

# The Relationship between Smallholder Irrigation and Household Food Availability and Dietary Diversity in Greater Tzaneen Municipality of Limpopo Province, South Africa

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Received: May 20, 2016 Accepted: June 18, 2016 Online Published: July 30, 2016

doi:10.5539/jsd.v9n4p165

URL: <http://dx.doi.org/10.5539/jsd.v9n4p165>

## Abstract

Irrigation farming has the potential to address household food security challenges in developing countries. This paper examines household food availability, consumption and dietary diversity for irrigating and non-irrigating households in Greater Tzaneen municipality of Limpopo Province of South Africa. The paper uses primary data collected from 180 households comprising of irrigation scheme irrigators, independent (non-scheme) irrigators, and non-irrigating households. Data analysis employed descriptive analysis and analysis of variance to compare food security components of the different types of households. Results provide sufficient evidence that smallholder irrigation farming contributes significantly to household food security through improved food availability and dietary diversity. However, since most households are net food buyers, it is essential to have policies that are formulated with an understanding that household food security is not only a function of the food that farming households produce for their own consumption but more so a function of total household income. The results inform agrarian reform debates on whether South Africa should continue investing in smallholder irrigation farming for improved household welfare. An integration of smallholder irrigation farming in strategies for growing the rural economy and contributing to improved livelihoods and poverty reduction is, therefore, recommended.

**Keywords:** dietary diversity, food availability, food security, irrigation, Limpopo, smallholder farmer

## 1. Introduction

Access to water for irrigation is expected to enable rural households gain access to more food and to a more diverse diet. In general, access to irrigation farming allows poor people to intensify food production. Food production through farming plays an important role in ensuring access to food for rural poor households (Baiphethi & Jacobs, 2009). Nhundu and Mushunje (2012) and Benson (2015) state that irrigation farming increases per unit area food production leading to improvement in food availability and accessibility. Evidence has shown that household food security in South Africa does not depend only on household food production but also on total household income (Hendriks, 2003; Human Sciences Research Council, 2004; Hendriks, Kirsten, & Vink, 2006; Van Averbek & Khosa, 2007; Shisanya & Hendriks, 2011). Van Averbek and Khosa (2007) confirm that although farming is not the main source of food and household income for South African households, it can provide income in kind, in the form of food for home consumption, thereby enhancing household food security.

There is extensive literature on the impact of irrigation farming on food security, particularly in South Asia and some African countries (Kumar, 2003; Rukuni, Svendsen, Meinzen-Dick, & Makombe, 1994; Smith, 2004; Hanjra, Ferde, & Gutta, 2009; Ghosh, Verma, Panda, Nanda, & Kumar, 2012; Mtonga, 2014; Benson, 2015; Dube & Sigauke, 2015). According to FAO (1996), irrigation farming, which is more productive than rain-fed farming, has contributed about 40% of world food production on 17% of cultivated land. In Asia, irrigated cropland has accounted for about 70% of total cereal production (Asian Development Bank, 2003; Hussain & Hanjra, 2004). Hussain and Hanjra (2004) report that cereal production in Asia more than doubled, between 1970 and 1995, owing to growth in irrigation farming together with the use of high-yielding varieties and fertilizers. In South Africa, irrigated agriculture contributes more than 30% of the gross value of the country's crop production

(FAO, 2002; Department of Government Communication and Information System, 2015). Increased production ensures high food availability at the household level due to intensification of crop production (Hussain, Giordano & Hanjra, 2003; Hussain, Namara, & Madar, 2004; Van Averbek, Denison, & Mnkeni, 2011; Benson, 2015; Nhundu & Mushunje, 2012). Irrigation farming makes food available and affordable for the poor, who tend to be net buyers of food and spend a major part of their monthly expenditure on basic food.

In South Africa, although there is adequate food for the population, there are large numbers of households that are food insecure (Altman, Hart, & Jacobs, 2009; Vink, 2012; D'Haese et al., 2013). According to the Human Sciences Research Council (2014), more than half of South Africa's population does not have regular access to enough food, more so in rural areas. It has, therefore, been argued that there is enough food in the country to adequately feed everyone, the problem is distribution. Food distribution, which concerns markets, livelihoods and value chains (Meyer, 2014) forms part of the Integrated Food Security Strategy for South Africa. According to this strategy, for food security to be achieved, policies must address all aspects of the food system, which include production, marketing, distribution, consumption and nutrition (Department of Agriculture, 2002).

Food security issues have occupied top priority in the policies that have shaped the history of South Africa over time (Hendriks, 2013 & 2014). Owing to the persistently changing international interpretation of food security, determinants of food security have been interpreted differently in the country (Hendriks, 2014). Noteworthy, however, is that the contribution of the agricultural sector in shaping consumption patterns and determining rural livelihoods has been central to the different contexts. The potential of smallholder irrigation farming in improving household food security has led the South African government to intensify investments in irrigation rehabilitation and revitalisation (Sinyolo, Mudhara, & Wale, 2014). However, the extent to which smallholder irrigation has been able to reduce poverty in the rural areas of South Africa is not well understood.

This paper presents results of an empirical analysis of the relationship between smallholder irrigation farming, household food availability and dietary diversity for households in Greater Tzaneen municipality. The rest of the paper is organised as follows: Section two presents the food security situation of rural households in Limpopo Province. Section three outlines the theoretical framework guiding this study. Research methods are outlined in section four. Results of the analysis are presented in section five. The final section presents conclusions.

## **2. The Food Security Situation of Rural Households in Limpopo Province**

The concept of food security has become an important indicator of progress in agricultural development (Vink, 2012). Although there is no agreed measure of food insecurity, both internationally and nationally, a few nationally representative samples have included food security indicators in South Africa. The indicator sets are, however, not consistent between surveys in the country (Hendriks, 2005; Headey & Ecker, 2012; Hendriks, 2013). Limpopo Province has the largest proportion of rural people (87% of the citizens live in rural areas) in the country (M'Marete, 2003; Mohamed, 2006; Human Sciences Research Council, 2012). The province is also one of the poorest in the country (Human Sciences Research Council, 2014).

A Household Food Insecurity Access Scale methodology that was developed by the Food and Nutrition Technical Assistance project of USAID was used by De Cock et al. (2013) to assess the food security status of households in Limpopo Province. The assessment indicated that 14.8% of people in the sample were food-secure, 5.8% were mildly food insecure, 26.4 % were moderately food insecure and 53.1% were severely food insecure. Mopani district, in particular, had a large proportion of severely food insecure households (65%). This district also came out as the poorest in terms of average household income and had the highest share of households living below the poverty line (Gumede, 2010). In certain districts, households experienced temporary lack of food or money during January and February. Some of the factors found to explain this food shortage included excessive spending patterns during the festive season and funds allocated to other cost items like school fees.

## **3. Theoretical Framework**

Comprehensive measurement of food security is quite challenging owing to its multidimensional nature. Different studies have obtained different results because each survey probes a different dimension of food security. The definition for food security as given by FAO (2008) and Barrett (2010) sums up food security as consisting of three hierarchical pillars; food availability, access to food, utilisation of food and stability. Food security exists when all four dimensions are realised simultaneously. According to the Department of Agriculture (2002), certain characteristics of a food system are necessary to achieve food security effectively and efficiently. These elements include a) the capacity to produce, store, distribute and if necessary, to import sufficient food to meet the basic food needs of people; b) a maximum level of robustness to reduce vulnerability to market fluctuations and political pressures; and c) minimal variations in access to food in relation to season, cycle and other factors.

Figure 1 shows a widely agreed upon framework for understanding food security. The framework has been applied in FAO and World Bank food security related publications (Hussain et al., 2003). Food security can be viewed at four levels, namely, the global, national, household and individual. The relationship between national food availability and individual nutritional security is clearly demonstrated in the framework.

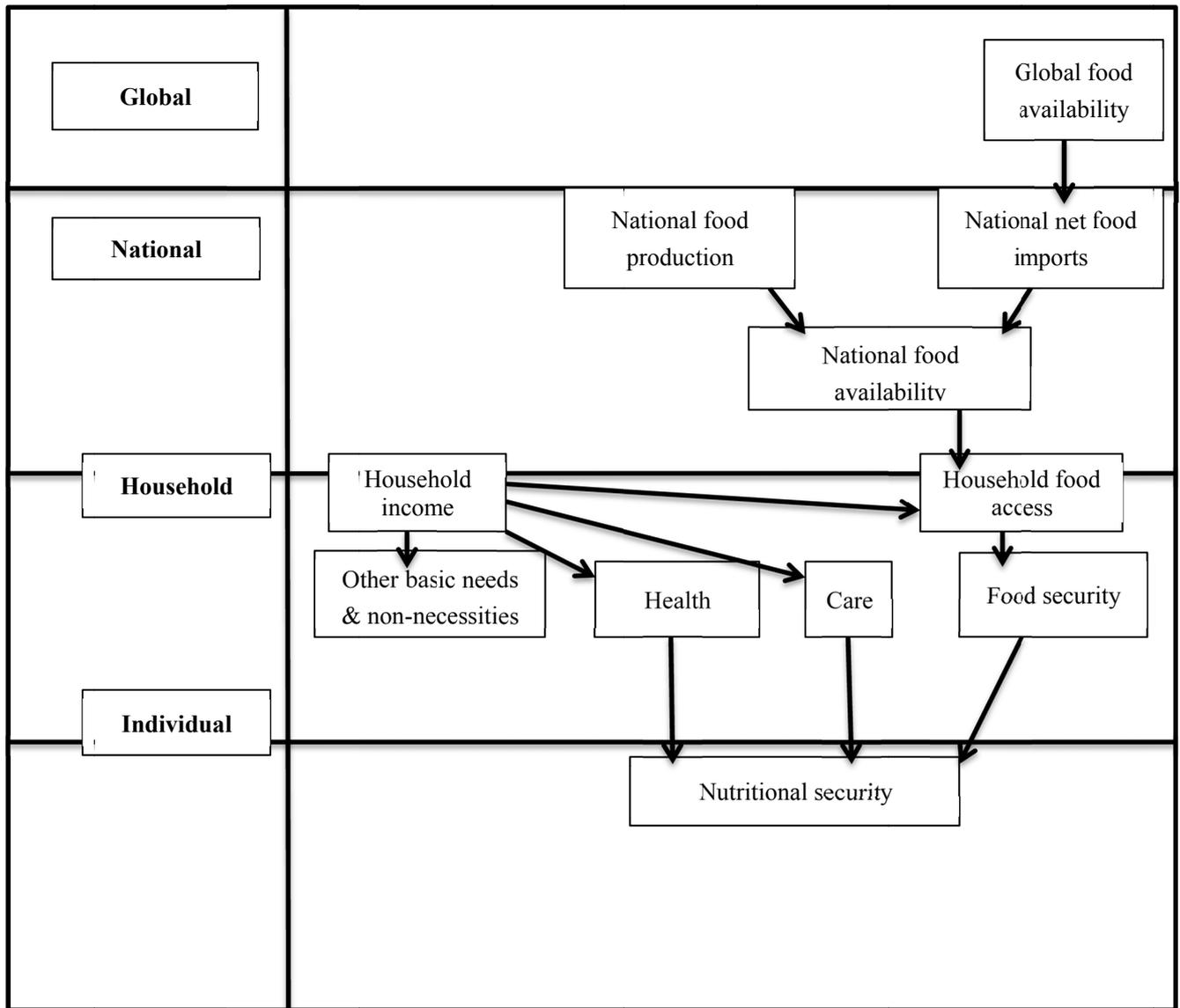


Figure 1. Framework for understanding food security

Source: Hussain et al. (2003)

Food availability refers to effective or continuous supply of food at both national and household levels. It is affected by production capabilities of the agricultural sector and input and output market conditions. However, enough food available at a national level is only a necessary, but not sufficient, condition for households to have access to food. The components of food security are distinct but inter-related. Access to food refers to the ability of a nation and households to acquire sufficient food on a sustainable basis. Households should have the necessary resources to acquire the available food. Issues of income to buy food and consumption behaviour are important here. Food utilisation determines the nutritional status of households. Utilization encompasses food preferences, intake of sufficient energy and nutrients, food preparation, diversity of the diet and intra-household distribution of food (Vink, 2012). Food security works through people’s dietary intakes to influence their nutritional security (Hussain et al., 2003). A stable food system is necessary for sustainable food security (Department of Agriculture, 2002). Instability in food security is caused by seasons, production cycles, politics,

macroeconomic and other factors. A food system should have minimal variations of food supply. To achieve nutritional security, individuals also need adequate care and a healthy living environment to be able to absorb the nutrients in food and thus use it in their daily lives.

Given that some aspects of food security cannot be measured, analysts can choose to measure either food security or food insecurity in any given circumstance, potentially influencing policy choices. However, previous research has demonstrated that food availability, access to food and its nutritional value, and dietary diversity can be measured.

#### **4. Research Methods**

##### *4.1 Previous Research*

A number of studies acknowledge the link between smallholder farming and improved household food security and welfare. Benson (2015) analysed data from an Integrated Household Survey to understand the impact of irrigation farming on nutritional outcomes for children in Malawian farm households and on the diversity of diets in those households. The analysis involved examining whether irrigation factors were significant determinants of the growth performance of children aged six months to five years (in terms of their height-for-age) and examining the association between irrigated farming and diversity in the foods consumed. A strong association was found between irrigated farming and diversity in the foods consumed by farm households. Conclusions were that irrigation is an important component in reducing effects of seasonality in household dietary diversity although it is only a necessary, but not sufficient, determinant of improved household nutrition.

Dube and Sigauke (2015) investigated the importance of rural irrigation schemes in addressing community and household food security and ensuring health nutrition uptake by irrigators and surrounding communities for an irrigation scheme in Zimbabwe. They computed Body Mass Indices of irrigators and non-irrigators as the only feasible indicator for checking whether food accessibility and availability had a bearing on the nutritional status of individuals. The study concluded that irrigation enables communities to have reliable access to health, safe and nutritious food and also affords farmers additional income through sale of surplus produce. Irrigators were able to strengthen food security further through asset accumulation.

Sinyolo et al. (2014) used a treatment effect model to assess the effect of access to irrigation farming on the welfare of rural households in KwaZulu-Natal Province in South Africa. The results pointed to a positive effect of irrigation farming on overall household consumption, justifying government investments in smallholder irrigation. De Cock et al. (2013) investigated the food security status and determinants of food security in rural areas of Limpopo Province in South Africa using descriptive statistics and scores. Recommendations were that promotion of rural education could improve food security coupled with creation of an enabling environment for the rural labour market with sustainable employment opportunities.

Tshuma (2012) reviewed evidence of the role that agriculture plays in addressing poverty and food security issues in South Africa and advocated for increasing agricultural profitability for smallholder farmers as a way out of poverty. Bacha, Namara, Bogale, & Tesfaye (2011) applied descriptive statistics, the Foster, Greer and Thobek poverty indices, and Heckman's selectivity model to understand the poverty reduction impacts of smallholder irrigation development in western Ethiopia in 2006. Results indicated that the incidence, depth, and severity of poverty were significantly lower among farm households with access to irrigation.

Leroy, Van Rooyen, D'Haese and De Winter (2001) quantitatively evaluated the food security position of food crop and cash crop producing rural households. Conclusions were that development of integrated food access and utilisation was important to link farming with non-farming economic activities for improved household food security. The contribution of own food production to household nutrition of rural and semi-arid settlements was investigated by Van Averbek and Khosa (2007) through estimating the nutrient content of the different foods consumed, with particular emphasis on protein, iron and Vitamins A and C as indicators. The conclusion was that, without farming, household food security would be reduced, particularly among the ultra-poor.

Furthermore, the Food Security Initiative of the University of Stellenbosch (Harper, 2014) emphasises food production increases in smallholder agriculture as a possible solution to the food insecurity challenges in rural areas. This was based on a study conducted in the rural areas of Limpopo Province in 2012/13. Overall, research has shown that no country can assure food security for its population if rain-fed agriculture is not coupled with significant investments in irrigation farming.

## 4.2 Methods Used in This Study

### 4.2.1 Sampling and Data Collection

The study was conducted in Mopani district of the Greater Tzaneen municipality as part of Water Research Commission Project K5/2179 (WRC, 2013), entitled, 'Water use productivity associated with appropriate entrepreneurial development paths in the transition from homestead food gardening to smallholder irrigation crop farming in Limpopo Province'. The research site was purposively selected guided by the need to study an operational irrigation scheme and enable inclusion of the two targeted types of smallholder farmers in the sample, namely, irrigating households (both scheme and non-scheme irrigators) and non-irrigating households (home gardeners, dryland farmers and non-farming households). Julesburg irrigation scheme was selected and the 27 active scheme irrigators were interviewed. Non-scheme (independent) irrigators were identified from villages surrounding Julesburg irrigation scheme through snowballing. A census approach was then adopted where all identified active independent irrigators were interviewed. As a result, 35 independent irrigators were interviewed. A total of 118 non-irrigating households were randomly selected from 800 households in the village within which Julesburg irrigation scheme is located<sup>1</sup>. These were interviewed as a control group of non-irrigators displaying similar contextual factors as the irrigators.

The same data collection instruments were used for both irrigators and non-irrigators to ensure that comparative analysis is possible across the different types of households. Data collection was done through face-to-face interviews using structured questionnaires. Questions dealt with household demographics, sources of household income, household expenditure, household well-being, assets, savings and loans, membership of associations, land and water access, farm production, support services and entrepreneurship and risk.

### 4.2.2 Analytical Technique

To examine the relationship between irrigation farming, household food availability and dietary diversity, descriptive statistics and analysis of variance (ANOVA) were employed. A combination of SPSS version 22 and STATA version 12.1 was used to perform the statistical analytical procedures of estimating the effect of participation in smallholder irrigation farming on household food availability and dietary diversity for the different types of households. Food availability was assessed in terms of on-farm food production and household food purchases. An assessment of a household's dietary diversity was based on a seven-day recall of the types of food consumed and the frequency of consumption.

Firstly, descriptive analysis was done for the variables dealing with the household head's perception about the food security situation of the household, types of crops grown and the monetary value of food consumed at home from own production. Secondly, an ANOVA was run to analyse differences in means of key variables among the different household types. The share of expenditure on food was calculated by expressing monthly food expenditure as a percentage of total monthly household expenditure and computing means by type of household.

To investigate the diversity of diets for the different types of households, an ANOVA of the number of meals of the various food groups consumed by a household in a week was run. The ANOVA significance value enables a conclusion that there is a statistically significant difference between the frequency of meals of the various food groups consumed by a household. However, this significance value does not indicate which condition means are different. To remedy this limitation, post-hoc tests were carried out. These tests are used when statistical significance between conditions has been found but it is not known where the statistical differences are. Noteworthy is that when the results of a one-way 'between subjects' ANOVA are not statistically significant, the post-hoc tests are not necessary. The Tukey post-hoc test is popular for comparing groups, to find out which of the groups were significantly different from each other in the consumption of certain food types.

## 5. Results

This section presents results of the analysis. Table 1 shows the food security situation of the different types of households within a period of a year. Overall, 4.5% of the households in the sample reported that food was never enough during the past year, for 29.1% of the households food was not enough most of the time, for 29.6% of the households food was enough half the time, for 19% of the households food was enough most of the time while for 17.9% of the households food was always enough. The largest proportion of households who reported that food was always enough was among independent irrigators (28.6%). Independent irrigators also had the greatest proportion of households who reported that food was never enough (8.6%). The inconsistent results point to the

<sup>1</sup> Of the 118 households, 53 were home gardeners and 65 comprised of dryland farmers and households that did not farm. The 65 households were selected as part of the sample to ensure complete representativeness of the village. They are referred to as 'other' in the analysis.

fact that the food insecurity situation remains a challenge among rural households. There was no statistically significant difference in the food security situation between the different types of households as indicated by the chi-square statistic ( $p=0.130$ ).

Table 1. Proportion of households indicating the food security situation by type of household (%)

	Never enough	Not enough most of the time	Enough half the time	Enough most of the time	Always enough	Chi-square
Scheme irrigators (n=27)	3.7	25.9	25.9	18.5	25.9	
Independent irrigators (n=35)	8.6	8.6	31.4	22.9	28.6	
Home gardeners (n=53)	3.8	39.6	22.6	22.6	11.3	$p=0.130$
Other (n=65)	3.1	32.8	35.9	14.1	14.1	
Total (n=180)	4.5	29.1	29.6	19	17.9	

Source: Survey data (2013)

Grouping the households into irrigators and non-irrigators indicated that about 77% of the irrigators reported being food-secure compared to 61% of the non-irrigators (Figure 2). There was a statistically significant difference in the food security situation of irrigators and non-irrigators. These results confirm reports by the Food Security Initiative that food production increase in smallholder agriculture is seen as a possible solution to the food insecurity challenges in the rural areas of Limpopo Province (Harper, 2014). The results also confirm findings of other studies in Ethiopia, Kenya, South Africa and Zimbabwe, which show that households participating in irrigation farming never run out of food and their hungry months are reduced substantially, unlike their non-irrigating counterparts (Mudima, 2002; Ngigi, 2002; IFAD, 2005; Benson, 2015).

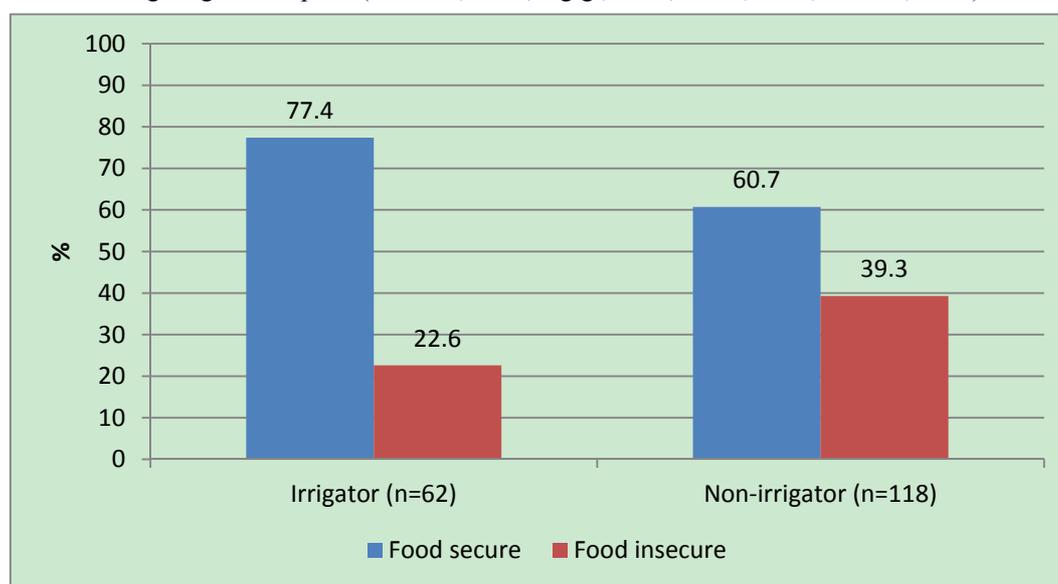


Figure 2. The food security situation of irrigators and non-irrigators

Source: Survey data (2013)

### 5.1 Household Food Production

This section presents results on types of crops cultivated by households and the monetary value of consumption from own production. It is important to deal with the question of the extent to which people produce their own food and how much that food adds to their current levels of food security (Altman et al., 2009; Baiphethi & Jacobs, 2009). Many researchers have focused on ways of increasing the productivity of rain water and irrigation water use for agricultural production to improve food security, nutrition and health (Backeberg & Sanewe, 2013). As documented in Ellis, Kutengule and Nyasulu (2003), the role of subsistence farming in rural livelihoods of the different farming households can be investigated through analysing the overall share of own consumption by value in household income across different income levels. Furthermore, according to IFAD (2015), a simple idea of eating what you grow has changed many people's lives in Senegal through significantly reducing the hungry season and providing jobs for thousands of people. However, as stated by Altman et al. (2009) and Baiphethi and Jacobs (2009), subsistence production does not necessarily translate into improved food security unless it is complemented by improved household income.

Table 2 shows the different crops cultivated by households in the sample in 2012/13. Smallholder irrigation farming allows households to diversify their crop mix (Benson, 2015). Access to smallholder irrigation enables farmers to grow crops more than once a year (Tesfaye, Bogale, Namara, & Bacha 2008; Bacha et al., 2011). There is a clear distinction between the crop mixes of irrigators and those of non-irrigators. Irrigators grew more crops during the year compared to non-irrigators.

Table 2. Proportion of households cultivating different crops by type of household in 2012/13 (%)

Type of crop	Scheme irrigators (n=21)	Independent irrigators (n=29)	Home gardeners (n=46)	ANOVA (p-values)
Tomatoes	9.5	37.9	2.2	0.00***
Onions	9.5	6.9	2.2	0.62
Sugar cane	4.8	20.7	0	0.01**
Soya beans	9.5	0	0	0.06*
Green beans	71.4	41.4	2.2	0.00***
Sugar beans	9.5	20.7	52.2	0.00***
Maize	52.4	58.6	17.4	0.01**
Okra	90.5	10.3	2.2	0.00***
Mustard	5.0	6.9	0	0.38
Green pepper	25.0	20.7	0	0.01**
Butternuts	0	27.6	0	0.00***
Cabbage	0	17.2	2.2	0.03**
Peas	5.0	0	0	0.29
Chillies	38.1	20.7	0	0.00***
Bambara nuts	5.3	4.2	2.4	0.95
Spinach	0	10.3	4.3	0.43
Paprika	9.5	0	0	0.06*
Pumpkin	0	0	30.4	0.00***
Beetroot	4.8	3.4	2.2	0.95
Peanuts	23.8	10.3	45.7	0.00***
Cowpeas	0	0	15.2	0.04**
Sweet potatoes	0	3.4	2.2	0.87

Note: \*, \*\*, \*\*\* = significant at 10%, 5% and 1% levels of significance, respectively.

Source: Survey data (2013)

In general, irrigating households tend to produce cash crops and vegetables for the market. A portion of the produce was consumed at home while the bulk of production was sent to the market. These results confirm findings by De Cock et al. (2013) that households produce for both home consumption and the market. These findings endorse statements that agriculture plays a major role in the livelihoods of rural people. It was, however, difficult to assess the true contribution of own food production as households did not keep records. They could not recall the quantities that were taken for home consumption and crop production, particularly from their home gardens.

Figure 3 shows the monetary value of food produced on the farm and consumed at home by type of household. Data included in this analysis were only for those households who reported consuming from their own production. Home gardening was primarily for home consumption. The rest of the households, particularly, scheme and independent irrigators, took most of their produce to the market and would consume from the income derived from farm produce sales. This result, however, is contrary to findings that irrigation farming increases a household’s consumption from own production and reduces expenditure on bought-in food.

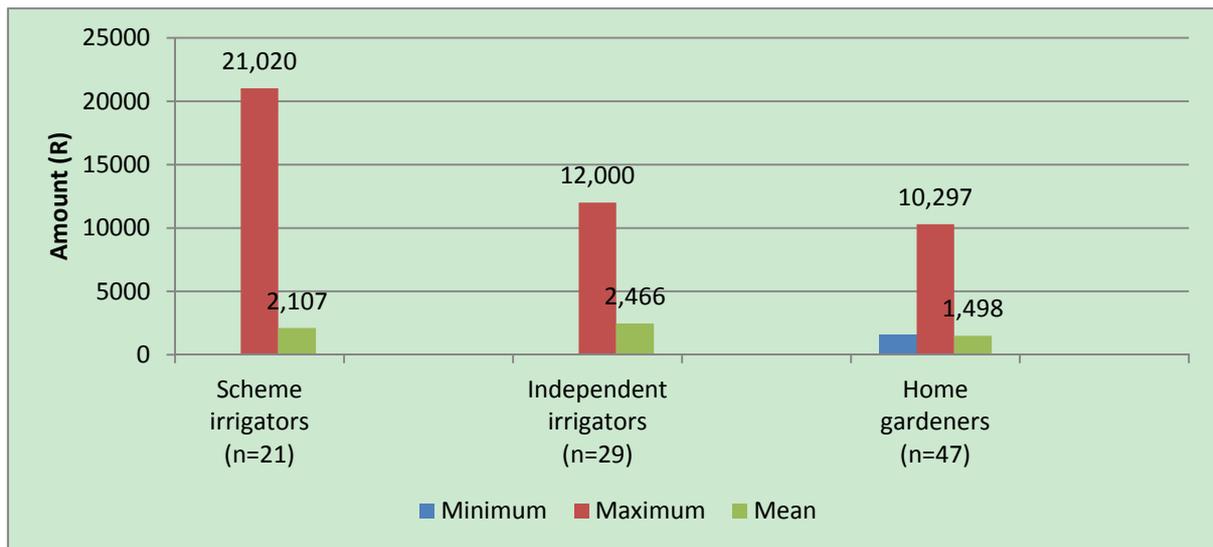


Figure 3. Monetary value of household consumption from own production by type of household  
Source: Survey data (2013)

5.2 Total Household Expenditure and Expenditure on Food

While the proportion of income spent on food is not a direct measure of food insecurity, according to Engel’s Law, a relative high share of food expenditure is often linked to poor households (Leroy et al., 2001; Mhlongo & Daniels, 2013). In the past, rural households produced most of the food consumed at home, while urban households purchased most of their food. However, recent studies have shown an increase in dependence on market purchases by both urban and rural households, in some cases reaching 90% of the food supplies. Consequently, food expenditures in some parts of sub-Saharan Africa range between 60 and 80% of the total household income for low-income households, with South African households spending, on average, 37% of their income on food (Baiphethi & Jacobs, 2009). It is noteworthy that expenditure on food will depend on other parameters including change in food prices and proximity to shops (De Cock et al., 2013).

The proportion of food expenditure in total household expenditure for the different types of households was computed (Table 3). It is evident that a significant proportion of total household expenditure goes towards food purchases.

Table 3. Total monthly household expenditure and expenditure on food by type of household

		<b>Total household expenditure (R)</b>	<b>Expenditure on food (R)</b>	<b>Proportion of food expenditure (%)</b>
Scheme irrigators (n=27)	<b>Mean</b>	5166.46 (10318.85)	933.33 (795.17)	31.7
	<b>Min</b>	662	300	
	<b>Max</b>	53550	3500	
Independent irrigators (n=35)	<b>Mean</b>	4960.94 (4739.45)	990.14 (912.96)	26.3
	<b>Min</b>	750	100	
	<b>Max</b>	23883	5000	
Home gardeners (n=53)	<b>Mean</b>	2667.39 (2346.62)	670.75 (371.54)	32.9
	<b>Min</b>	370	160	
	<b>Max</b>	10950	2000	
Other (n=65)	<b>Mean</b>	2697.76 (2472.97)	632.31 (366.36)	31.4
	<b>Min</b>	463	0	
	<b>Max</b>	12262	2000	
Total (n=180)	<b>Mean</b>	3499.18 (4979.38)	758.36 (601.18)	30.9
	<b>Min</b>	370	0	
	<b>Max</b>	53550	5000	

Note: Figures in parenthesis are Standard Deviations

Source: Survey data (2013)

Overall, households in the sample spent 30.9% of their household income on food. However, for independent irrigators, the proportion of income spent on food is relatively lower (26.3%) although the actual amount spent on food is higher compared to other households interviewed (R990.14). Home gardeners had the largest proportion of expenditure on food (32.9%). Other households had 31.4% of income taken up by food purchases, similar to scheme irrigators (31.7%). Independent irrigators are, therefore, deemed the wealthier households as their proportion of income spent on food is the least compared to all households in the sample.

### 5.3 Dietary Diversity

Table 4 shows the diversity of diets among different household types.

Table 4. Diversity of food types consumed in a week by type of household

Food types consumed per week	Group	Mean	ANOVA ( <i>p</i> -values)
Legumes	Scheme irrigators	2 (2.23)	0.00***
	Independent irrigators	2 (2.08)	
	Home gardeners	1(0.89)	
	Other	1(1.49)	
	Total	2 (1.67)	
Vegetables	Scheme irrigators	5 (2.67)	0.03**
	Independent irrigators	6(2.08)	
	Home gardeners	4(2.55)	
	Other	5(2.46)	
	Total	5(2.49)	
Fruits	Scheme irrigators	3(2.66)	0.32
	Independent irrigators	4(2.46)	
	Home gardeners	3(2.46)	
	Other	3(2.75)	
	Total	3(2.60)	
Meat	Scheme irrigators	4(2.52)	0.43
	Independent irrigators	3(2.03)	
	Home gardeners	3(1.98)	
	Other	4(2.20)	
	Total	3(2.16)	
Eggs	Scheme irrigators	3(2.56)	0.21
	Independent irrigators	2(2.20)	
	Home gardeners	3(2.61)	
	Other	2(2.53)	
	Total	2(2.51)	
Dairy	Scheme irrigators	4(2.94)	0.37
	Independent irrigators	3(2.88)	
	Home gardeners	3(2.95)	
	Other	3(2.74)	
	Total	3(2.86)	

Note: Figures in parenthesis are Standard Deviations

\*\* , \*\*\* = significant at 5% and 1% levels of significance, respectively.

Source: Survey data (2013)

There was a statistically significant difference between the frequency of consuming legumes and vegetables among the different types of households at 5% level of significance. Scheme irrigators and independent irrigators consumed legumes twice a week while home gardeners and other households consumed legumes once a week. Vegetable consumption was more frequent overall at five times per week. Independent irrigators consumed vegetables six times a week while scheme irrigators and other households consumed vegetables five times a week. Home gardeners consumed vegetables less frequently at four times a week. For the rest of the food types,

fruits, meat, eggs and dairy, there were no statistically significant differences in the frequency of consumption of these food types per week.

Table 5 shows results of the Tukey post-hoc tests for legume and vegetable consumption.

Table 5. Tukey post-hoc test results for legume and vegetable consumption by type of household

Comparison between two groups		Consumption of legumes	Consumption of vegetables
		( <i>p</i> -values)	( <i>p</i> -values)
Scheme irrigators	Independent irrigators	0.94	0.7
	Home gardeners	0.07*	0.4
	Other	0.33	0.91
Independent irrigators	Scheme irrigators	0.94	0.7
	Home gardeners	0.01***	0.02**
	Other	0.06*	0.18
Home gardeners	Scheme irrigators	0.07*	0.4
	Independent irrigators	0.01***	0.02**
	Other	0.71	0.63
Other	Scheme irrigators	0.33	0.91
	Independent irrigators	0.06*	0.18
	Home gardeners	0.71	0.63

Note: Fruits, Meat, Eggs and Dairy were excluded from this table as the post-hoc tests *p*-values indicated no statistically significant differences in the frequency of consumption between the different types of households

\*, \*\*, \*\*\* = significant at 10%, 5% and 1% levels of significance, respectively.

Source: Survey data (2013)

The number of times legumes were consumed by home gardeners in a week was statistically significantly lower than that for scheme irrigators ( $p = 0.07$ ) and for independent irrigators ( $p = 0.01$ ). Consumption of legumes by other households was also statistically significantly lower than that for independent irrigators ( $p = 0.06$ ). The number of times vegetables were consumed by home gardeners was statistically significantly lower than that for independent irrigators ( $p = 0.02$ ).

## 6. Conclusions

Although not all the dimensions of food security were analysed directly, food security was assessed in terms of availability and dietary composition for irrigating and non-irrigating households. It is clear from the analysis that access to smallholder irrigation farming enabled households to diversify crops and grow crops in all seasons. This ensured increased production, consumption and income, and consequently improved household food security. The significant difference in the frequency of consuming legumes and vegetables among the different types of households shows that irrigation farming enabled households to consume legumes and vegetables more frequently in a week, indicating the value of own production to dietary diversity. Irrigation farming also enabled households to produce high value crops for the market, thereby contributing to improved household income.

The lower proportions of household income spent on food for irrigators, particularly independent irrigators, indicate their relatively higher level of wealth compared to non-irrigators. However, the generally high proportion of income spent on food across all interviewed households indicates that rural households have not escaped poverty completely.

The study, therefore, concludes that smallholder irrigation farming significantly contributes to household food availability and dietary diversity. However, it is apparent that a large proportion of households are net food buyers. Therefore, it is essential to have policies that are formulated with a clear understanding that household food security is more a function of total household income than it is a function of only the food that farming households produce for their own consumption. An integration of smallholder irrigation farming in strategies for

growing the rural economy and contributing to improved livelihoods is, therefore, recommended.

### Acknowledgements

The work presented in this paper is based on research findings generated by Water Research Commission Project K5/2179 (WRC, 2013), which was initiated, managed and funded by the Water Research Commission.

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