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An Assessment of Factors Affecting Income Generation from Crop Production under Irrigation in the Limpopo Province of South Africa

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ABSTRACT The objective of this study was to assess factors that impact on income generation by smallholder irrigation famers in the Vhembe District, South Africa. A sample of 370 smallholder irrigators was randomly selected for participation in the study. Data was collected through a pre-tested questionnaire designed to obtain information related to the study objectives. The study revealed that most respondents were aged married males who derived income mostly from *tomatoes, garlic* and *sweet potatoes*. The study showed that plot size, access to credit, access to markets, marital status, gender, level of education and age all had significant effect on income from crop production. The age of respondents however, revealed negative association with income generation. The paper recommended for an extension service that would support the elderly to transfer their farming skills to the younger generations. The second recommendation was for the development of strategies that would encourage farmers under irrigation to focus on more profitable crops like sweet potatoes, garlic and cabbage that appeared to have high average gross margins per growing season.

Besides the government's intention to upscale food security through revitalisation of small-scale irrigation schemes, most poor households in South Africa remain dependent on the market, subsistence production and government transfers for their food needs (Jasen 2004). The overarching question that needs to be unravelled could therefore be "what are the factors that will impact on smallholder irrigation farmers' income generation?" A review of literature provides scant evidence of an assessment of such factors, calling for this paper to provide some necessary inputs towards this venture. It was therefore fitting for this study to assess the extent to which biographic factors (age, educational achievement, gender and marital status), sizes of farming units, access to both credit and markets, and investment in production inputs could have impacted on income generation by smallholder irrigation farmers in the Vhembe District of South Africa.

The South African government adopted several policies that focused on small-scale irrigation farming for poverty alleviation, notably the revitalisation of small-scale irrigation schemes initiated during the apartheid era especially in the former homeland areas. More so, in that almost twenty years after the achievement of democratic rule in South Africa, the rural spatial landscape still reflects that era with most of the poor black inhabitants still resident and deriving their livelihoods from those localities. While a recent framework developed by Mwendera and Chilonda (2013) could be very useful in understanding basic imperatives for revitalisation of small-scale irrigation schemes, specifically as related to the physical, cropping, economic and social-organisational systems, internal factors that impact on the income generation abilities of these schemes need to be ascertained, including the linkage between income generation and food security.

As articulated above there are many smallholder irrigation schemes in the Limpopo Province of South Africa with Vhembe as one of its five districts. For these schemes to alleviate poverty there is a need for them to generate sufficient income to those farmers that depend entirely on their existence. Basing their arguments on low crop yields and declining investments in research and infrastructure, Rosegrant and Cline (2003) postulated that food security at the global level will remain a challenge for at least the next five decades, and thus calling for governments worldwide to initiate counteractive policies. In response to similar calls, the South African government adopted a number of policies that targeted smallholder farming, inclusive of

the Integrated Food Security and Nutrition Programme (IFSNP), embedded in the Comprehensive Agricultural Support Programme (CASP) (DOA 2007). The custodian of this policy initiative is the South African Department of Agriculture. The programme provides food parcels and starter packs for food production.

In South Africa smallholder irrigation schemes are characterised by the involvement of a multitude of poorly resourced farmers, each occupying an area of less than five hectares (Van Averbeke 2004; Denison and Manona 2007). Using this definition, the country counted 287 smallholder irrigation schemes in 2004, a figure that has remained almost stable, with a mean irrigated land holding per plot holder of 1.56 hectares. Most of these small-scale irrigation schemes were located in Limpopo Province (almost 171 schemes founded on approximately 200 000 ha) (Perret 2001). Similar trends in smaller size holdings have been reported for some African countries, notably Ethiopia, Kenya, Malawi, Tanzania and Zimbabwe where the average plot size ranged between 0.3 ha and 1 ha (Ferguson and Mulwafu 2004; Awulache et al. 2009). An assessment estimated that two-third of South Africa's small-scale irrigation schemes were dedicated to subsistence food production by close to 23 000 black people (IPTRID 2000). While as noted, Gulati (2001) and Singh et al. (2002) the above small plot size compares favourably with those observed in other developing countries outside Africa, (from 0.5ha to 2ha for Bangladesh, India, Nepal and Thailand) the impact of small-scale irrigation in terms of income generation and associated factors remain unravelled, particularly in the study area, that is, the Vhembe District Municipality in the Limpopo Province of South Africa.

Objectives of the Study

The main objective of the study was to assess factors affecting income generation from crop production under irrigation in rural areas of the Limpopo Province in the Vhembe District of South Africa. The ultimate purpose of this study was to cascade the study results to the targeted beneficiaries and policy makers. In the end it was expected that smallholder irrigators would take advantage of those factors that increase their ability to generate more income. Policy makers were expected to employ the results to intervene farming activities of smallholders from informed positions.

METHODOLOGY

This study was conducted in the Limpopo Province of South Africa in the Vhembe District Municipality (VDM). The VDM is situated in the Northern part of Limpopo Province, sharing borders with Zimbabwe in the north, Mozambique in the east and Botswana in the North West. It was established in 2000 through the process of transformation of local government structures (Arcus 2004). Three hundred and seventy (370) smallholder irrigation farmers were interviewed following a proportionally clustered simple random sampling technique for each local municipality. All irrigation schemes were taken into account, but clustered per local municipality resulting in three clusters. To achieve the above a list of all irrigation schemes in each cluster was drawn from which a systematic simple random sampling was applied, that is, obtaining a sample fraction from each local municipality and selecting respondents from the list commencing from a particular respondent.

The data collection tool was a pre-tested questionnaire that was designed to obtain the required data, in line with the study objectives. The questionnaire elicited household characteristics such as demographic information (sex, age, level of education, etc.), farm specific characteristics (spread of crops grown and hectares cultivated). Other pertinent data covered by the questionnaire included area planted, quantities harvested and income generation. The questions were designed such that ambiguity and sensitivity could be avoided. Besides both open- and close-ended questions the questionnaire also encompassed face-to-face interviews administered by the researcher and trained enumerators. Collected data were captured into the Statistical Package for Social Scientists (SPSS V19) spreadsheet. Major tools for data analyses were descriptive statistics and regression modelling.

Data Analysis

Multiple regression models show the relationship between the dependant and some explanatory variables. The dependent variable is also called the explained variable while the in-

dependent variable is also referred to as the explanatory variable. There could be one or more independent variables. In short, the dependent variable depends on the independent variable in that it always reacts to what the latter does. In this study, a multiple regression model was used to estimate the unknown effect of changing one variable over another (Jansen 2004). When running a regression model assumptions are made: i) there is a linear relationship between two variables (that is, *X* and *Y*) and ii) this relationship is additive (that is, $Y= X_1 + X_2 + \ldots + X_n$). Technically, linear regression estimates how much *Y* changes when *X* changes one unit. Before running a regression model it is recommended to have a clear idea of what you are trying to estimate (that is, which are your outcome and predictor variables). A regression makes sense only if there is a sound theory behind it. Usually the dependent variable is denoted by the letter Y, while independent variables are shown by X_i, that is, (X_1, X_2, X_3 etc.). The model for this study was specified as:

$Y_t = \alpha + \beta_1 AGE + \beta_2 EDU + \beta_3 GEN + \beta_4 MARSTAT + \beta_5 PLOTSIZ + \beta_6 CREACC + \beta_7 MARACC + U_i)$

Where:

Y_t = dependant variable (Average gross margin from crop production per season in Rand: proxy for income generation);

α_1 to β_7 = Predictor variables:

AGE (X_1) = Age group in years of irrigation scheme leader (categorical);

1= Youth (<35 years); 2= Adult (36 to 65 years); 3= Aged (>65 years).

EDU (X_2) = Educational level of irrigation scheme leader (categorical); 1= Primary;

2= Secondary; 3 =Tertiary; 4= Never attended school.

GEN (X_3) = Gender of irrigation scheme leader (1= female, 0 = male)

MARSTAT (X_4) = Marital status (1 = married, 2 = single; 3 = Never married);

PLOTSIZ (X_5) = Plot size in ha (numerical); (1= < 0.5ha; 2= 1.0 to 2.0ha; 3= >2.0ha).

CREACC (X_6) = Credit access (1= access to credit, 0 = not access to credit);

MARACC (X_7) = Market access (1= farm gate; 2=local market; 3= hawkers; 4= retailers;

5= national fresh produce market).

U_i = stochastic disturbance term (impact of other factors that are not explicit in the model).

RESULTS

The socio-economic characteristics as shown in Table 1 revealed that most respondents were above 60 years old (47.8%) with relatively low youth participation (11.62%). As regards the participation of women in irrigation farming, the study found that males were the dominant gender (67.80%). Women were however found to be the main providers of farm labour.

Table 1: Demographic characteristics of respondents

Variable	*Frequency*	*Percentage*
Farmer's Age (AGE)		
Youth (<35 years)	43	11.62
Adult (36 to 65 years	150	40.54
Aged (>65 years)	177	47.84
Total	370	100.00
Gender (GEN)		
Female	119	32.20
Male	251	67.80
Total	370	100.00
Marital Status (MARSTAT)		
Married	271	73.20
Single	64	17.30
Never married	35	9.50
Total	370	100.00
Level of Education (EDU)		
Primary	129	34.86
Secondary	177	47.83
Tertiary	47	12.70
Never attended school	17	4.61
Total	370	100.00
Plot Size (PLOTSIZ)		
Less than 0.5 ha	262	70.80
Between 1.0 and 2.0 ha	66	17.80
Greater than 2.0 ha	42	11.40
Total	370	100.00
Credit Access (CREACC)		
No access to credit	350	94.60
Access to credit	20	5.40
Total	370	100.00
Market Access (MARACC)		
Farm gate	19	5.14
Local market	222	60.00
Hawkers	50	13.51
Retailers	38	10.27
National market	41	11.08
Total	370	100.00

Source: Study survey 2011

The finding that most irrigation scheme projects were managed by married people (73.20%) was encouraging as this component is considered to be more stable than its counterparts. Most smallholder irrigators had acquired secondary education (47.83%) with a substan-

tial proportion that had reached the tertiary education level (12.70%). It was a matter of concern though that some smallholders were completely illiterate (4.61%). This category needs to be exposed to Adult Basic Education (ABET) programmes offered by the South African Department of Basic Education and Training as a matter of urgency. Farmers used different marketing channels to market their produce depending on access to market information and knowledge on specific markets as well as geographic location. However, it was noted that most of the channels used by the sampled farmers were informal local markets (60.0%). A small proportion (13.51%) of the farmers sold their produce to hawkers with only 10.27% that sold their produce to retailers. An insignificant proportion (5.14%) sold their produce at the farm gate, while 11.08% sold their produce on the National Fresh Produce Market. The average plot size held by irrigation scheme farmers was relatively very low, with most (70.80%) occupying less than 0.5 ha. From a total of 370 farmers surveyed, 94.6% did not have access to credit facilities. The income generation potential of small-scale irrigation schemes is shown in Table 2 for the 2009/2010 production season. The most profitable crops were tomatoes, sweet potatoes and garlic. Onions and cabbage and other crops yielded low average gross margins per season.

Multiple linear regression results are presented in Table 3. The model explained 74% of variations in the predictive power of the model (R^2= 0.74). Total hectares allocated to each farmer was significant at the 1% level while access to credit and markets, gender of smallholder farmer and marital status were all significant at the 5% level. The farmer's age and level of educational achievement were significant at the 10% level.

Table 3: OLS regression results

Variables	*β*	*Std error*	*Significance*
Farmer's age (AGE)	-0.040	0.0189	0.052
Level of education (EDU)	0.026	0.021	0.079
Gender (GEN):	0.024	0.035	0.032
Marital status (MARSTAT)	0.222	0.948	0.050
Credit access (CREACC)	0.283	0.760	0.030
Market access (MARACC)	2.686	1.050	0.011
Plot size (PLOTSIZ)	0.491	0.599	0.000

R^2 = 0.74; n=370; Dependent variable= average gross margin from crop production per farmer

DISCUSSION

It has been shown by several studies that women participate in farming mainly for ensuring family food security rather than being driven by profit motives. The dominance of males is therefore a matter that needs immediate redress. This could be achieved by changing mind sets that regard women as inferior to men, particularly through education and women empowerment, including focusing financial assistance towards women led farming ventures. This finding has serious implication for the sustainability of irrigation schemes in particular and food security generally. Strategies to attract youth towards agricultural production activities need to be developed. The low income generated from farming activities is a matter for serious concern. Youth should not only be provided with high production oriented inputs such as tractors and other labour serving equipment, but also be

Table 2: Crops grown by irrigation scheme farmers

Type of crop	*Number of farmers*	*Percentage*	*Average gross margin/season (R)**
Cabbage	215	58.1	5 356
Tomatoes	207	55.9	7 711
Green maize	206	55.7	2 827
Sweet Potatoes	191	51.6	7 038
Tomatoes	184	49.7	309
Sweet potatoes	118	31.9	146
Spinach	107	28.9	792
Okra	78	21.1	222
Onions	55	14.9	4 176
Garlic	29	7.8	7 384
Beans	22	5.9	1 831

Source: Survey data, 2011; * Average gross margin= Total gross margin ÷ Area planted

encouraged to produce high value export crops that could generate attractive incomes.

According to Randela (2005), the marital status of households is usually used to determine the stability of a household in African families. It is normally believed that married household heads tend to be more stable in farming activities than unmarried heads. According to Yokwe (2009) the level of education in most agricultural projects is medium to relatively high on average with secondary level being the most frequent level attained. Normally, farm investments are cross-subsidized by primary off- farm income, so that the level of production and the farming intensity are higher. Thus one can estimate that the level of education, off-farm income and farm income have a positive correlation. This is an encouraging result, more so in that educated people access information (both print and electronic) much easier. Magingxa et al. (2009) indicated that training of farmers and their collectives is needed in the domains of farm and scheme management.

CONCLUSION

The study revealed that most respondents were aged, male dominated, mostly married. Many farmers practised their farming on small plots and depended extensively on local markets for disposal of their produce. Crops such as tomatoes, garlic and sweet potatoes proved to be the most profitable in terms of average income generation. Inferential statistical results reflected positive significant effect of total hectares allocated to each farmer, access to credit and markets, gender of smallholder farmer and marital status on income generation. In line with previous findings, age of respondent revealed a negative association with income generation. The provision of support with the development of reliable networks for the marketing of produce beyond the local environment is also found to be critical. Through this type of linkage farmers are expected to gain access to information on formal markets. The implication for income generation by smallholder irrigation is that all the variables save for the level of education attained reflects an increasing tendency to the income generated. The negative Beta sign confirms a decreasing tendency in income generation with increases in the age of the farmer.

RECOMMENDATIONS

This paper recommends the increase in household income of farmers on smallholder irrigation schemes in the Vhembe District through the involvement of youth in crop farming ventures. The dominance of elderly farmers in the management of smallholder irrigation schemes is a matter for serious concern requiring the need to impress upon existing farmers to develop succession plans that would largely incorporate youth. This can be achieved through an extension service that would not only encourage the elderly to transfer their farming skills to younger generations, but also harness efforts that would attract youth to farming. The latter could involve road shows directed at unemployed agricultural graduates and youth at universities and colleges of agriculture.

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