

Impact Analysis of Taung Irrigation Scheme on Household Welfare among Farmers in North-west Province, South Africa

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KEYWORDS Food Security. Household Welfare. Per Capita Expenditure. Irrigation Scheme

ABSTRACT The study examines the impact of Taung irrigation scheme on the household welfare among farmers in the North West Province. Irrigation farming is one of the most important rural development investment strategies that can have both direct and indirect impact on poverty and food security. The sampling frame of the study consists of 137 farmers and a sample of sixty farmers was selected for the study. The relationship between the household welfare and the independent variables were estimated using an ordinary least square regression estimation procedure. The dependent variable used to capture household welfare is per capita expenditure. Per capita expenditure is used as a proxy for per capita income and employed as a measure of welfare. The results of the multiple regression analysis shows that the independent variables relate significantly to knowledge levels of the extension officers with an ($=2.25$, $p<.05$) an R (.67). The significant determinants of household welfare amongst farmers were age ($t=1.78$), gender ($t=1.76$), educational level ($t=2.48$), household head type ($t=1.87$), access to natural capital ($t=-1.95$) and socio-economic status ($t=2.47$).

INTRODUCTION

Agricultural production is the mainstay of the economy. In 1991, it accounted for 40.2 percent of the GDP and employed 57.8 percent of the labour force. About 80 percent of the population is dependent on agriculture for their livelihood. It is estimated that the livestock sector accounts for 33 percent of national income, rainfed traditional agriculture for 25 percent, irrigated agriculture for 25 percent, rain-fed mechanized agriculture for 12 percent and forestry and fisheries for 5 percent. Crop production consists primarily of food grain, sorghum, millet, wheat, sesame, groundnuts and cotton. Livestock population consists of about 21 million cattle, 20 million sheep, 14 million goats and 2.6 million camels. Livestock production is carried out mainly through nomadic pastoralist using traditional practices. Self-sufficiency in food production and food security are important elements in the economic strategy of the country (FAO 2000).

Some argue that nations have an interest in ensuring that there is sufficient domestic production capability to meet domestic needs in the event of a global supply disruption. Significant dependence on foreign food producers makes a country strategically vulnerable in the event of war, blockade or embargo. Maintaining adequate domestic capability allows for food self-sufficiency that lessens the risk of supply shocks due to geopolitical

events. Agricultural policies may be used to support domestic producers as they gain domestic and international market shares. This may be a short-term way of encouraging an industry until it is large enough to thrive without aid. Or, it may be an ongoing subsidy, designed to allow a product to compete with or undercut foreign competition. This may produce a net gain for a government despite the cost of interventions because it allows a country to build up an export industry or reduce imports. It also helps to form the nation's supply and demand market (FAO 2000).

The Taung irrigation scheme was established in 1939 by the South African government as part of the Vaal-Hartz scheme. During the 1970's, political and administrative independence of the Bantustan or native area was encouraged, resulting in the central government's withdrawal and homeland administration taking over. This prompted the incorporation of the Taung Scheme into the Bophuthatswana homeland during the independent homeland era which lasted from 1970 until 1990's and was an integral part of the economic development of the homelands. Irrigation development during the independent homeland era was characterised by modernisation, functional diversification and centralisation of irrigation management (Van Averbeké and Mohamed 2006). The Bophuthatswana government had to take proper control and supervision of the scheme with

uniform regulation as regard water rates, credit facilities and conditions of settlements and maintenance (ARDRI Report 2000).

The scheme was originally developed as 1.7 hectares (2 Morgen), plots per farmer that were irrigated by floods. Almost 200 farmers used the plots for subsistence; growing maize and pumpkin by preference. According to the Tomlison Commission, the 1.7 hectares irrigated holdings were adequate to "provide a family with a living that would satisfy them whereby the whole family will work on the scheme". About 2 500 hectares is under centre pivot system and about 1000 hectares irrigated by conventional sprinkler system. In 1994, after the Bophuthatswana government, the Taung irrigation scheme was reported to have deteriorated and some farms had been abandoned. In the new dispensation, farmers had to make decisions regarding the use of the scheme themselves. Secondly, there was a major shift in government support/services to the scheme. In view of these, some of the participating farmers could not cope. From the foregoing, the need to ascertain the new direction of the scheme in the quest for finding out if it is still achieving its objectives cannot be over-emphasised. The purpose of the study is to investigate the socio-economic impact of the Taung Irrigation Scheme and to determine if the objectives of the scheme are still being realised. The objectives for the establishment of the scheme was to provide for continued improvement of the quality of life for all stakeholders in Taung through the creation of jobs, improvement of food security of rural households and the efficient utilization of resources through sustainable economic farming and agribusiness enterprises (Tapson 1999).

Literature that examines the impact of irrigation on agricultural performance, household income and poverty is mixed. While few studies have found no linkage between irrigation and household welfare, many others have found irrigation to be of great significance for household welfare. Most studies have used poverty as an indicator of household welfare. Jen et al. (2002) also did not find a link between irrigation and the total factor productivity growth of any major grain crop in China between 1981 and 1995. In Tigray region, Ethiopia, Berhanu and Pender (2002) showed that the impacts of irrigation development on input use and the productivity of farming practices controlling all other factors were insignificant. In line with irrigation and poverty linkage, there are a number of studies in different countries which show that irrigation

has served as the key driver behind growth in agricultural productivity and in increasing household income and alleviating rural poverty. Lipton et al. (2004: 10) state that irrigation can reduce poverty, through increasing production and income, and reduction of food price. This helps very poor households meet the basic needs associated with improvements in household overall economic welfare, protection against risks of crop loss due to erratic, unreliable or insufficient rainwater supplies, promotion of greater use of yield enhancing farm inputs and creation of additional employment, which together, enable people to move out of the poverty cycle.

Narayanamoorthy (2001) points out that besides increasing cropping intensity and productivity of crops, the intensive cultivation of crops due to timely access to irrigation, increase the demand for agricultural labourers and hence wage rates for those who lived below the poverty line in India. He concluded that improvement in access to irrigation and investing in human capital development, are the two most important factors for agricultural growth and rural poverty reduction in India. Moreover, a study carried out by Fan et al. (1999) examining the linkages between government spending, growth and poverty in rural India, using state level data from 1970 to 1993, showed that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads, electricity, and education) which target the rural poor, have all contributed directly to the reduction of rural poverty. They found that irrigation development, in addition to raising agricultural productivity, also encourages private investment in these regions.

Empirical evidence from Australia shows that a dollar worth of output generated in irrigated agriculture generates more than five dollars worth of value to the regional economy, which suggested irrigation development has a strong multiplier effect on other sectors of the economy (Ali and Pernia 2003). Shah and Singh (2004) found in India that more irrigation means fewer people below the poverty line. Moreover, Fan et al. (2000), in their study on the role of public investment on growth and poverty, noted that government expenditure on productivity enhancing investment which includes investment in irrigation, has played a significant role in poverty reduction and enhancing productivity in rural China.

Bhandari et al. (2006: 15-20) using farm-level data collected from 324 households in Nepal, also

indicated that shallow well tub wells irrigation has generated a significant positive effect in increasing rice yields and overall farmers' incomes. An average yield of shallow tube well irrigation owners was increased by 86 percent when compared to that of rainfed farmers. The net income of shallow tube well irrigation owners exceed that of the rainfed farmers by \$69 per hectare, which has an obvious effect on the ability of the farmers to reduce poverty and sustain their livelihood strategies. Moreover, Hussain and Hanjra (2002, 2004), also found that the productivity of irrigated lands were twice that of non-irrigated reference areas, the net productivity benefits defined as the difference in net output values between irrigated and non-irrigated lands varied widely across settings from US\$23 to US\$600 per hectare.

Lire (2005), in eight public managed micro dams and 29 surrounding villages in Tigray, Ethiopia showed that agricultural yield and farm profit have significantly increased in villages with closer proximity to the dams than in those farther away from the dam water resource. According to the study, the overall evidence suggests that carefully designed irrigation dams could significantly improve agricultural production and overall food security. Empirical results on the determinants of poverty in Tigray reported by Hagos and Holden (2003), indicate that physical asset endowment, in terms of access to irrigation, farm size and livestock holding, were reported to have a positively significant effect in improving household welfare and food security status. Irrigation, not only contributes to increased crop production but, may also reduce variability in production through improved control of the crop environment. In this respect, an empirical study carried out in Nigeria showed that the proportions of population of irrigation beneficiaries that experienced crop failure and poor harvest dramatically declined in comparison to the pre-irrigation status (Babatunde 2006).

A study conducted by Madhusuda et al. (2002) in India, indicated that availability and access to irrigation infrastructure, coupled with the availability and access to new technologies- high yielding varieties and fertilizers, were major underlying factors for the success of the green revolution in India. They noted that better access to irrigation has facilitated intensification of cropping practices and inputs used, and contributed to the "modernisation" of the agricultural sector.

By creating more secure and stable rural communities, access to irrigation water can also

help stop migration to already overcrowded cities and slums (van Hofwegen and Svendsen 2000; Chambers 1988). This is supported by Hussein et al. (2002) that, labour employment per hectare and wage rate were found to be significantly higher in irrigated settings than in non-irrigated settings in Sri Lanka and Pakistan. Furthermore, a study conducted by Hussein and Hanjra (2003) in South and South-east Asia, found that higher labour employment and wage rates were reported in irrigated than rain-fed areas, and they concluded that this change in wage was a direct result of irrigation development. Furthermore, they provide evidence on the significant contribution of irrigation to employment generation in agriculture. They noted that the annual labour work per hectare in the Ganges-Kobadak irrigation system of Bangladesh was around 100 days more than that in nearby non-irrigated areas. This additional labour demand creates better full time employment opportunities for farm family members and also create employment opportunities for hired labour. Moreover, they indicated that hired labour used in irrigated settings was double compared to that of nearby non-irrigated areas and the wage rate was 15 percent higher in the former than in the latter areas.

Qiuqiong et al. (2005) argues that the green revolution in Asia would not have happened without massive irrigation development. Without continuous irrigation, many countries would have been unable to achieve the agricultural and economic growth rates required to achieve food security and reduce poverty. They state that, irrigation has been tremendously effective in generating a variety of benefits such as improvements in productivity, employment, wages, incomes and consumption expenditures which directly has an effect in reducing poverty within the irrigated perimeter. Van Koppen (1998) states that, small-scale irrigation schemes given their dispersed nature, and relatively small size, suitability for households under resource-poor conditions, small-scale water harvesting, are not likely to attract significant external support, although small-scale irrigation schemes do offer considerable potential for poverty eradication and equitable resource access.

Frequent drought and adverse economic conditions are the major problems faced by the irrigation sector in semi-arid areas of sub-Saharan Africa. To reduce risks associated with rainfall variability and increase yields of food crops, more public investments in yield-enhancing technologies—such as small-scale irrigation and irrigation

management systems—have been recommended as one important rural development and poverty reduction strategy (Pinstrup-Andersen and Pandya-Lorch 2001). Irrigation farming is one of the most important rural development investments that can have both direct and indirect impacts on poverty and food security in semi-arid tropical countries (IFPRI 2002; Bhattarai and Narayanamoorthy 2004).

Stephen (2004) indicates that in many Asian countries, irrigation would continue to play a major role in poverty alleviation by providing food security, protection against famine and expanding employment opportunities. However, access to irrigation has only been possible where there are adequate developed water resources. Postel et al. (2001) noted that, with affordable drip systems, small farmers can shift from subsistence production to production for the market. This doubles their income and greatly enhances household food security. However, though water harvesting and supplemental irrigation technologies have greater promise for increasing crop yields; their adoption by farmers has been extremely limited, as the risk and costs seem to have outweighed the benefits.

Francois et al. (2003) indicted that 4 micro dams and 2 river diversions irrigation projects in Tigray have been successful in enabling farmers obtain a certain amount of wealth suggesting that farmers involved in irrigation schemes have shown significant improvement in their livelihoods, and earn higher incomes than non-irrigation users. Beneficiary households were able to produce enough for the year round household consumption, build household assets such as different livestock, and better improved houses which directly mitigate vulnerability to shocks. They also stated that irrigation offers the rural population an alternative source of employment and income.

The Taung irrigation scheme has been promoted since 1939 as a means of ensuring food security and in improving the standard of living of the rural people of Taung. On the contrary, the scheme has not lived up to expectation. Since 1994, the scheme has been plagued with technical, financial, institutional, economic and political problems. Based on this, the study is intended to ascertain the impact of the Taung irrigation scheme on household welfare among farmers in the North West Province, South Africa.

The objective of the study is to assess the impact of the Taung irrigation scheme on the farmers' livelihood. The specific objectives are to identify

demographic characteristics of participants of the scheme; examine the livelihood strategies they are engaged; assesses the contribution of the scheme to food security and the standard of living of the farmers; and identify the capital asset that is available because of the irrigation scheme. The study also explored the relationship between socioeconomic characteristics of farmers, participation within Taung irrigation scheme and their household welfare.

METHODOLOGY

The study was conducted in the Taung area, Bophirima district of the North West province. The province lies between 22 and 28 degrees longitude east of the Greenwich Meridian and between 25 and 28 degrees latitude south of the Equator (Cowley 1985). The region is situated 1,200mm above sea level and has an annual rainfall of 430mm. The climate is very dry, especially in winter and summers are hot with temperatures ranging from 16-38 degree celsius. The size of the scheme is 1054 hectares and plots are divided into 7.5 and 10ha respectively. Agriculture plays an important role with approximately 60 percent of rural livelihood. A random sampling method was used to obtain a representative sample. The technique draws sample from an identified population in such a way that every unit in that population has precisely the same chance (probability) of being included in the sample. There are 137 farmers participating in the scheme and a sample of 60 farmers was selected for the study.

Data was collected with a structured questionnaire which was developed based on the study objectives and review of literature. An open and close-ended questionnaire was used to collect demographic information like age, gender, marital status, educational level, household size, household head, and number of dependents, household income and expenditure. The second section on the five capital assets; like natural, physical, human, financial capitals were used to measure the livelihood strategies used by the farmers on the scheme. The financial capital was measured on a three scale indicating availability, adequacy and non adequacy. Physical capital is about the infrastructure, human capital is about knowledge and skills and natural capital about natural resources, mainly land and water. The last section is on socio-economic status, considering at access to credit and farm incomes. Data was analysed with SPSS using frequency distribution

for demographics, regression analysis for determinants of household welfare. The variables in the study include personal characteristics of farmers on Taung irrigation scheme, their production characteristics and indices. The relationship between the household welfare and the independent variables were estimated using an ordinary least square (OLS) regression estimation procedure. The dependent variable used to capture household welfare is per capita expenditure. Expenditure on food and non-food items were aggregated for each household and divided by household size to obtain the per capita expenditure for each household. Per capita expenditure is used as proxy for per capita income and employed as a measure of welfare.

Model Specification

$Y = f(X_1, X_2, \dots, X_{13}) \dots\dots\dots 1$
 $Y = \text{Log of per capita expenditure (Total household expenditure/ household size)}$
 $X_1 = \text{Age}$
 $X_2 = \text{Gender}$
 $X_3 = \text{Marital status}$
 $X_4 = \text{Education level}$
 $X_5 = \text{Household size}$
 $X_6 = \text{Household head}$
 $X_7 = \text{No of dependants}$
 $X_8 = \text{Income}$
 $X_9 = \text{Access to financial capital}$
 $X_{10} = \text{Access to human capital}$
 $X_{11} = \text{Access to physical capital}$
 $X_{12} = \text{Access to natural capital}$
 $X_{13} = \text{Socio-economic status}$

RESULTS AND DISCUSSION

Figure 1 shows that the largest age group is 40-50 which accounts for 19 percent while the least age is less than 40 years and accounts for 7 percent. This confirms that younger people are massively withdrawing from agriculture. This is also in line with the findings of Anyanwa in Akinbile et al. (2007), which active participants in farming activities were between 40 and 50 years. Figure 1 also shows that 92 percent of participants are male while only 2 percent are female, indicating low participation of women in agricultural activities. The other reason is that when the scheme was established men were given preference over women and also, men felt that women could not cope with the demands of the scheme. Women only provided labour especially during harvesting and other off-farm activities to supplement household income.

Figure 1 also shows that 48 percent of farmers in the scheme are married, 6 percent divorced and 13 percent single. Ninety percent of the household is male headed while 10 percent is female headed and the household size ranges from 1 – 10 people.

Thirty six percent of farmers went up until primary, 42 percent secondary and only 3 percent tertiary. This impact on decisions in managing the scheme. Eighty two percent of farmers' income range from 1 000- 15 000, while 12 percent and 6 percent ranges from 16 000 to 30 000 and more than 30 000 respectively. This could be because the expenditure is very high and the income they get from the harvest is not enough to support their household income.

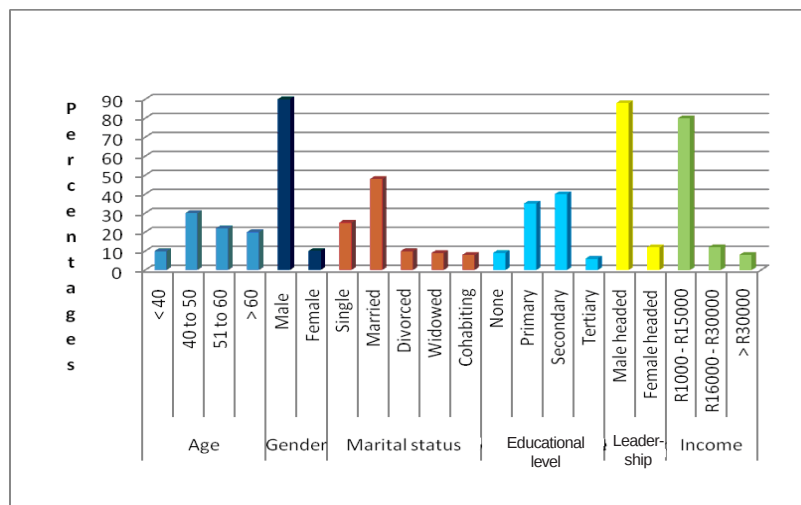


Fig. 1. Household characteristics to assess the impact of Taung irrigation scheme

Sources of Household Income

The sources of household income are divided into two broad categories of farm and non-farm sources. Farm incomes include income derived from the sale of farm produce and non-farm sources include pensions, remittance, wages and salaries and other sources. Table 1 shows that pension is the greatest contributor of 33 percent, followed by remittance at 26 percent, wages and salaries contributing 24 percent and others 20 percent. This finding correspond with results other studies (Ardington and Lund 1996; Carter and May 1999) which indicate that remittance, wages and transfers are more important sources of income for rural household than farming. Farming is the second most important source of income confirming its importance as a contributor to household income. Agriculture plays an important role in poverty alleviation and food security in rural areas, but farming alone is not an adequate source of household income for all farmers regardless of farm size.

Table 1: Sources of income (n = 60)

<i>Income source</i>	<i>Percentage</i>
Pension	30
Remittance	26
Wages	24
Others	20

Access to Financial Capital

Table 1 shows that only 3 percent of farmers get credit from banks and 66 percent complain that they do not have adequate credit, 34 percent get credit from cooperatives, 33 percent from money lenders, 37 percent from personal savings 41 percent from contractors and only 4 percent from government subsidies. Generally, farmers indicated that financial capital is inadequate. Inadequate financial capital limits the farmer's ability to pay for water, electricity, costs of operating and maintaining the irrigation system. This may be attributed to the fact that MAFISA has not been very active in the study area when compared to other provinces in South Africa. Inadequate finance can also prevent households from investing in new methods of crop production and irrigation. In addition, many households are risk averse because they have limited financial abilities to respond to unexpected shortfall in income (FAO, 2008). Inadequate finance also prevents farmers from accessing all the

complementary inputs required to maximize the productivity of land and water resources.

Machete et al, (2004) argues that one of the most critical problems threatening the viability of smallholder irrigation is the absence of credit. Access to credits need collateral mostly in the form of land right, which some smallholder farmers do not possess. Credit is very important in that it helps farmers to acquire all the necessary inputs in right quantities and qualities at the right time. Other services like contract harvesting can be hired on credit and be done on time. Adequate credit could help adopt better new technologies.

Table 2: Access to financial capital (n=60)

<i>Access to credit from:</i>	<i>Availability</i>	<i>Adequate</i>	<i>Not adequate</i>
Banks	3(6)	14(28)	33(6)
Cooperatives	34(68)	12(24)	4(8)
Moneylenders	33(66)	17(34)	0
Relatives	38(76)	10(20)	2(4)
Personal savings	3(6)	10(20)	3(74)
Contractors	41(82)	7(14)	2(4)
Government subsidies	4(8)	2(4)	44(8)

Access to Human Capital

Table 2 shows the vocational training received by farmers in Taung. Ninety eight percent of farmers say they receive extension service household need to enhance their human capital, but many poor households do not have sufficient resources making such an investment. Extension service is important in boosting agricultural productivity; only 88 percent of farmers were trained in water management. With regard to water in agriculture, important enhancement in human capital include knowledge of methods for improving water management to enhance agricultural production. Forty six percent received record-keeping skills, 50% received financial management training. Curtis (1994) argues that an understanding of financial management will generate a continuous flow of information concerning the schemes' profitability, liquidity and reducing risks. This will provide a basis for forward planning. Ninety-eight percent received training in crop protection and 92% in soil management respectively. It is important that farmers should have adequate knowledge and skills of operating within a given level of technology given their resource constraints (FAO 2008). Efforts to intensify and diversify production require investment in new

knowledge and skill that will improve their livelihoods.

Table 3: Vocational training received by farmers on the Taung irrigation scheme

<i>Training</i>	<i>Yes</i>	<i>No</i>
Extension services	49(92)	1(2)
Record keeping	23(46)	27(54)
Water management	44(88)	6(12)
Equipment handling	42(84)	8(16)
Financial management	25(50)	25(50)
Soil management	49(98)	1(2)
Crop protection	46(92)	4(8)

Access to Physical Capital

Physical capital is about infrastructure. Investments in irrigation enhance physical capital. Table 3 shows that 19 percent of farmers have transport while 33 percent are said to have no transport, 88 percent responded by mentioning that roads are not accessible. Sixty-six percent of farmers complained about the availability of electricity. Before ARDC withdrew from the provision of support services, it operated and maintained irrigation pumps in addition to paying for electricity. Irrigation infrastructure consist of 76 percent sprinkler and 18 percent pivot irrigation systems respectively.

Since 1998, the responsibility for maintenance and repairs of irrigation equipment and electricity payment was vested in the farmers themselves. The allocation of water within irrigation is done by water users associations with little interference from government in the allocation of water. Eighty-four percent of farmers complained about storage facilities and these forces farmers to sell their produce immediately after harvest at a lower price. Most farmers (60 percent), lack information on output markets. Other farmers suggested the formation of farmer groups in order to jointly market and get involved in contracts with commercial buyers.

Table 4: Availability of physical capital to Taung farmers

<i>Type</i>	<i>Availability</i>	
	<i>Yes</i>	<i>No</i>
Transport	31(62)	19(38)
Water supply	4(8)	46(92)
Markets	20(40)	30(60)
Road accessibility	44(88)	6(12)
Electricity	22(44)	33(66)
Storage Irrigation	8(16)	42(84)
Sprinkler	31(76)	
Pivot	18(36)	

Access to Natural Capital

Natural capital is about natural resources, mainly land and water. Providing security of tenure is often seen as a pre-condition for intensifying agricultural production and is increasingly stressed as a prerequisite for better natural resource management and sustainable development. The current tenure system that prevails in the Taung irrigation scheme is a communal one. Farmers have PTO (Permission to occupy) with usufruct rights only. Forty percent of the cultivated size is on 7.5ha and 60 percent of the cultivated farm size is on 10ha. Machete et al.(2004) argues that the tenure which prevails in smaller holder areas limits tenure security and also hampers the exchange of land for productive use.

Land tenure status is considered to be an important factor in determining the productivity of farmers. Providing security of tenure is often seen as a pre-condition for intensifying agricultural production and is increasingly stressed as a prerequisite for better natural resource management and sustainable development. The literature suggests that increased security of tenure in productive resources leads to enhanced and sustainable agricultural production. Bembridge (2000) indicates that insecure tenure limits farmers' incentives in making long-term development investments on their land. In principle, farmlands are communally owned. Rukuni (2002) also suggests that communal ownership of land would promote productivity only if communal ownership were secure. Farmers' perception on ownership status differs. They feel that for them to be productive, they should have ownership rights so that they can sell or rent their land and also that their children can inherit the land. The farmers were also asked about the demand for additional land. Only 10 percent were interested and 90 percent were not interested in cultivating larger areas because of low returns from irrigation farming (Table 5).

Table 5: Respondents accessibility to natural capital

<i>Natural capital</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Land Availability</i>		
Yes	38	76
No	4	8
<i>Land Tenure System</i>		
Leased	16	32
Communal land	34	68

Household Food Security

Irrigation is considered as one of the best technologies for ensuring household food security and for sustainable rural development within South Africa's largest semi-arid zone. Hence, it increases employment and household food security. Irrigation schemes can play a significant role in improving household food security. Eighty four percent of respondents acknowledged that the scheme contributes to food security. The household welfare model was estimated using equation 1 and the results of the estimated model is presented in Table 5 The independent variables were significantly related to knowledge levels of extension officers with an F value of 2.25, $p < .05$. Also, an R value of 0.67 showed

type ($t = -1.87$), income ($t = 2.21$), access to financial capital ($t = 3.21$), access to human capital ($t = 1.87$), access to natural capital ($t = -1.95$), and socio-economic status ($t = 2.47$). These findings imply that, the higher the age, education, income and socio-economic status of farmers and the availability of male on the irrigation scheme, the higher the household welfare. Also, the more farmers on the irrigation scheme have access to financial and human capital, the higher the household welfare. However, as the household head type changes from male headed to either female headed or child headed and access to natural capital decreases, the lower the household welfare of farmers on the irrigation scheme.

Table 6: Determinants of household welfare among farmers on the Taung irrigation scheme

	<i>B</i>	<i>Std. error</i>	<i>t</i>	<i>p</i>
(Constant)	1.761	.610	2.885	.007
Age	.010	.006	1.782	.083
Gender	.32	.189	1.764	.060
Marital status	.019	.053	.361	.720
Educational level	.085	.034	2.483	.018
Household size	-.002	.021	-.080	.937
Household head	-.273	.146	-1.879	.068
No of dependants	-.016	.018	-.882	.384
Income	1.813	.819	2.21	.001
Access to financial capital	0.288	0.09	3.21	.030
Access to human capital	2.013	1.07	1.87	0.06
Access to physical capital	-.017	.021	-.826	.414
Access to natural capital	-2.030	1.04	-1.95	0.05
Socio-economic status	1.56	.630	2.47	.004
<i>F</i>	2.25			
<i>p</i>	0.027			
<i>R</i>	0.67			
<i>R Square</i>	0.45			

that there was a strong correlation between the independent variables and household welfare. The results further predicted 45 percent of the variation in household welfare. Nine out of 11 independent variables were significant; with 3 variables being significant at 10 percent (age, gender and household head type); while 6 variables were significant at 5 percent (educational level, income, access to financial capital, access to human capital, access to natural capital, and socio-economic status). Significant determinants of household welfare among farmers were age ($t = 1.78$), gender ($t = 1.76$), educational level ($t = 2.48$), household head

CONCLUSION

Irrigation plays a central and dynamic role in the improvement of rural livelihood, but it is often characterised by inefficient water use, high capital and recurrent cost, lack of sustainability and inequity in the distribution of land. The following conclusion can be drawn based on the findings and focusing on the objectives of the study. The higher the age, educational, income and socio-economic status of the farmers and the availability of males on the scheme, the higher the household welfare. The availability of financial and human capital also contributes to a higher household welfare. The male-headed household has a significant relationship to the household welfare while the female and child headed household lower household welfare. Unavailability of natural and physical capital lowers the household welfare of farmers on the irrigation scheme.

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