The Impact of 'Women's Empowerment in Agriculture' on Household Vulnerability to Food Insecurity in the KwaZulu-Natal Province

Stanley Sharaunga[a], Maxwell Mudhara[b] & Ayalneh Bogale[c]

[a] School of Agricultural, Earth and Environmental Sciences,
Discipline of Agricultural Economics, University of KwaZulu-Natal,
Pietermaritzburg, South Africa

[b] School of Agricultural, Earth and Environmental Sciences,
University of KwaZulu-Natal, Pietermaritzburg, South Africa

[c] African Centre for Food Security, School of Earth and
Environmental Sciences, University of KwaZulu-Natal,
Pietermaritzburg, South Africa
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[a]School of Agricultural, Earth and Environmental Sciences, Discipline of Agricultural Economics, University of KwaZulu-Natal, Pietermaritzburg, South Africa; [b]School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa; [c]African Centre for Food Security, School of Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa

It is argued that empowering women in smallholder agriculture is very crucial in reducing vulnerability to food insecurity among rural households. This study contributes to this literature by adapting the vulnerability as expected poverty approach to determine which dimensions of 'women's empowerment in agriculture' reduces household's vulnerability to food insecurity based on cross-section data collected from 300 randomly selected primary female heads-of-households in Msinga rural areas of KwaZulu-Natal. It was found that empowering women in socio-cultural aspects that creates hindrances in agriculture reduces the probability of their households being vulnerable to food insecurity. Surprisingly, access to irrigation and improved water-use security did not significantly influence household vulnerability to food insecurity. However, other forms of women's empowerment including economic agency and physical capital empowerment were found to reduce the likelihood of a household being vulnerable to food insecurity. Women with high levels of financial capital empowerment invested less in other capital assets and were more vulnerable to food insecurity in the future. In addition to women's empowerment, demographic characteristics of a household influence its vulnerability status. A household's vulnerability to food insecurity reduces as the husband's income increases but increases with increased dependency ratio. It was concluded that empowerment in agriculture alone is not a panacea to reduce household vulnerability to food insecurity. Efforts should be made to improve physical assets that determine the off-farm income earning and agricultural production capacity of households.

Keywords: women's empowerment; agriculture; vulnerability to food insecurity; South Africa

1.   Introduction

An understanding of the extent to which women's empowerment interventions can reduce households' probability of being vulnerable to food insecurity could be of great value to government, non-governmental organisations and development agencies in the design of effective food security strategies. In most rural areas where subsistence agriculture is a predominant source of livelihoods, women play multiple roles throughout the processes of production, handling and preparation of food (Bob, 2002; Galie, 2013). As a result, women's empowerment has become a frequently cited goal of rural development, aimed at reducing household vulnerability to poverty and food insecurity. It is considered an essential way to provide the most vulnerable households with the means to their livelihood strategies and food security (Galie, 2013).

In South Africa, post-apartheid governments have tried to empower rural people through intervention in agriculture. Although smallholder agriculture's contribution to household incomes and food availability remains very low in South Africa, it is argued that subsistence/smallholder agriculture plays an important role in reducing rural households' vulnerability to food insecurity (Baiphethi and Jacobs, 2009; Fanadzo, 2012). While considerable attention has been given to the study of food insecurity, there are relatively few empirical studies on the effect of empowerment on vulnerability of rural households to future food insecurity. Nevertheless, empowerment of rural women aims to ensure self-reliance and reduce vulnerability to shocks in the future (Lovendal and Knowles, 2005). In recent years, there has been increasing awareness that the analysis of food insecurity should not just consider its current incidence, but also identify the individuals, households or the communities who are more at risk of suffering in the future (Scaramozzino, 2006).

There are gaps in literature on which dimensions of women's empowerment in agriculture contribute to the reduction of household vulnerability to food insecurity. Various studies have failed to incorporate the various forms of women's empowerment in models to analyse rural households' vulnerability to food security, yet women are the principal actors in ensuring rural household food security. Therefore, this paper identifies the dimensions of women's economic and agricultural empowerment that are crucial in reducing households' vulnerability to food insecurity among irrigating and non-irrigating households in the Msinga rural area in the KwaZulu-Natal province of South Africa.

2.   Concepts of women's empowerment and household vulnerability to food insecurity

Since the late 1990s, strategies for tackling global poverty have begun to emphasise the importance of empowering marginalised people to advocate for their own change (Pandya, 2008). Empowering rural women to produce more food for local consumption and local markets is believed to be the best path to reduce household vulnerability to poverty and food insecurity by increasing agricultural incomes and food availability (Baiphethi and Jacobs, 2009). This argument has been advanced because women

play key roles in the achievement of all 4 pillars of food security in rural areas, as producers of food, income earners and caretakers of household food and nutrition security (Bob, 2002; Galie, 2013). There is growing evidence that investments in women's empowerment contribute to improved broader development outcomes related to health, education, poverty reduction, reducing vulnerability to food insecurity and economic growth (Mayoux, 2006). By empowering women in agriculture, rural households can have sustainable ways of feeding themselves and get income from selling the surplus produced, thereby becoming less vulnerable to both poverty and food insecurity (ActionAid International, 2011).

2.1. *Women's empowerment*

Various authors (e.g. Kabeer, 1999; Malhotra et al., 2002; Mosedale, 2005) point out that empowerment is a multidimensional and complex process which can be interpreted differently by different people. The different dimensions of women's empowerment, which can overlap include financial, human capital, material/physical, socio-cultural, familial/interpersonal, legal, political, psychological and agricultural (Alsop et al., 2006; Kabeer, 2005; Malhotra et al., 2002; Mayoux, 2006; Mosedale, 2005). Some studies (e.g. Alsop et al., 2006) highlight that 'women's empowerment' occurs at a number of levels, covers a range of different dimensions and materialises through a variety of different processes. Other studies define empsowerment according to the different processes/domains which make up the definition of empowerment, for example, agency and achievements (Kabeer, 2001); control over resources and agency (Malhotra, et al., 2002); agency and opportunity structure (Alsop et al., 2006). The 3 different processes or domains through which women's empowerment occurs are resources, agency and outcomes (Alsop et al., 2006; Kabeer, 2005).

Despite several definitions of empowerment in literature, this study adopts the definition by Sen (1989) and the World Bank (2001) who regard it as the expansion of assets and capabilities that enable vulnerable people to participate in, negotiate with, influence, control and hold accountable institutions that affect their lives. It incorporates the multidimensional approach, the resource-agency-outcome approach (Alsop et al., 2006; Kabeer, 2005) at the individual and household levels (Alsop et al., 2006) to conceptualise women's empowerment. It uses the capabilities (i.e. resources and agency) to identify and measure women's agricultural and economic empowerment. Women's 'empowerment in agriculture' is one of the most important dimensions of empowerment for rural women as rural households are largely dependent on agriculture for their livelihoods which, in turn, is crucial for reducing household vulnerability to food insecurity (IFAD, 2011).

2.2. *Household vulnerability to food insecurity*

Food security has been defined as a situation when all people, at all times, have physical and economic access to sufficient, safe and nutritious food needed to maintain a healthy

and active life (FAO, 2009). This definition introduces a stability dimension, which points to the need for understanding both current and future statuses of household food security. Moreover, FAO (2009) has shown that access to adequate and sufficient food in many countries is unstable. Many households frequently move in and out of a state of food security, suggesting that the notion of food insecurity is best approached in a dynamic sense. Therefore, a framework for analysing food security must capture its temporal dynamics. Vulnerability analysis offers a solution to this problem by providing a quantitative estimate of the probability that a given household will lose access to sufficient food in the near future (Babatunde et al., 2008).

The main advantages of the vulnerability approach are twofold. First, it is explicitly dynamic and forward-looking as it considers both current outcomes and future incidences of food insecurity. Second, the analysis uses a stochastic framework and can therefore fully consider the uncertainties associated with future food insecurity, such as the role of external shocks and the strategies that households, communities or public institutions can adopt in order to reduce the likelihood of negative outcomes (Scaramozzino, 2006). The notion of vulnerability as a risk of shortfall can be expressed as a probability statement regarding the failure to attain a certain well-being threshold in the future (Christiaensen and Boisvert, 2002). The probability of becoming food insecure in the future is determined by the present conditions, risks potentially occurring within a defined period and the capacity to manage the risks. At the household level, the major types of risk include health (illness, disability, injuries), life cycle-related (old age, death, dowry), social (inequitable intra-household food distribution), economic risks (unemployment, harvest failure, price changes) and threats related to the natural environment (Babatunde et al., 2008). These risks cause food insecurity by lowering food production, reducing income, reducing assets holding, increasing indebtedness and reducing food consumption (Lovendal and Knowles, 2005).

2.2.1.   Methods of measuring vulnerability to food insecurity

Although several empirical methodologies of assessing vulnerability to food insecurity have been proposed in the literature, none of them has evolved into a unanimously accepted approach (Bogale, 2012). Three different methodologies are commonly used to assess vulnerability and these include vulnerability as uninsured exposure to risk (VER), vulnerability as low expected utility (VEU) and vulnerability as expected poverty (VEP) (Hoddinott and Quisumbing, 2003). All 3 methods construct a measure of welfare loss attributed to shocks, but differ in that VER and VEU measure the ex-ante probability of a household's consumption or utility falling below a given minimum level in the future due to current or past shocks, while VEP measures ex-post welfare loss due to shocks (Hoddinott and Quisumbing, 2003). Therefore, this study adopted the VEP approach to measure the ex-post probability of households becoming food insecure in the future.

According to the VEP approach, an individual's vulnerability is the prospect of that person becoming poor in the future if currently not poor, or the prospect of him/her continuing to be poor if currently poor (Christiaensen and Subbarao, 2004). Thus, vulnerability is seen as expected poverty, while consumption (income) is used as a proxy for well-being. This method estimates the probability of a given shock or set of shocks moving household consumption below a given minimum level (such as a consumption poverty line), or force the consumption level to stay below the minimum if it is already below the level (Chaudhuri et al., 2002). Even though lengthy panel data are preferred for the estimation of household vulnerability using the VER and VEU, the VEP approach can be used to assess vulnerability of households based on cross-section data where there is no panel data, as is often the case in developing countries (Günther and Harttgen, 2009).

3.   Research methodology

3.1.   *Conceptual framework*

The sustainable livelihoods framework (Figure 1) provides a comprehensive, and complex, approach to understand how people make a living. It was adapted in this study as a guide to the analysis of how the dimensions of women's empowerment in agriculture affect their households' vulnerability status. According to this framework, livelihood assets are the resources on which people draw in order to carry out their livelihood strategies (Chambers and Conway, 1992; Ellis and Allison, 2004). However, in the context of women's empowerment, this study argues that in addition to livelihood assets, people need a sense of agency to achieve their livelihood outcomes. Therefore, households use their empowerment capabilities (i.e. resources and agency), not only capital assets, to pursue activities that will enable them to achieve the best possible

Figure 1:   Sustainable livelihood framework
Source: Adapted from DFID (1999).
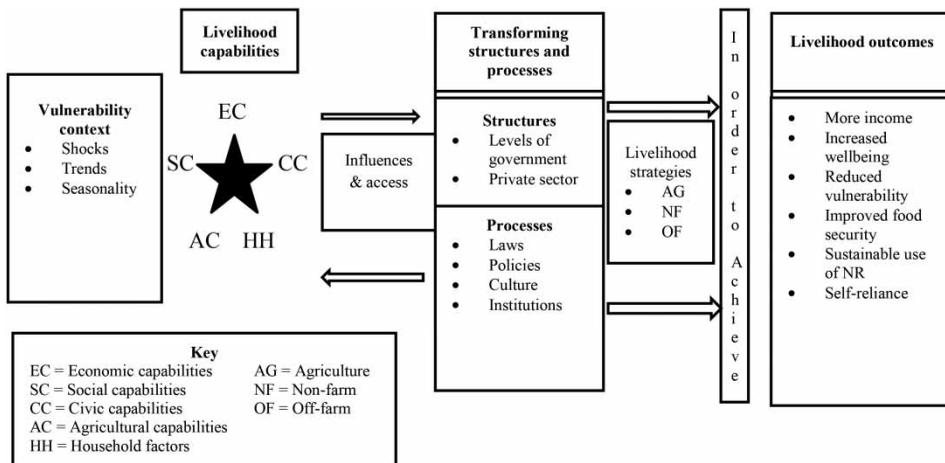
livelihood for themselves. Thus, in place of the different types of capital resources identified in the DFID's sustainable livelihood framework, this study argues that women's ability to reduce their households' vulnerability to food insecurity depends on their empowerment capabilities. Therefore, each household's vulnerability status can be expressed as a function of these capabilities, reflecting women's agricultural and economic empowerment plus other household factors. It is hypothesised, in this study, that women with higher levels of empowerment in agriculture are less vulnerable to food insecurity.

3.2.   *Identification of agricultural and economic dimensions of women's empowerment*

This study adopted the definition of empowerment proposed by Sen (1989) and the World Bank (2001) and uses women's capabilities as indicators for measuring women's agricultural and economic forms of empowerment. To identify and measure levels of women's empowerment in agriculture, the study listed all dimensions of women's empowerment in agriculture and their indicators based on the Women's Empowerment in Agriculture Index proposed by the US government's Feed the Future Initiative (IFPRI, 2012), which reflected women's capabilities (i.e. resources and agency). These included access to resources, agricultural skills training (e.g. crop management skills, animal husbandry skills, etc.), socio-cultural aspects and water-use security.

Since households' vulnerability to food insecurity is also influenced by off-farm incomes, it was hypothesised that vulnerability to food insecurity is also influenced by dimensions of women's economic empowerment. To identify and measure levels of women's economic empowerment, financial, human, physical and natural capital were listed as forms of empowerment. Indicators of women's capabilities (i.e. resources and agency), under each of these sub-dimensions of empowerment, in the context of South African rural areas were identified. These were quantified as either continuous variables or ordinal variables on a 5-point Likert scale. The lists of indicators were compiled following Uphoff (2003), Kabeer (1999; 2005), Alsop and Heinsohn (2005) and Alsop et al. (2006).

Principal component analysis (PCA) was applied to all the indicators of agricultural and economic empowerment to generate indices representing the different dimensions under the 2 main dimensions. The dominant principal components (PCs) (i.e. with Eigen values greater than 1 using the Kaiser criterion) were retained in each dimension. Following other studies (e.g. Nieuwoudt, 1977), absolute PC loadings greater than 0.50 were considered as dominating and indicated a strong association among the resources used to generate that particular PC.

3.3.   *Empirical approach to identify households' vulnerability status*

Based on the definition of vulnerability given by Chaudhuri et al. (2002), this study considers food insecurity as the state of a household consuming less than the required

threshold and uses food insecurity as a measure of welfare. Accordingly, this approach is divided into 3 basic steps, that is, identifying the welfare indicator; identifying the vulnerability threshold and measuring vulnerability.

Chaudhuri et al. (2002) uses consumption measures as a welfare indicator, arguing that it provides a more adequate picture of wellbeing, especially in low- or medium-income countries. Consumption measures also have the advantage that they are accurately measured. However, rather than using mere consumption expenditure as in Chaudhuri et al. (2002) and Bogale (2012), this study improves the measure by using the household's consumption expenditure per adult equivalent (i.e. from both own production and purchases) as a measure of welfare. This approach was motivated by the fact that households in the 3 study communities depended on their own production and market purchases for household food consumption requirements.

The studied smallholder farmers in Msinga commonly produce a range of crops including green maize and maize grain, potatoes, cabbages, tomatoes, onions, beans, butternut, green pepper and spinach for consumption and for selling. The annual yields (i.e. both winter and summer), prices per kilogram, quantity sold and quantity consumed for each of these crops were obtained through the survey. The total value of own livestock products consumed annually was also estimated in the survey. The questionnaire also established the total annual expenditure on food for each household through market purchases. The total annual household consumption expenditure was calculated by adding the annul value of crops consumed, the total value of livestock produce consumed and the total consumption expenditure on food obtained from the market. The total number of persons and their age groups were also obtained from the survey. These were used to calculate the annual consumption expenditure per adult equivalent for each household.

A household with high annual consumption expenditure per adult equivalent is generally more likely to meet its consumption needs and be food secure. The daily energy requirement, as recommended by the South African Medical Research Council, is 2261 kilocalories per adult person. Using the 2000 Income and Expenditure Survey data, Statistics South Africa has estimated that when consuming the kinds of foodstuff commonly available to low-income South Africans, the basket of food costs R211 per person every month (in 2000 prices) to satisfy a daily energy requirement of 2261 kilocalories. In other words, R211 is the amount necessary to purchase enough food to meet the basic daily food-energy requirements for the average person over 1 month (Stats, 2007). Using the Consumer Price Index to adjust for inflation, the annual consumption expenditure per adult equivalent to meet the recommended 2261 kilocalories translated to R R2532.00.

The approach developed by Chaudhuri et al. (2002) adopted in this study identifies the vulnerability level at a given time as the probability that a household will find itself poor at the next time period, and estimates this probability. The choice of the vulnerability threshold involves generating a sample that is classified into 2 groups, that is those that are vulnerable and those that are not vulnerable to food insecurity. It entails establishing a vulnerability threshold v, such that a household is said to be vulnerable

if its vulnerability probability is greater or equal to v, that is, $v_h \geq v$. According to Chaudhuri et al. (2002), the choice of the vulnerability threshold is quite arbitrary. A common choice in literature is a threshold vulnerability probability of .5. Thus, a household was considered vulnerable to food insecurity if the probability was equal to or greater than .5 and less vulnerable to food insecurity if the probability was less than .5.

Following Chaudhuri et al. (2002), the vulnerability level of a household h in year t is defined as the probability that the household will find itself consumption poor, that is the annual per capita value of food consumed will not be adequate to meet the recommended 2261 kilocalories per person in year $t + 1$. Therefore, the probability that a household will be food insecure in the future can be expressed as

$$V_{ht} = \Pr(C_{h,t+1} \leq Z) = \int_{-\infty}^{Z} f(C_{h,t+1}) \partial C, \tag{1}$$

where V_{ht} is the vulnerability of household h to be food insecure in year t; $C_{h,t+1}$ is the food consumption expenditure per adult equivalent for a household h in year $t + 1$ and Z is the value of food appropriate to meet the recommended minimum daily calorie requirement of 2261 kilocalories per adult equivalent (i.e. food security threshold).

To assess a household's vulnerability to food insecurity, there is need to make inferences about its future consumption levels. In order to do that, a framework for thinking explicitly about both the inter-temporal aspects and cross-sectional determinants of food availability at the household level is needed (Chaudhuri et al., 2002). The food security status (i.e. annual food consumption expenditure per adult equivalent) is dependent on the household's own production level and food purchases from farm and off-farm incomes. Consumption from own food production, agricultural and non-agricultural incomes is influenced by a number of household socio-economic factors including women's empowerment in agriculture and women's economic empowerment. This suggests the following reduced form expression for per capita annual value of food consumption expenditure:

$$C_{ht} = C(X_h), \tag{2}$$

where X_h represent a bundle of observable household characteristics including household size, age of the women, husband's income and employment status, woman's marital status, dimensions of women's economic empowerment and, most importantly, dimensions of women's empowerment in agriculture, among other factors. Substituting Equation (2) into Equation (1) the expression for vulnerability level is rewritten as

$$V_{ht} = \Pr(C(X_h) \leq Z | X_h), \tag{3}$$

The expression in Equation (3) suggests that a household's vulnerability level is derived from the household observable characteristics and this is compared to the

household consumption expenditure per adult equivalent adequate for meeting the recommended consumption requirements (Z) (Chaudhuri et al., 2002). Following Chaudhuri et al. (2002), Gaiha and Imai (2008) and Günther and Harttgen (2009) who derived empirically a variant of VEP from the food consumption expenditure function, we specify Equation (3) as

$$\ln C_h = X_h \beta + \varepsilon_h, \tag{4}$$

where

- C_h is consumption expenditure per adult equivalent for the household,
- X_h represents a bundle of observable household characteristics, including capital forms of women's empowerment and other risk management instruments,
- β is a vector of parameters to be estimated, and
- ϵ_h is a mean-zero disturbance term that captures idiosyncratic factors (shocks) that contribute to different per-capita values of food consumption in different households that are otherwise observationally equivalent.

The consumption expenditure per adult equivalent for the household (C_h) is assumed to be log-normally distributed and as such the disturbance term, ϵ_h will be normally distributed. Furthermore, it is assumed that ϵ_h captures the idiosyncratic shocks that contribute to the difference in food consumption expenditure levels for households that share the same characteristics. However, it is unlikely that it captures covariate shocks which can affect all households at a given time and unexpected very large negative shocks such as economic crises. Furthermore, it is assumed that the variance of the unexplained part of per adult equivalent value of food consumed ϵ_h depends on household h's observable characteristics:

$$\hat{\varepsilon}^2_{\text{OLS,h}} = X_h \theta + \eta_h, \tag{5}$$

where θ represents a vector of parameters to be estimated, η_h is the vector of residuals of this second estimation. Standard regression analysis based on ordinary least squares (OLS) assumes homoscedasticity, and estimates of β and θ will be unbiased but inefficient if this assumption does not hold. To deal with this problem and obtain consistent estimate of parameters, it is necessary to allow heteroskedasticity, that is, variances of the disturbance term across households depending on X_h. Thus, the estimates of β and θ could be obtained using 3-step feasible generalised least squares (FGLS) (Bogale, 2012; Chaudhuri et al., 2002; Christiaensen and Subbarao, 2004). In the FGLS, Equation (4) is estimated using an OLS procedure. Then the estimated residuals from Equation (4) are used as a dependent variable to estimate equation 5. The predictions from Equation (5) are used to

transform equation 5 as follows;

$$\frac{\hat{\varepsilon}_{hOLS}^2}{X_h\hat{\theta}_{OLS}} = \left[\frac{X_h}{X_h\hat{\theta}_{OLS}}\right]\theta + \frac{\eta_h}{X_h\hat{\theta}_{OLS}}. \qquad (6)$$

This transformed equation is estimated using OLS to obtain an asymptotically efficient FGLS estimate, $\hat{\theta}_{FGLS}$. Note that $X_h\hat{\theta}_{FGLS}$ is a consistent estimate of $\hat{\varepsilon}_{OLS,h}^2$, the variance of the idiosyncratic component of the household's food consumption expenditure per adult equivalent. The estimates

$$\hat{\sigma}_{\varepsilon,h}^2 = \sqrt{X_h\hat{\theta}_{FGLS}} \qquad (7)$$

are then used to transform Equation (4) as follows:

$$\frac{\ln C_h}{\hat{\sigma}_{\varepsilon,h}^2} = \left[\frac{X_h}{\hat{\sigma}_{\varepsilon,h}^2}\right]\beta + \frac{\varepsilon_h}{\hat{\sigma}_{\varepsilon,h}^2}. \qquad (8)$$

OLS estimates of Equation (8) yield consistent and asymptotically efficient estimates of β. Using the estimated coefficients (i.e. $\hat{\beta}$ and $\hat{\theta}$), the expected log household's food consumption expenditure per adult equivalent is measured as;

$$\hat{E}\{\ln C_h|X_h\} = X_h\hat{\beta} \qquad (9)$$

and the variance of log per capita value of food consumed

$$\hat{V}\{\ln C_h|X_h\} = \hat{\sigma}_{\varepsilon,h} = X_h\hat{\theta} \qquad (10)$$

for each household. Following Gaiha and Imai (2008) and Günther and Harttgen (2009) and assuming that per adult equivalent food consumption is log-normally distributed, and using the estimated parameters of the model, the probability that a household will be food insecure in the near future (say, at time $t + 1$) is expressed as

$$\hat{V}_h = \hat{Pr}\{\ln C_h < \ln Z|X_h\} = \Phi\left[\frac{\ln Z - X_h\hat{\beta}}{\sqrt{X_h\hat{\sigma}}}\right], \qquad (11)$$

where $\Phi(.)$ is the cumulative density of the standard normal distribution function, $\hat{\sigma}$ is the standard error of the regression; Z is the prescribed threshold per adult equivalent value of food consumed to meet the minimum energy requirement (i.e. food poverty line). $\hat{V}_h$ is a set of estimates one for each household and denotes the probability of falling below the minimum threshold in the future that each household

faces. The value of $\hat{V}_h$ lies between 0 and 1. When $\hat{V}_h = 0$ a household's per capita value of food consumed will be adequate to meet the minimum amount of calories required, and when $\hat{V}_h = 1$ the value of food consumed will be lower than the prescribed threshold.

3.4. *Modelling households' vulnerability to food insecurity*

Various models including the 2-stage least squares regression analysis (Kakota et al., 2013) and the binomial logit model (BNL) (Bazezew and Bewket, 2013; Bogale, 2012) have been used for determining factors influencing households' vulnerability to food insecurity. This study used the BNL since household vulnerability status was a binary variable which takes a value of 1 for vulnerable households and 0 for non-vulnerable households. The cumulative logistic probability model was specified by Pindyck and Rubinfeld (1981) as

$$P_i = F(Z_i) = \frac{1}{1 + e^{-(\alpha + \sum^{\beta_i X_i})}}, \tag{12}$$

where P_i is the probability that a household is vulnerable to being food insecure given X_i (the explanatory variables including dimensions of empowerment); α and β_i are parameters to be estimated. For ease of exposition, the probability that a given household is vulnerable to food insecurity is expressed as

$$P_i = \frac{1}{1 + e^{-(Z_i)}}. \tag{13}$$

And the probability that a given household is not vulnerable to food insecure is $1 - P_i$:

$$(1 - P_i) = \frac{1}{1 + e^{Z_i}}. \tag{14}$$

And thus,

$$\left(\frac{P_i}{1 - P_i}\right) = \frac{1 + e^{(Z_i)}}{1 + e^{-(Z_i)}} \tag{15}$$

is the ratio of the probability that a household is vulnerable to food insecurity to the probability of that it is not vulnerable. The log odds of the probability that a household is vulnerable to being food secure in the future is given by:

$$\text{Log}\left(\frac{P_i}{1 - P_i}\right) = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_k X_k. \tag{16}$$

If the disturbance term u_i is taken into account the logit model becomes

$$Z_i = \alpha + \sum_{i=1}^{k} \beta_i X_i + u_i. \qquad (17)$$

3.5. *Variable definition and hypothesis*

Descriptions of the variables hypothesised to influence vulnerability of households to food insecurity and included in the empirical model are given in Table 1. These variables include economic and agricultural forms of women's empowerment in addition to other household socio-economic characteristics. A household's socio-economic characteristics that influence food security include gender of the household head, family size, dependency ratio and age of the head of the household. Since age captures the experience accumulated in farming, it may, therefore, be associated with better opportunities to acquire food (Albert and Collado, 2004). Men have a better opportunity to access assets and, therefore, married women's households are expected to be less susceptible to food insecurity (Bigsten et al., 2002; Bogale et al., 2005). It is also hypothesised that households with a higher dependency ratio have a greater probability of being food insecure (Bogale, 2012).

Since women in rural areas are largely dependent on agriculture for their livelihoods (IFAD, 2011), households' vulnerability to food insecurity is greatly influenced by their levels of empowerment in agriculture. The dimensions of women's empowerment in agriculture include their access to agricultural equipment and machinery, agricultural skills (i.e. crop management skills, animal husbandry skills, etc.), levels of water-use security and empowerment in socio-cultural aspects that affect agricultural production. All these dimensions of women's empowerment influence sustainable agricultural productivity and reduce vulnerability to food security (Quisumbing and Meinzen-Dick, 2001).

Women's access of and control over physical/material assets were hypothesised to be negatively associated with the likelihood of a household becoming vulnerable to food insecurity because such assets are crucial for the pursuit of sustainable farm and off-farm livelihood strategies. These assets include ownership and control over land, livestock and machinery as well as the goods and services produced from them (Uphoff, 2003). In addition, the assets include women's basic needs for housing, food and services required to build a livelihood (e.g. electrification, access to roads, transportation, potable water and various technologies). These assets reduce the likelihood of a household being vulnerable to food insecurity by ensuring economic production and providing security against difficult times (Quisumbing and Meinzen-Dick, 2001). Likewise, more financially empowered women have the capacity to invest in agricultural productivity, which in turn increases food availability. Some studies have also shown that improvement in household welfare depends not only on the level of household income, but also on who earns that income. Such studies found that women, relative

Variable	Description
Dependent variable	
Log (per adult equivalent value of food available)	Natural log of households' food consumption expenditure per adult equivalent
Explanatory variables	
AGE	Continuous variable for primary female head-of-household
EMPLOMENT_STAT	Dichotomous; 1 if woman is employed and 0 otherwise
MARITAL_STAT	Dichotomous; 1 if woman is married and 0 otherwise
HUSB_INCOME	The total amount of annual income obtained by the husband
DEP_RATIO	The ratio of dependents (i.e. children under 12, elderly above 65 and those with disabilities or chronic illness) to able-bodied working members of the family
CROP_MX_SKILLS	PCA index representing women's empowerment in crop management skills
FARM_FINAN_SKILLS	PCA index representing women's empowerment in farm financial skills
WATER_USE_SEC	PCA index representing the water use security level
SOCIO_CULT_EMP	PCA index representing women's empowerment in socio-cultural aspects hindering agriculture
ANIMAL_HUS_SKILLS	PCA index representing women's level of animal husbandry skills empowerment
WEED_PEST_MX_SKIL	PCA index representing women's empowerment in weed and pest management skills
ECONOMIC_AGENCY	PCA index representing women's level of economic agency
FINANCIAL_CAP_EMP	PCA index representing women's level of financial capital empowerment
HUMAN_CAP_EMP	PCA index representing women's level of human capital empowerment
VOCATION_SKIL_EMP	PCA index representing women's level of vocational skills empowerment
PHYSICAL_CAP_EMP	PCA index representing women's level of physical capital empowerment
D_1	Area dummy: 1 if household is from Tugela Ferry and 0 otherwise
D_3	Area dummy: 1 if household is from Mooi River and 0 otherwise

Table 1: Description of variables used for estimating household vulnerability to food insecurity.

to men, tend to spend disproportionately more of their income on food for the family. Thus, women's financial empowerment was expected to be strongly associated with improvements in household food security in the future (Quisumbing et al., 1995).

Women are the principal actors in ensuring household food security in rural households, such that their human capital empowerment is a key determinant of households'

vulnerability to food insecurity. The human capital dimension refers to women's skills, knowledge, capability for labour, good health and physical capability, important for the successful pursuit of different livelihood strategies (Carney, 1998). Women's human capital also determines how employable a woman may be, in terms of her skills, knowledge, education and leadership (Lanjouw, 2001). Similarly, human capital in terms of agricultural training and good health is crucial for sustainable agricultural productivity (Corral and Reardon, 2001).

3.6.   *Methods of data collection*

3.6.1.   Study area

Since access to irrigation is one of the essential opportunities to increased food production and a critical factor for sustainable agriculture and achieving self-reliance among rural women, the availability of an irrigation scheme with a neighbouring rain-fed area was the main criterion for selection of the study sites. This was to allow comparisons between women farming in rain-fed agriculture and those using irrigation with regards to household vulnerability to food insecurity. Thus, women practising irrigation were sampled from Tugela Ferry and Mooi River Irrigation Schemes, while those practising dry-land agriculture were taken from the Machunwini communal area, which lies between the 2 irrigation schemes. The 3 study areas all lie under the Msinga Municipality of Umzinyathi District in KwaZulu-Natal.

3.6.2.   Sampling procedures for survey

This study considers a household as having 2 heads (i.e. a primary female and a primary male head-of-household) who head the household in pursuing different livelihood activities. Only women who were the primary female heads-of-households were selected for this study. Households in the 3 study sites were stratified into 3 main groups, namely gravity-fed irrigators, pump-fed irrigators and dry-land farmers (Table 2). The gravity-fed and pump-fed irrigators/farmers were obtained from Tugela and Mooi River Irrigation Schemes. However, gravity-fed irrigators/farmers

Irrigation method	Total number of households in each scheme			Number of respondents sampled in each scheme			
	Tugela Ferry	Mooi river	Machunwini	Tugela Ferry	Mooi river	Machunwini	Total
Gravity-fed	0	473	0	0	100	0	100
Pump-fed	270	403	0	40	60	0	100
Dry-land	0	0	1234	0	0	100	100
Total							300

Table 2:   Distribution of sampled women farmers in each study area by irrigation type.

in Tugela Ferry were not included in the study because the irrigation scheme was under-going a major revitalisation at the time of the survey. Moreover, these farmers had not been producing food crops for almost a year, which made it difficult to assess the impact of the irrigation scheme on households' livelihood outcomes. Dry-land farmers were sampled from the Machunwini area. The proportional random sampling method was used to select the primary female heads-of-households used for the study to equally represent the 3 categories by which farmers access water for agricultural pur-poses (i.e. gravity-fed, pump-fed and dry-land farmers).

4.   Results

4.1.   *Socio-demographic characteristics of women's households*

Table 4 summarises the socio-demographic characteristics of households according to their household vulnerability to food insecurity status. Households that were vulnerable to food insecurity had larger household sizes and higher dependency ratios. The majority of women (93.5%) and their husbands (75.0%) among the vulnerable households were not employed. A large proportion of them (69.9%) and their husbands (50.0%) had no formal education. On the other hand, households that were not vulnerable to food insecur-ity had the largest proportion of women who were married. They also had the largest pro-portion of women and husbands with tertiary education and more husbands with formal employment than the vulnerable group. None of the households with a husband with ter-tiary education or formal employment was vulnerable to food insecurity. However, a few women with tertiary education were vulnerable to food insecurity. In addition, the largest proportion of food-insecure households were in Tugela Ferry while the largest proportion of food-secure households were in the Mooi River Scheme (Table 3).

4.2.   *Dominant dimensions of agricultural and economic empowerment among rural women in Msinga*

Analysis of the level of resources and agency among the sampled primary female heads-of-households, through PCA, generated a number of dimensions of women's empowerment in each of the 4 main dimensions of empowerment. The results of this analysis were reported by Sharaunga et al. (2014). According to Sharaunga et al. (2014), application of PCA to indicators of women's empowerment in agriculture pro-duced 12 PCs that had Eigen values greater than 1 using the Kaiser criterion and jointly explained 73.4% of the total variation in the variables used. From these 12 PCs, the first 6 PCs were retained because they allowed for meaningful interpretation of the PCs. The different factors represented the different dimensions of empowerment in agriculture among women in Msinga which included empowerment in crop management skills, farm financial management skills, water-use security, animal husbandry skills and weed and pest management skills (Table 4) (Sharaunga et al., 2014).

Characteristic	Household vulnerability status	
	Non-vulnerable ($N = 53$)	Vulnerable ($N = 93$)
Average age of women	50.8	51.8
Household size	7.0	7.6
Mean dependency ratio	0.7	1.4
Marital status (%)		
Married	45.3	35.5
Single	11.3	28.0
Widowed	39.6	33.3
Separated/divorced	3.8	3.2
Employment status (%)		
Unemployed	84.9	93.5
Informal employment	15.1	5.4
Formal employment	1.0	0.0
Husbands' employment status (%)		
Unemployed	40.0	75.0
Informal employment	40.0	25.0
Formal employment	20.0	0.0
Women's level of education (%)		
No formal education	56.6	69.9
Primary education	22.6	14.0
Secondary education	18.9	15.1
Tertiary education	1.9	1.1
Husbands' level of education (%)		
No formal education	29.2	50.0
Primary education	25.0	15.6
Secondary education	37.5	34.4
Tertiary education	8.3	0.0
Area (%)		
Mooi River	52.8	49.5
Tugela Ferry	9.4	65.6
Machunwini	37.7	34.4

Table 3:   Salient socio-demographic characteristics of sample women's households.

Application of PCA to indicators of women's economic empowerment produced 12 PCs that had Eigen values greater than 1 using the Kaiser criterion and jointly explained 65.0% of the total variation in the variables used. From these 12 PCs, the first 5 PCs were retained because they also allowed for meaningful interpretation of the PCs. These first 5 PCs represented economic agency, human capital empowerment, financial capital empowerment, empowerment in vocational skills and physical capital empowerment as the dominant dimensions of women's economic empowerment in the study areas of Msinga (Table 5) (Sharaunga et al., 2014).

	PCs (Eigen value)					
Indicators of empowerment in agriculture	Crop management skills	Farm financial management	Water use security	Socio-cultural inhibition	Animal husbandry skills	Weed and pest management skills
Decisions on crop production	0.051	−0.097	0.018	0.054	−0.029	0.498
Freedom on what to produce	0.065	−0.091	0.017	0.056	−0.061	0.491
Access and control of land	0.156	−0.075	0.010	0.014	−0.104	0.143
Decisions on credit	0.118	−0.077	−0.134	0.102	0.126	0.073
Control of income	−0.082	0.137	−0.104	0.165	0.027	0.297
Confidence to speak	−0.012	0.433	0.039	0.388	0.162	0.334
Satisfaction with leisure time	0.182	−0.003	−0.018	**0.721**	−0.053	0.147
Domestic workload	0.185	−0.173	0.109	**0.758**	0.058	−0.048
Hindrance by customary law	0.038	−0.106	0.093	**0.838**	0.029	0.087
Satisfaction with institution	−0.157	−0.040	0.012	**0.845**	−0.104	0.088
Satisfaction with water consistency	−0.007	0.135	**1.021**	0.136	0.012	−0.130
Satisfaction with water sufficiency	−0.007	0.176	**0.878**	0.185	−0.034	−0.079
Satisfaction with water quality	−0.076	−0.034	**1.075**	0.047	−0.011	0.131
Satisfaction with capacity to pay	−0.122	−0.343	**0.859**	−0.031	0.103	−0.024
Satisfaction with claim to water	0.029	0.208	**1.062**	−0.325	−0.064	0.556
Determining seed depth	**0.773**	0.130	−0.043	0.017	0.024	0.011
Select appropriate planting method	**0.818**	0.111	−0.006	0.091	0.004	−0.026
Determining spacing	**0.771**	0.029	−0.033	0.024	0.006	0.032
Water conservation methods	**0.839**	0.072	−0.049	0.121	0.122	0.292
Fertiliser application	**0.586**	0.064	0.086	0.099	0.027	0.267
Determining nutrient deficiency	**0.599**	0.179	0.004	−0.010	0.103	0.290
Herbicide/pesticide application	**0.816**	0.121	0.065	0.220	0.050	**0.936**
Use of snapsack	**0.735**	0.227	0.111	0.227	0.007	**0.921**
Harvesting methods	0.374	0.107	0.383	0.068	−0.019	0.159
Packaging produce	0.483	0.363	0.047	−0.258	−0.086	−0.156
Storage of produce	**0.525**	0.397	0.097	−0.219	−0.043	−0.293
Record keeping	0.255	0.470	0.136	−0.067	0.167	−0.011

(*Continued*)

Table 4:   (*Continued*).

Indicators of empowerment in agriculture	PCs (Eigen value)					
	Crop management skills	Farm financial management	Water use security	Socio-cultural inhibition	Animal husbandry skills	Weed and pest management skills
Financial management	0.159	**0.638**	0.058	−0.050	0.137	−0.068
Knowledge of marketing contracts	0.135	**0.681**	0.031	0.015	0.047	−0.008
Price determination	0.006	**1.022**	−0.075	−0.135	0.039	−0.088
Knowledge of product market	0.016	**0.880**	0.112	−0.138	0.027	0.060
Knowledge of animal health	0.253	−0.100	−0.153	0.016	**1.030**	−0.026
Animal nutrition	0.118	0.063	−0.048	−0.022	**1.060**	−0.071
Welfare requirements	−0.055	0.191	−0.010	0.031	**0.912**	−0.007
Meat processing skills	−0.022	0.136	0.062	−0.035	0.265	0.005
% of variation	18.1	12.2	8.8	7.8	6.6	5.9
Cumulative %	18.1	30.3	39.2	47.0	53.6	59.4

Table 4:   Dimensions of 'empowerment in agriculture' among primary female heads-of-households in Msinga.

Note: PC loadings greater than 0.5 are indicated in bold.
Source: Extracted with permission from Sharaunga et al. (2014).

4.3.   *BNL to estimate households' vulnerability to food insecurity*

Table 6 presents the BNL empirical results generated to identify the dimensions of women's empowerment influencing their households' vulnerability to food insecurity in Msinga. The highly significant likelihood ratio chi-square value suggests that the model was well-fitting. The high overall percentage classification accuracy of 96.6% indicates that the model correctly classified households in the 2 categories (i.e. vulnerable and not vulnerable). The degree of multicollinearity among the variables used in the BNLs was minimal (i.e. mean variance inflation factor (VIF) less than 10), confirming that there was no strong correlation among the independent variables. The estimated standard errors for the estimated parameter estimates were all below 2, indicating that micronumerosity (small sample size) was not a problem (Pedhazur, 1997) cited by Garson, 2009). The akaike information criterion (AIC) and bayesian information criterion (BIC) values were the smallest, indicating that the model was the best-fitting one.

4.4.   *Dimensions of women's empowerment influencing households' vulnerability to food insecurity*

Among the dimensions that reflect women's empowerment in agriculture, only the coefficient estimate for socio-cultural hindrances was negative and statistically significant (SOCIO_CULT_EMP). This implies that primary female heads-of households

Indicators of economic empowerment	PCs (Eigen value)				
	Economic agency	Human capital	Financial capital	Vocational skills	Physical assets
Land under women's control	0.018	0.030	0.091	−0.037	−0.005
Tropical livestock units	0.056	0.069	0.017	−0.100	−0.022
Value of machinery women control	0.078	0.370	0.327	0.290	−0.078
Road access	−0.030	−0.112	−0.081	−0.101	0.364
Communication infrastructure	0.118	0.113	0.127	−0.045	**0.738**
Electricity reliability	0.065	0.073	−0.045	0.065	0.096
Reliability of domestic water supply	−0.094	−0.123	−0.098	0.198	**0.594**
Education level	0.071	**0.597**	0.207	−0.077	0.092
Numeracy level	0.246	**0.782**	−0.035	0.126	0.007
Health status	0.152	0.275	0.038	−0.407	0.461
Employment status	0.038	0.187	−0.095	−0.073	−0.101
Literacy level	0.178	**0.826**	−0.041	−0.132	−0.001
Crop production skills	0.224	0.218	0.032	0.073	0.046
Animal production skills	0.013	−0.032	−0.066	−0.016	−0.026
Business management skills	0.141	0.213	0.183	0.044	0.275
Craftwork skills	0.156	0.094	−0.123	**0.752**	−0.017
Construction skills	0.072	−0.034	0.014	**0.627**	0.105
Saloon skills	−0.095	0.166	0.127	0.241	−0.100
Sewing skills	−0.093	−0.028	0.015	−0.105	−0.033
Cooking skills	0.250	0.324	0.053	**−0.513**	−0.076
Total credit value	−0.024	−0.006	0.027	0.186	0.307
Farm income	0.057	0.019	**0.972**	−0.063	0.028
Non-farm income	0.057	0.019	**0.972**	−0.063	0.028
Old-age-grant income	−0.051	0.002	−0.147	0.227	−0.059
Child-grant income	−0.049	−0.006	−0.032	0.060	0.037
Disability-grant income	−0.145	−0.063	−0.002	−0.068	0.041
Power to aspire 'in economic arena'	**0.601**	0.099	0.038	−0.074	0.178
Bargain power ''	**0.668**	−0.067	0.056	−0.087	0.103
Manipulation power ''	**0.656**	0.383	0.069	−0.057	0.204
Subversion power ''	**0.771**	0.021	−0.010	0.070	−0.025
Resist power ''	**0.686**	−0.144	−0.068	0.136	−0.189
Reflect power ''	**0.707**	0.168	0.086	0.126	−0.383
Analysis power ''	**0.625**	0.227	0.021	−0.111	−0.214
Level of motivation ''	**0.736**	0.080	−0.003	0.037	0.101

(*Continued*)

Table 5:   (*Continued*).

Indicators of economic empowerment	PCs (Eigen value)				
	Economic agency	Human capital	Financial capital	Vocational skills	Physical assets
Level of determination ''	**0.649**	0.222	0.026	0.053	0.145
Level of resilience ''	**0.663**	0.156	0.076	-0.014	0.028
% of variation	16.2	7.4	5.8	5.4	5.2
Cumulative %	16.2	23.6	29.4	34.8	40.0

Table 5:   Dominant dimensions of economic empowerment among women in Msinga.

Note: PC loadings greater than 0.5 are indicated in bold.
Source: Extracted with permission from Sharaunga et al. (2014).

Variable	Coeff.	Stand. Error	$P > z$	Marginal effects (dy/dx)
AGE	-0.04	0.04	0.32	$-1.4E-03$
EMPLOYMENT_STAT	-0.52	1.94	0.79	-0.02
MARITAL_STAT	1.83	1.66	0.27	0.06
HUSB_INCOME	**$-2E-04$**[**]	$9E-05$	0.02	**$-7.1E-6$**[***]
DEP_RATIO	**2.12**[**]	1.05	0.04	**0.07**[**]
CROP_MX_SKILLS	-1.43	0.92	0.12	**-0.05**[*]
FARM_FINAN_SKILLS	-1.34	1.36	0.32	-0.04
WATER_USE_SEC	-0.17	0.71	0.81	-0.01
SOCIO_CULT_EMP	**-3.01**[**]	1.32	0.02	**-0.10**[***]
ANIMAL_HUS_SKILLS	-1.27	0.89	0.15	-0.04
WEED_PEST_SKILLS	0.45	0.87	0.61	0.01
ECONOMIC_AGENCY	**-5.4**[**]	2.16	0.01	**-0.17**[***]
HUMAN_CAP_EMP	-1.09	0.86	0.21	-0.04
FINANCIAL_CAP_EMP	**5.63**[*]	3.28	0.09	**0.18**[*]
VOCATION_SKIL_EMP	1.07	0.87	0.22	0.03
PHYSICAL_CAP_EMP	**-2.39**[**]	0.96	0.01	**-0.08**[***]
D_1	-3.23	2.08	0.12	-0.10
D_3	0.05	2.26	0.98	$1.6E-03$
_cons	4.97	2.9	0.09	$-1.4E-03$
Number of obs $= 146$		Pearson $\chi^2 = 78.26$		
LR χ^2 (18) $= 160.14$		Sensitivity $= 97.85\%$		
Prob$> \chi^2 = 0.00$		Specificity $= 94.34\%$		
Pseudo $R^2 = 0.8371$		Percent correctly predicted (Count R^2) $= 96.58\%$		
AIC $= 70.92$		BIC $= 130.59$		

Table 6:   BNL results of the factors influencing household vulnerability status ($n = 300$).

Note: PC loadings greater than 0.5 are indicated in bold.
[*]Significant at less than the 10% probability level.
[**]Significant at less than the 5% probability level.
[***]Significant at less than the 1% probability level.

who were empowered in their socio-cultural aspects that create hindrances to agriculture were less likely to be vulnerable to food insecurity. The marginal effects for women's socio-cultural empowerment indicate that a unit increase in women's socio-cultural empowerment decreases the probability of a household being vulnerable to food insecurity by 10%.

As far as economic dimensions of empowerment are concerned, women with higher levels of economic agency (ECONOMIC_AGENCY) and physical capital empowerment (PHYSICAL_CAP_EMP) are less likely to be vulnerable to food insecurity. However, women with higher levels of financial capital empowerment (FINANCIAL_-CAP_EMP) were more vulnerable to being food insecure. The marginal effects indicate that a unit increase in women's economic agency and physical capital empowerment decreases the probability of a household being vulnerable to food insecurity by 17% and 8%, respectively.

The negative and statistically significant coefficient for husband's income (HUSB_INCOME) shows that higher levels of husband's income reduce the likelihood of a household becoming vulnerable to food insecurity in the future. The positive and statistically significant coefficient estimate for dependency ratio (DEP_RATIO) indicates that households with a larger dependency ratio were more likely to be vulnerable to food insecurity. None of the coefficients of the marginal effects were statistically significant. The estimates of marginal effects, computed at sample means, show that a unit change in the husband's income reduces the likelihood of a household becoming vulnerable to food insecurity by 0.0006% while a unit increase in the dependency ratio increases the likelihood of a household being vulnerable to food insecurity by 7%.

5. Discussions

Women empowered more in socio-cultural aspects were less likely to be vulnerable to food insecurity because they experienced less inhibitions imposed by socio-cultural rules and norms. Socio-cultural inhibitions (e.g. customary laws) are among the barriers that render women vulnerable to food insecurity (Bob, 2002; Galie, 2013; Quisumbing et al., 1995). For example, although most women in the studied areas had their crops destroyed by livestock, which are managed by men, they were prohibited by customary laws to argue with male livestock owners or take them to court, in the event of crop damage. Thus, although the legal system was in place to ensure security of women's livelihood, women who observed the deep Zulu customs and traditions (i.e. *Binga*'s) were less empowered by the socio-cultural laws and were vulnerable to food insecurity unlike those who did not follow the 'deep' traditions of the Zulu culture (i.e. *Amakholwa*).

Women who are also disempowered in socio-cultural aspects are more likely to be vulnerable to food insecurity because they are disadvantaged by both statutory and customary tenure systems, resulting in weak property and contractual rights to land, water and other natural resources. Even if civil law gives women the right to own property

(e.g. inherit land) local customs may rule otherwise (Bob, 2002). Customs or traditions also contribute to vulnerability to food insecurity among women since some women are subjected to the customary assumption that only men can own property (SAHO, 2012). Whilst South African law ratifies that women should be given equal access to important natural resources, especially land, this is not always socially practised and may be blocked through broader social discourses, structures and processes, which tend to be in favour of patriarchal organisation. The study communities in Msinga are well known for being adamantly traditionalist, and widely acknowledged as staunch preservers of 'the old Zulu ways' (Fowler, 2011, p. 177). Curran and Bonthuys (2004) argue that while there are statutes that seek to empower women married according to customary law, 'living' customary law continues to oppress them. Customary law treats women as minors under the guardianship of a male figure who retains control of all assets (Curran and Bonthuys, 2004). As a result, women less empowered in socio-cultural aspects are more likely to be food insecure because they have less access to and control over assets.

Women with high levels of economic agency are less likely to be vulnerable to food insecurity because they have the 'inner drive' to act independently and to make their own free choices and utilise economic resources to achieve food security in the future (Kabeer, 1999). According to Kabeer (2005), individuals require the resources and their agency to develop the capacity needed to achieve their desired outcomes on a sustained basis. Thus, as long as women continue to have a high sense of agency, they are less likely to be vulnerable to food insecurity. High levels of own aspirations, bargaining, negotiating and analytical power, which constitute the agency among women, influence their motivation to control and utilise resources and achieve food security in the future. Although Sen's (1989) influential entitlement approach links vulnerability to inadequate access to assets, including intangible ones, such as social capital, the findings of this study suggest that in addition to their entitlements, women/individuals need a higher sense of agency to recover from shocks threatening household food security in the future. As far as the marginal effects are concerned, it can be noted that women's economic agency has the largest marginal effects, implying that the largest reduction in the probability of a household becoming vulnerable to food insecurity is achieved by increasing women's level of agency than any other forms of empowerment. This supports arguments from other authors (e.g. Alsop et al., 2006; Kabeer, 2001; Malhotra et al., 2002) who have noted that access to assets alone (i.e. resource forms of empowerment) offers no guarantee that they will be used in an effective fashion to reduce vulnerability to food insecurity.

Higher levels of physical capital among women reduce the likelihood of their households becoming vulnerable to food insecurity. Women with higher levels of physical capital empowerment have the capacity to recover after risky events since they have the assets to engage in alternative economic activities. Physical assets increase household resilience to shocks or help arrest a decline in the availability

of resources. Moreover, the physical assets can also be sold to mitigate a crisis that may befall a household and thus are often a source of income in the future (Prowse, 2003). The sustainable livelihoods approach recognises that households need to possess assets in order to take sustainable livelihood strategies (Chambers and Conway, 1992; Ellis and Allison, 2004). High levels of physical capital empowerment ensure sustainability of livelihoods by giving women the ability to adjust to threats and survive shocks to their livelihoods, thereby ensuring stable access to food in the future (Matshe, 2009). The statistically significant parameter estimate for women's physical capital empowerment shows that households need adequate ownership of livelihood physical assets for pursuing a range of livelihood opportunities and reducing household vulnerability to food insecurity in the face of risks (e.g. seasonal climatic and market).

Although asset endowment is known to reduce households' vulnerability to food insecurity, women with higher levels of financial capital empowerment, in the study areas, were more vulnerable to food insecurity in the face of a changing environment. This is because vulnerability is a 'forward looking' concept and a household is said to be vulnerable to future loss of welfare if any risky event reduces household welfare below socially accepted norms. The degree of vulnerability depends on the characteristics of the risk and the household's ability to respond which, in turn, depends on household characteristics, notably their asset base (Alwang et al., 2001; Dilley and Boudreau, 2001). Since most of the women in the study areas were having high levels of financial capital empowerment through access and control of social grants and remittances, they had low levels of household assets, possibly because of the dependency syndrome of relying on the state and relatives for income. As a result, they were prone to being unable to cope with uncertain adverse events, such as prolonged lack of rainfall, or other difficulties, since they had only few assets to cushion such adverse conditions. The marginal effects also indicate that a small increase in women's financial empowerment had the largest effect in increasing the probability of a household becoming vulnerable to food insecurity. This possibly reflects that social grants and remittances create a 'dependency syndrome' and disinvestments in livelihood assets.

According to Bogale and Shimelis (2009), in general, households that have access to better income opportunities are less likely to become food insecure than households with less access. A number of studies including those of Bigsten et al. (2002) and Bogale et al. (2005) have also found that men have better opportunities to access assets than women. Therefore, more husbands' income could possibly mean an investment in assets (e.g. livestock and agricultural tools and equipment) that reduce households' vulnerability to food security. Husbands' income indirectly influences women's capacity to produce own food in the future. The availability of non-farm sources of income, for example, informal employment, reduces the vulnerability of rural households. In a study done by Famine Early Warning Systems (FEWS, 1995) cited by Omamo (1998), the vulnerability of subsistence farmers in Kenyean districts of Kitui and Makueni was reduced by the high share of non-agricultural income in those

districts. Considering that the majority (i.e. above 80%) of women's husbands were involved in off-farm incomes, they offered an excellent way of diversifying households' livelihood strategies, thereby reducing the risk of being food insecure in the future. Besides being used directly for buying food, husbands' income could also be used to buy inputs such as improved seed varieties and fertiliser that increase production levels of the household after experiencing shocks (Bogale and Shimelis, 2009; Fankhauser et al., 1997).

Households with a larger dependency ratio are more likely to be vulnerable to food insecurity because they have more number of non-working people being fed by a few able-bodied and working household members. Higher dependency ratios tend to aggravate households' vulnerability to food insecurity, as more mouths rely on the meagre income to survive resulting in low investment in assets to cushion shocks in the future (Tawodzera, 2011). Moreover, more dependents mean lower household savings. This results in lack of income to initiate other income-generating activities that could assist households in the future (Tawodzera, 2011).

Although most studies, including Bacha et al. (2011), have found that access to irrigation reduces vulnerability to food insecurity by enabling rural households to produce more than 1 crop per year, increase their income, diversify their cropping systems and curb shocks due to weather and climatic changes, the coefficient estimates for irrigating or dry-land farming areas were not statistically significant. Thus, irrigation alone cannot be considered as a panacea for curbing household vulnerability to food insecurity (Bacha et al., 2011). Some households may remain food insecure irrespective of their access to irrigation because there are other correlates of household vulnerability to food insecurity including family size, lack of education, training and improved inputs. These must also be addressed in order to have a deep and lasting impact on food insecurity.

6. Conclusions and policy recommendations

This study has been motivated by the fact that women who are the principal actors in ensuring household food security in rural areas rely on agriculture, yet they face low levels of empowerment in agriculture. With the aim to inform policy, this paper identifies the dimensions of women's empowerment in agriculture that impact on their households' vulnerability to food insecurity. In agriculture, women can be empowered through crop management skills, farm financial management skills, improved level of water use security, animal husbandry skills and weed and pest management skills. In the economic arenas, women can be empowered in economic agency, financial capital, human capital, vocational skills and physical capital forms of empowerment. The socio-cultural inhibitions affect women's participation in agriculture and make their households vulnerable to food insecurity. Therefore, empowering women in these socio-cultural aspects that create hindrances to improved agricultural production among women is crucial for reducing their household vulnerability to food insecurity.

Apart from agricultural forms of empowerment, households' ability to survive shocks affecting food security can also be improved by enhancing women's economic forms of empowerment. In this category, improving women's sense of agency appears to be the guaranteed way of reducing their vulnerability to food insecurity in the future. Having a higher sense of agency gives individuals higher motivation levels needed to utilise resources and pursue own livelihood goals that reduce households' vulnerability to food insecurity in the future. Thus, although capital assets are central to all livelihood strategies, they are not sufficient on their own to ensure progress towards a sustainable livelihood. Women need both a sense of agency and resources to reduce households' vulnerability to food insecurity. Among the capital forms of women's empowerment, the level of women's physical capital empowerment is the major determinant of household vulnerability to food insecurity. It is the physical assets that determine a household's ability to cope with risks to food security in the future. They also allow a household to diversify and pursue alternative livelihood strategies in the event of shocks that threaten food consumption in the future.

Although households' access to income is the most significant indicator of households' vulnerability to food insecurity, the source of the income more than anything else determines whether households will be able to cope with shocks in the future. Husbands' income, especially from off-income sources, provides an excellent form of livelihood diversification that curbs households' vulnerability to food insecurity. On the other hand, social grants and remittances tend to create a dependency syndrome that influence negatively households' investment in capital assets needed to resist risks to food insecurity in the future. Households with more mouths to feed in the future are more vulnerable to food insecurity.

Based on the above conclusions, this study recommends that

- Since empowerment is multidimensional, a diversified approach of empowerment interventions is required to reduce vulnerability to food insecurity.
- There is need to bring together stakeholders to discuss collaborative efforts to reduce household vulnerability to food insecurity through empowerment of women.
- The government should put in place institutions that address the socio-cultural and customary aspects that create hindrances to improved agricultural production among women.
- Empowerment agencies should target to improve women's sense of agency to reduce vulnerability to food insecurity.
- Women farmers should be assisted in accessing the physical capital resources to reduce household vulnerability to food insecurity.
- Health education and child planning awareness are recommended among the poor to reduce the size of their household and their dependency ratio.
- Rural employment opportunities of both women and their husbands need strengthening.

Notes on contributors

Stanley Sharaunga is a PhD student at University of KwaZulu-Natal. He holds a BSc and an MSc in Agribusiness from the same University.

Dr. Maxwell Mudhara is the Director of Farmer's Support Group and Lecturer at University of KwaZulu-Natal. He holds an MSc and a PhD in Agricultural Economics from University of Florida, USA.

Prof. Ayalneh Bogale is an Associate Professor and a Director of the African Centre for Food Security at University of KwaZulu-Natal. He holds a BSc, MSc and a PhD in Agricultural Economics.

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