 2019 where family farming has been declared a mean to reach the Sustainable Development Goals as it "offers a unique opportunity to ensure food security, improve livelihoods, better manage natural resources, protect the environment, and achieve sustainable development, particularly in rural areas" (FAO, 2019). However, small landholding farmers cannot reach their potential within their occupation if they are food insecure which can have important implications for nation's production. A farmer, and family, with food insecurity, like the farmers in this study, is likely to experience food shortages and limited dietary diversity that may result in malnutrition (nutrient deficiencies and obesity) (Khumalo & Sibanda, 2019; Onyutha, 2018) as a result of consuming more affordable energy-dense, high sugar- and salt containing foods (Drewnowski 2005; Drewnowski & Darmon, 2005). Regular consumption of the previously described food types is a known risk factor of chronic non-communicable diseases (Herfort et al., 2012; Rustad & Smith, 2013; UNICEF 2013). These conditions have detrimental long-term implications: it may decrease the adults' ability to work, reduced their agricultural productivity and increase their health care bills (Khumalo & Sibanda, 2019). On the other hand,

it may compromise children's cognitive, motor and socio-emotional development (Grantham-McGregor et al., 2007).

The SA FBDGs is an evidence-based tool that can be used to educate the public about nutrition and motivate people to make good food choices, that can result in optimal nutrition and protect against under and over nutrition diseases related, thus improving individuals overall health conditions (Vorster et al., 2013). Limited data, however, exist about the nutrition knowledge of smallholder farmers and this is the only study that the authors are aware of that focused on nutrition knowledge of smallholder farmers in KZN. Although the majority of the smallholder farmers thought they had good or even very good to excellent nutrition knowledge, the overall nutrition knowledge score was only 46.1%. This is lower than the national nutrition knowledge score of 53.0% (Shisana et al., 2013). The results indicated the farmers' knowledge was fair with respect to hygienic preparation of food. The majority (71.8%) also knew the importance of consuming breakfast, but reflected poor knowledge in terms of food groups, nutrients, and the meaning of malnutrition. Only 19.2% of the farmers had seen the fortification logo before and only 5.1% knew what it meant. In addition, only 9.0% of the farmers had heard about the FBDGs despite the FBDGs being adopted by the Department of Health as early as 2002. The poor nutrition knowledge was consistent with a Kenyan study among smallholder farming households (Ng'endo et al., 2018). Although no association between food insecurity and nutrition knowledge could be established in this study, the number of farmers with poor nutrition knowledge is high, similarly to a high percentage of the farmers being categorized as food insecure. These results suggest that, in order to achieve sustainable food and nutrition security, all agricultural interventions should include health awareness and nutrition education (Ng'endo et al., 2018). Although many studies have reported the impacts of agricultural interventions, limited studies are available on the impact of interventions on household diets and nutrition and those that are available, focus mainly on dietary diversity (Sibhatu & Qaim, 2017). However, this study results also point to the importance of educating smallholder farmers not only on how to improve production and consumption, but also on why it is important to consume a healthy diet and how it can be achieved through the implementation of FBDGs. Nutrition education can further be employed to assist farmers in healthy food choices on a limited budget (Kerr et al., 2019) as nutrition knowledge is an important predisposing factor for positive dietary and health changes (Rustad & Smith, 2013). An example is a study undertaken among rural Kenyan farm women where a nutrition education positively influenced nutrition knowledge, dietary intake practices and diet quality (Walton et al., 2017). In addition, a food production, combined with a behaviour change communication intervention in Burkina Faso significantly improved child health (de Jager et al., 2018).

The nature of this study led to two limitations in the sampling method, namely: 1) A convenience sampling method was used, and the results thus have low external validity and should not be generalized to any larger smallholder farmer population; and 2) The HFIAS was a self-reported measure, and it has been found that self-reported measures may overstate food insecurity (Devereux & Tavener-Smith, 2019; Kennedy, 2002). Another limitation is that this study was undertaken during the winter season and seasonal variations that have been observed among smallholder farmers (Devereux & Tavener-Smith, 2019), have not been taken into account.

It can be concluded that the prevalence of food insecurity, as determined by food access, was high among the smallholder farmers in the Bergville area of KZN and that they employed various coping strategies to deal with the situation. In addition, although the smallholder farmers

thought they had good nutritional knowledge, this was not the case. Nutrition knowledge is an important predisposing factor for behavior change. The results of this study justify the need for continued, targeted efforts to ensure food and nutrition security among smallholder farmers in KZN. It is recommended that all agricultural training interventions for smallholder farmers should not only focus on production, but should also include nutrition education, based on the FB DGs to educate them about the health impact of producing and consuming a balanced diversified diet.

References

- Altman, M., Hart, T. G., & Jacobs, P. T. (2009). Household food security status in South Africa. *Agrekon*, 48(4), 345–361. <https://doi.org/10.1080/03031853.2009.9523831>
- Baiphethi, M. N., & Jacobs, P. T. (2009). The contribution of subsistence farming to food security in South Africa. *Agrekon*, 48(4), 459–482. <https://doi.org/10.1080/03031853.2009.9523836>
- Chakona, G., & Shackleton, C., (2018). Household food insecurity along an agro-ecological gradient influences children's nutritional status in South Africa. *Frontiers in Nutrition*, 4(2). <https://doi.org/10.3389/fnut.2017.00072>
- Coates, J., Swindale, A., & Bilinsky, P. (2007). *Household food insecurity access scale (HFIAS) for measurement of household food access: Indicator guide*. Food and Nutrition Technical Assistance Project, Academy for Educational Development. http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/doc-training/hfias.pdf
- Deitchler, M., Ballard, T., Swindale, A., & Coates, J. (2010). *Validation of a measure of household hunger for cross-cultural use*. Food and Nutrition Technical Assistance II Project (FANTA-2), FHI 360
- De Jager, I., Giller, K. E., & Brouwer, I. D. (2018). Food and nutrient gaps in rural Northern Ghana: Does production of smallholder farming households support adoption of food-based dietary guidelines? *PLOS One*, 13(9): e0204014. <https://doi.org/10.1371/journal.pone.0204014>
- Devereux, S., & Tavener-Smith, L. (2019). Seasonal food insecurity among farm workers in the Northern Cape, South Africa. *Nutrients*, 11(7), 1535. <https://doi.org/10.3390/nu11071535>
- Drewnowski, A. (2005). Concept of a nutritious food: toward a nutrient density score. *The American Journal of Clinical Nutrition*, 82(4), 721–732. <https://doi.org/10.1093/ajcn/82.4.721>
- Drewnowski, A., & Darmon, N. (2005). Food choices and diet costs: An economic analysis. *Journal of Nutrition*, 135(4), 900–904. <https://doi.org/10.1093/jn/135.4.900>
- Drysdale, R.E., Moshabela, M., & Bob, U. (2019). Food security in the District of iLembe, Kwazulu-Natal: A comparison of coping strategies between urban and rural households. *Ecology of Food and Nutrition*, 58(4), 379–396. <https://doi.org/10.1080/03670244.2019.1602528>
- Food and Agriculture Organization of the United Nations (FAO). (2019). *Introducing the UN decade of family farming* [web post]. <http://www.fao.org/family-farming-decade/en/>
- Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD) & World Food Programme (WFP). (2017). *The state of food security and nutrition in the world 2017: Building resilience for peace and food security* [Adobe Digital Edition version]. <http://www.fao.org/3/a-I7695e.pdf>

- Frayne, B., Battersby-Lennard, J., Fincham, R., & Haysom, G. (2009). *Urban food security in South Africa: Case study of Cape Town, Msunduzi and Johannesburg* [working paper series No.15]. Development Planning Division, DBSA: Midrand.
<https://pdfs.semanticscholar.org/6bc3/7fb61a74354a60f1b6213ccd8ef8537561d4.pdf>
- Grantham-McGregor, S., Cheung, Y.B., Cueto, S., Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet*, 369(9555), 60–70. [https://doi.org/10.1016/s0140-6736\(07\)60032-4](https://doi.org/10.1016/s0140-6736(07)60032-4)
- Gwebu, J. Z., & Matthews, N. (2018). Metafrontier analysis of commercial and smallholder tomato production: A South African case. *South African Journal of Science*, 114(7/8).
<https://doi.org/10.17159/sajs.2018/20170258>
- Kennedy, E. (2002). Qualitative measures of food insecurity and hunger. In FAO (Ed.), *Proceedings of the international scientific symposium: measurement and assessment of food deprivation and undernutrition*, FAO, Rome, Italy, 28-29.
- Kepe, T., & Tessaro, D. (2014). Trading-off: rural food security and land rights in South Africa. *Land Use Policy*, 36, 267–274. <https://doi.org/10.1016/j.landusepol.2013.08.013>
- Kerr, R., Young, S. L., Young, C., Santoso, M. V., Magalasi, M., Entz, M., & Snapp, S. S. (2019). Farming for change: developing a participatory curriculum on agroecology, nutrition, climate change and social equity in Malawi and Tanzania. *Agriculture and Human Values*, 36(3), 549–566. <https://doi.org/10.1007/s10460-018-09906-x>
- Khumalo, N. & Sibanda, M. (2019). Does urban and peri-urban agriculture contribute to household food security? An assessment of the food security status of households in Tongaat, eThekweni municipality. *Sustainability*, 11(4), 1082.
<https://doi.org/10.3390/su11041082>
- Kirsten, J. F., & Van Zyl, J. (1998). Defining small-scale farmers in the South African context. *Agrekon*, 37(4), 551–562. <https://doi.org/10.1080/03031853.1998.9523530>
- Kruger, A., Lemke, S., Phometsi, M., van't Riet, H., Pienaar, A., & Kotze, G. (2006). Poverty and household food security of black South African farm workers: The legacy of social inequalities. *Public Health Nutrition*, 9(7), 830–836. <https://doi.org/10.1017/phn2005927>
- Herforth, A., Jones, A., & Pinstrip-Andersen, P. (2012). *Prioritizing nutrition in agriculture and rural development: guiding principles for operational investments*. Health, Nutrition and Population Discussion Paper Series. World Bank.
- High Level Panel of Experts [HLPE], (2013). Investing in smallholder agriculture for food security. A report by the high-level panel of experts on food security and nutrition of the committee on world food security.
- Lemke, S. (2005). Nutrition security, livelihoods and HIV/AIDS: implications for research among farm worker households in South Africa. *Public Health Nutrition*, 8(7), 844–852.
<https://doi.org/10.1079/phn2005739>
- Lemke, S., van Rensburg, F. J., Voster, H., & Ziche, J. (2000). Black South African households, gender relations and food and nutrition security. *South African Journal of Clinical Nutrition*, 13, 106.
- Maziya, M., Mudhara, M., & Chitja, J. (2017). What factors determine household food security among smallholder farmers? Insights from Msinga, KwaZulu-Natal, South Africa. *Agrekon*, 56(1), 40-52. <https://doi.org/10.1080/03031853.2017.1283240>
- Ng'endo, M., Bhagwat, S., & Keding, G. B. (2017). Contribution of nutrient diversity and food perceptions to food and nutrition security among smallholder farming households in

- Western Kenya: A case study. *Food and Nutrition Bulletin*, 39(1), 86-106.
<https://doi.org/10.1177/0379572117723135>
- Ngidi, M. S., & Hendricks, S. L. (2014). Coping with food insecurity in rural South Africa: The case of Jozini, KwaZulu Natal. *Mediterranean Journal of Social Science*, 5(25):278
- Ngqangweni, S. S., Kirsten, J. F., & Degado, C. L. (2001). How efficient are African smallholders? A case study in the eastern cape province of South Africa. *Agrekon*, 40(1), 58–65. <https://doi.org/10.1080/03031853.2001.9523694>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill
- Oldewage-Theron, W., & Egal, A. A. (2012). Impact of a soy nutrition education programme on knowledge in a low-income community in Qwa-Qwa, South Africa. *International Journal of Consumer Studies*, 36(4), 480–485. <https://doi.org/10.1111/j.1470-6431.2011.01064.x>
- Onyutha, C. (2018). African crop production trends are insufficient to guarantee food security in the sub-Saharan region by 2050 owing to persistent poverty. *Food Security*, 10(5), 1203–1219. <https://doi.org/10.1007/s12571-018-0839-7>
- Oyo, B., Kalema, B. M., & Guma, I. P. (2018). Re-conceptualizing smallholders' food security resilience in sub-saharan Africa: A system dynamics perspective. In A. Azar, & S. Vaidyanathan (Eds.), *Advances in System Dynamics and Control* (pp. 568-586). IGI Global. <https://doi.org/10.4018/978-1-5225-4077-9.ch018>
- Pienaar, P. L. (2013). *Typology of smallholder farming in South Africa's former homelands: towards an appropriate classification system*. Ph.D. thesis, Stellenbosch University. S Stellenbosch University library archive. <http://hdl.handle.net/10019.1/85627>
- Republic of South Africa [RSA]. (2015). *General household survey 2014*. Pretoria, South Africa. Statistics South Africa. <http://www.statssa.gov.za/publications/P0318/P03182014.pdf>
- Rustad, C., & Smith, C. (2013). Nutrition knowledge and associated behavior changes in a holistic, short-term nutrition education intervention with low-income women. *Journal of Nutrition Education and Behavior*, 45(6), 490–498.
<https://doi.org/10.1016/j.jneb.2013.06.009>
- Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., Reddy, P., Parker, W., Hoosain, E., Naidoo, P., Hongoro, C., Mchiza, Z., Steyn, N.P., Dwane, N., Makoae, M., Maluleke, T., Ramlagan, S., Zungu, N., Evans, M.G., Jacobs, L., & Faber, M. (2013). *South African national health and nutrition examination survey (SANHANES-1)* [Adobe digital editions]. Cape Town: South Africa. Human sciences research council.
[http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch%20edition%20\(online%20version\).pdf](http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch%20edition%20(online%20version).pdf)
- Sibhatu, K. T., & Qaim, M. (2017). Rural food security, subsistence agriculture, and seasonality. *PLOS ONE*, 12(10), e0186406. <https://doi.org/10.1371/journal.pone.0186406>
- Statistics South Africa. (2012). *South African statistics*. Stats SA.
- Statistics South Africa. (2019). *Towards measuring the extent of food security in South Africa: an examination of hunger and food adequacy*. Stats SA.
- Tibesigwa, B., & Visser, M. (2015). Multiple and concurrent sex partnerships and social norms: Young adults' sexual relationships in the metropolitan communities of Cape Town, South Africa. *Sexuality Research & Social Policy: A Journal of the NSRC*, 12(4), 301-316.
<http://dx.doi.org/10.1007/s13178-015-0200-2>

- United Nations Children’s Fund [UNICEF]. (2013). *Improving child nutrition: the achievable imperative for global progress* [Adobe Digital Editions].
https://www.unicef.org/publications/index_68661.html
- Vorster, H. H., Badham, J. B., & Venter, C. S. (2013). An introduction to the revised food-based dietary guidelines for South Africa. *South African Journal of Clinical Nutrition*, 26(3) (Suppl): S5-S12. <http://sajcn.co.za/index.php/SAJCN/article/view/740>
- Walsh, C. M., & van Rooyen, F. C. (2015). Household food security and hunger in rural and urban communities in the Free State Province, South Africa. *Ecology of Food and Nutrition*, 54(2), 118-137. <https://doi.org/10.1080/03670244.2014.964230>
- Walton, C., VanLeeuwen, J., MacLellan, D., Talor, J., & Mbungu, S. (2017). Effect of nutrition education and dairy group membership on nutrition knowledge, practices and diet quality for rural Kenyan farm women. *African Journal of Food, Agriculture, Nutrition and Development*, 17(03), 12343–12361. <https://doi.org/10.18697/ajfand.79.15350>