ANALYSIS OF IRRIGATION DEVELOPMENT POST FAST TRACK LAND REFORM PROGRAMME. A CASE STUDY OF GOROMONZI DISTRICT, MASHONALAND EAST PROVINCE, ZIMBABWE

By

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Abstract

Irrigation development is a gateway to increased agricultural, water and land productivity, increased household and national food security. However, irrigation development has been a major challenge in many developing countries, including Zimbabwe. The launch of the Fast Track Land Reform Programme (FTLRP) in 2003 ushered in new unskilled cadres and this was followed by a reduction in area developed for irrigation from 200,000ha to approximately 120,000ha. This was due to thefts, dilapidation, and vandalism of irrigation infrastructure. The government made efforts to develop and bring back the 200,000ha into operational, but little has been achieved. To assess irrigation development post FTLRP, a case study was done in Goromonzi District. Using a Trend Analysis to assess the trend in irrigation funding, a downward trend was revealed. A Gross Margin Analysis, modeled via the Business Coefficient Expansion Factor (BCEF) to evaluate productivity and profitability of the irrigation enterprises showed that farmers performed below average and major irrigation crops were below the ideal BCEF threshold of 2.5, suggesting non-profitability of irrigation enterprises. An analysis on infrastructure revealed that most of it was partially or non-functional, hence farmers reduced area under irrigation. The study also revealed non-accessibility of training services by farmers. The study concluded that inadequate irrigation funding, low irrigation productivity, non-profitability of irrigation enterprises, poor cost recovery mechanisms and lack of relevant training has led to low irrigation development. The study recommends that national governments should formulate and hold sound irrigation development strategies and encouraged to partner with public and private institutions in defining and implementing such comprehensive strategies for sustainable irrigation development.

Key Words: Irrigation, irrigation development; funding; productivity; cost recovery; viable; FTLRP;

1. INTRODUCTION

Rukuni *et al* (2006) notes agriculture has dominated the Zimbabwean economy despite contributing only 15-20% to Gross National Product. It provides income to over 75% of the population of 12 million. In most years, 95% of all food beverages have been locally produced and agriculture accounted for 30% of formal sector employment and over 40% of total national exports. Manufacturing is dependent on agriculture as a source of raw materials with most consumer expenditure on products derived from agriculture. Moreover, about 80% of the rural population lives in Natural Regions III, IV and V where rainfall is erratic and unreliable, making dry-land cultivation a risky venture. Climatic conditions are largely sub-tropical with one rainy season, between November and March. Rainfall reliability decreases from north to south and also from East to West. Only 37% of the country receives rainfall considered adequate for agriculture. This makes irrigation development a prerequisite in these areas.

The Government of Zimbabwe (GOZ) has recognized the role of irrigation development as a key drought mitigation measure. Tremendous strides have been made by the government, the private sector and the donor community in the area of irrigation development since independence in 1980, (Rukuni et al, 1994). The country is divided into five broad agro-ecological Natural Regions in which the dominant partitioning factor is rainfall. The irrigation sector plays a vital role in food production and rural economies. Looking forward, the strong demographic and increased income push to food demand is expected to continue in the future, and irrigated agriculture needs to continue rapidly expanding and intensifying. The estimated irrigable area in Zimbabwe is 550 000 hectares, of which 200 000 hectares has been developed. The area includes functional and non-functional irrigation systems, as well as informal irrigation schemes. On the basis of physical criteria, only some extra 200 000 to 250 000 hectares can be irrigated (FAO, 1990).

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Manzungu (2003) indicates that the current functional area stands at 120,000 hectares since the FTLRP was launched. New entrants in the irrigation sub-sector include A1, A2 and indigenous large-scale commercial farmers, who between them now account for about 30% of the irrigated area. It has been observed that about 30% of farmers in the small holder irrigation schemes lack the ability to fully utilise their irrigated plots and it will be interesting to see whether the new irrigated plots are fully utilised in future.

The major objective of this study is to analyse irrigation development post FTLRP of 2003 in Zimbabwe. The study focuses on the level of irrigation funding, irrigation systems at farms, performance of farmers and accessibility of irrigation services. It further assesses the profitability of irrigation enterprises and existing cost recovery mechanisms. Section 2 presents literature studies on irrigation development and management. Section 3 briefly presents on the methodology and analytical tools employed in the study. Empirical findings of the study follow in section 4 and section 5 presents conclusions and recommendations of the research study.

2. IRRIGATION DEVELOPMENT AND MANAGEMENT

2.1 Irrigation Infrastructure Investments

Irrigation development continues to expand, but now the pace is slowing worldwide. In many countries, there are now challenges and constraints to irrigation development, particularly social and environmental concerns. Low productivity of many existing schemes has prompted a change in investment policy away from new infrastructure and toward programs that improve the performance of existing schemes (Water Sector Board, 2007). Jones (1995) indicates that there has been a sharp decline in World Bank lending for new irrigation schemes. Jones also states that funding for new irrigation construction has largely stopped and the emphasis is on the sustainability and efficiency of existing systems. In partial support of Jones, Thompson (2001) states that irrigation is still one of the core investments activities of the World Bank's Rural Portfolio though the number of irrigation schemes is expected to decrease. This, according to Thompson, is attributed to the fact that investments in irrigation systems are perceived to have failed to address the changing needs of irrigation services as rehabilitation of existing schemes was mostly carried out to restore original project objectives as this did not take into account or ignored the desirable changes in cropping patterns and irrigation techniques, thus allowing low water-productivity practices. Thompson (2001) further states that cost and time overruns in irrigation projects have further eroded the confidence of funding agents in irrigation development.

Mara (1990) points out that related issues of financial and physical sustainability tend to be naturally linked to revenue and expenditure sides of government operations given that irrigation supply comes largely from the public sector investments; hence the institutional options have significant implication for the efficiency of irrigation operations. Denison *et al* (2007) states that despite the South African government pouring millions of Rands into smallholder irrigation schemes, many of these have collapsed or remain under-utilised. Denison *et al* concludes that infrastructure development alone is unlikely to succeed, rather, comprehensive strategies which considers all the activities that make up irrigation enterprise, such as markets, finance, inputs, institution-building and crop production information are needed for success. A report by FAO (1997) identified constraints that have slowed irrigation investments to include relatively high cost of irrigation development inadequate physical infrastructure and markets, poor investments in irrigation, lack of access to improved irrigation technologies, lack of cheap and readily available water supplies.

2.2 Irrigation Funding

Irrigation is expensive and the profitability of irrigated production is critical in justifying both short-term and long term viability of an enterprise, thus strong management is needed to enhance efficiency, cost recovery and be able to sustain the whole system Rukuni (2006). Development costs for small-scale irrigable schemes continued to rise due to several factors, with the development of a hectare of land estimated to be between US$2,000 to US$3,000 for engineering works yet Zimbabwe is faced with an acute shortage of foreign currency and this has affected the costs of raw materials that are procured from outside the country.

2.3 Operation and Management

Gyasi *et al* (2006) in Ghana looked at the determinants of the success of community-based institutions for irrigation management and the assumption that communities and user groups will manage the systems sustainably may not hold in all cases. Evidence of success especially in the context of small scale irrigation systems is limited. Indeed, previous experiences with community managed irrigation schemes in northern Ghana have not always been positive. Many schemes severely deteriorated or broke down completely in the past due to insufficient maintenance. Gyasi *et al* also notes that market integration generates exit options as maintenance schedules that coincide with market days would receive very poor response. Similarly, higher wages (and in general, exit options) outside the schemes increase the opportunity cost of labour and reduce the incentive for households to participate in the maintenance of the irrigation schemes. Transparent and accountable leadership is also shown to be an important concern that affects the incentives for households to contribute to the maintenance of the schemes. Lack of transparency, accountability and incidences of rent-seeking reduce trust and confidence in leadership, and undermine management efficiency. Leaders perceived to be corrupt lose their moral authority to enforce rules and regulations.

2.4 Irrigation Viability and Cost Recovery

A Southern African Development Community (SADC) report in 1992 reported that most new smallholder irrigation schemes in the Southern Africa region will not cover the cost of development and operation and are therefore uneconomic. Mupawose (1984) questioned the economic viability of smallholder irrigation schemes in Zimbabwe and pointed out that certain smallholder schemes have failed and are under-utilized due to poor management, lack of inputs and irrigation experience by farmers. In the same report Mupawose advocated for the reduction of subsidies on smallholder irrigation and indicated that irrigation development has become expensive. He suggested that some form of cost recovery should be employed in these schemes. However, FAO (2002) concluded that cost recovery from poor farmers for operation and maintenance of irrigation systems is controversial as subsidising these services and providing irrigation water far below cost is financially unsustainable. Stepped tariffs in which the basic need is provided free to poor people may work in the case of drinking-water but is difficult to implement for irrigation water. Monitoring the efficiency of water use in agriculture for many small farmers each using a small amount of water is expensive, but providing irrigation water below cost contributes to water wasting.

3.0 DATA ANALYSIS

Statistical Package for Social Scientists (SPSS version 15.0) and Microsoft Excel were used to run the data collected from the farmers. The main analytical tools used were the Gross Margin Analysis using the *Business Coefficient Expansion Factor (BCEF).* The main descriptive indicators that were employed in the study are frequency and mean values.

The Trend Analysis was used to assess the funding trend in irrigation development since 2003. The nominal value approach was not appropriate as it does not reflect the value of the irrigation funds over time, especially in Zimbabwe where hyperinflation was experienced and inflation eroded the value of the irrigation funds. The real value of the irrigation funds were thus computed to find the value of funding over time. Nominal values were collected, using 2003 as a benchmark year and the value was changed to real values using the formula below, adopted from Bromley (2006):

$$Y = \frac{Xt}{Za} * Z\beta$$

Where; Y represents the Real Value in Year A

Xt = Nominal Value in Year B

$Z\alpha$ = Consumer Price Index in Year B

$Z\beta$ = Consumer Price Index in Year A

In this study, year A is taken as 2003, the base year.

The Gross Margin Analysis has been chosen to assess the general performance of the farmers in the irrigation farming. A further analysis, using the Business Coefficient Expansion Factor (BCEF) was done. BCEF measures the Return/$VC invested in irrigation agriculture, which is the rate at which the business expands as it operates. In such a scenario, any positive figure is, by default, ideal, but for efficient commercial production, an expansion factor equal or above 2.5 is considered the most ideal, to send profit signals in favour of any crop that enjoys such an expansion factor (Johnson, 1992).

4.0 EMPIRICAL FINDINGS OF THE STUDY

4.1.1 Household characteristics

It is vital to describe household characteristics of sample households for primarily informing explanations. Characteristics such as age, marital status, sex structure, employment, agricultural equipment endowment, livestock ownership, land ownership (irrigable area, homestead and dry land farming area) and ownership of other assets were considered important. This is because the asset base and household demographic structure of the household have implications on flexibility and capabilities with respect to irrigation agriculture and consequently level of development and its management.

4.1.2 Demographic Structure of Households

A household is a dynamic entity, just as a country's population is. The dynamism emanates mainly from demographic variables, most vital age and sex structures. Consideration of household demographic features offers one of the platforms on which to explain observations relevant to this study.

Table 1: Household Demographic Analysis of Households

Variable	Sample Mean
Household size	8.20
Males	3.44
Females	5.64
Household head's age	47
Total number of children	5.77
Children 16 ≤ x ≤18 years	3.29
Children ≤15 years	2.48
Total no. of adults i.e. ≥ 18	2.43

Source: survey data, 2008

NB: The assumption made in this demographic analysis is that an adult is 18 years or above.

The results in Table 1 above show that the average household size is 8.20. The average number of adults is 2.43 and the total number of children per household is 5.77. This has an overall impact on labour availability for any activities at the scheme ranging from irrigation maintenance, repairs to crop production activities. The age group between 16 and 18 years is school-going and limit labour availability in the irrigation farm. On average, there are more females (5.64) to males (3.44), possibly because males work in towns and females are based at the schemes

and tend to oversee all the irrigation works at the farm. Also, this implies that all decisions pertaining to any irrigation developments lies with women in the absence of their male counterparts.

4.1.3 Household Land Ownership

The quantity of land available per household is one of the most important constraint to production for communal farmers, both in irrigation and dry land farming. This information is also important in that it will help in realising whether any activities on different types of land have an effect on the overall level of irrigation development. Irrigation and dry land compete for resources for farming, maintenance of fields among other farming activities.

Table 2: Type of Plots and Area

Type of Plot	Average Total Area (Ha)	Average Operational Area (Ha)	%age Operational Area (Ha)
Homestead	2.08	1.96	94.2%
Dry land	2.62	1.97	75.2%
Irrigation	30.68	14.4	46.9%

Source: Survey Data

Table 2 shows that the average total area owned by a household is 2.08ha at the homesteads, with 94.2% utilisation. Farmers own 2.62ha of dry land area on average with 75.2% utilisation. In normal terms, the onset of summer rains results in most farmers tending their fields and this might explain this higher utilisation rate. However, farmers have 30.68ha for irrigation agriculture on average, but utilise an average area of 14.4ha representing 46.9% utilisation, which is less than half the irrigation area available to them. Low utilisation of irrigation area can be explained in terms of constraints faced by the farmers in irrigation farming and these constraints include dilapidated equipment, inadequate funding for irrigation development, working capital for irrigation activities and labour shortages amongst other challenges.

Labour shortages can be explained with reference to household members available in each household. Table 1 shows an average size of 8.20 household members of which 5.77 are children who cannot tend the fields as they are young and attending school. Also, the irrigation enterprise competes for labour with dry-land farming and other non-farm activities. This concurs to a study by Gyasi *et al* (2006) who stated that market integration generates exit options as maintenance schedules that coincide with market days would receive very poor response. Similarly, higher wages outside the schemes increases the opportunity costs of labour and thus reduce the incentive for households to participate in irrigation schemes. This poses competition for labour on irrigation schemes and hence low utilisation of irrigation land. As such, farmers are forced to reduce the area under irrigation, thereby contributing to low utilisation of irrigable land.

4.1.4 Livestock Ownership

Livestock are an important component of household assets in the communal areas. They contribute to agricultural productivity through providing draught power to both irrigation and dry land farming. They supply manure that is needed in both dry land and irrigation plots and contributes to household food availability through production, as a production asset and through household food accessibility, through income generation. This therefore makes livestock an important asset to the households.

Table 3: Livestock Ownership

Livestock	No. of Owners n = 60	Average No. Owned (n = 60)	%age owners
Cattle	60	24.0	100%
Sheep	29	5.9	48.3%
Goats	34	11.3	56.7%
Chickens	60	16.7	100%
Turkeys	19	4.8	31.7%
Rabbits	16	4.6	26.7%
Donkeys	8	2.4	13.3%

Source: survey data

Results in table 3 show a 100% ownership of cattle and chicken, with an average per owning of 24 and 16.7 respectively. Cattle provide draught power and manure for both irrigation and dry land farming. The other important animals households keep are goats, sheep, turkeys and rabbits. These animals act as sources of food and income generation. Although donkeys are a source of draught power, they seem not to be that important as only 13.3% of the farmers own them due to their monotonous function of draught power for farmers.

4.1.5 Ownership of Agricultural Equipment

Ownership and availability of agricultural implements by households influences timeliness of cultivation and therefore irrigation production yields. Table 4.4 below shows agricultural equipment onwership of farmers.

Table 4.4: Agricultural Equipment Endowment

Implement	No. of Owners	Average No. Owned	%age owners
Hoes	60	5.6	100%
Shovels	33	1.4	55.0%
Ploughs	42	1.2	70.0%
Harrows	25	1.0	41.7%
Wheelbarrow	39	1.2	65.0%
Scotch cart	34	1.0	56.7%
Tractor	8	1.0	13.3%

Source: Survey data

Table 4 shows that the most important tools on the farm are the ploughs (70% owners) and the hoes (100% owners). Farmers often can do without other implements as scotch carts, harrows, cultivators and wheelbarrows. These are important in irrigation farming in form of more timeliness in land preparation and other tillage practices.

4.1.6 Household Off-Farm Employment

Employment is defined as the number of able bodied people who are willing to work and can find a job. The table below shows the employment status of household members.

Table 5: Employment Status of Households

Employment Status	%age
Households with no member in regular employment (locally or elsewhere)	76%
Households with at least one member in regular employment	24%
Total	100%

Source: Survey data

The results show that 76% of the households do not have members in regular employment, suggesting they are fully engaged in farming activities, with 24% of the households confirming having at least one household member in regular employment. This is a source of off-farm income that can be used in irrigation activities.

4.2 IRRIGATION FUNDING

The hypothesis being tested using this approach is that lack of adequate irrigation funding has led to low irrigation development. Generally, an increase in area under irrigation is expected that commensurate with the increase in level of funding. Table 4.6 below shows information on the level of irrigation funding since 2003.

Table 6: Irrigation Funding Post-Fast Track Land Reform

Year	*Consumer Price Index*[3]	*Level of Funding*	
		Nominal Value	**Real Value**
		(Z$ Mil)	**(Z$ Mil)**
2002	432.2	-	-
2003	3,019.9	800,000.00	515,583.25
2004	7,028.7	1,200,000.00	364,516.36
2005	48,205.6	2,500,000.00	289,621.36
2006	665,774.1	4,000,000.00	12,064.13
2007	441,490,130.8	8,000,000.00	-

Source: Department of Irrigation, through questionnaire administration

The data in table 6 above shows that the level of funding has generally increased based on the nominal value, but the real value shows a downward trend. The calculation of real value is as shown below (Bromley R, 2006):

$$Y = \frac{Xi}{Za} * Z\beta$$

Where; Y = Real Value in Year A
Xi = Nominal Value in Year B
Za = Consumer Price Index in Year B
$Z\beta$ = Consumer Price Index in Year A

[3] Source: Central Statistical Office (www.cso.co.za)

In this case, year A is taken as 2003, the base year.

Based on the information in the table above, a general trend graph was computed as shown below:

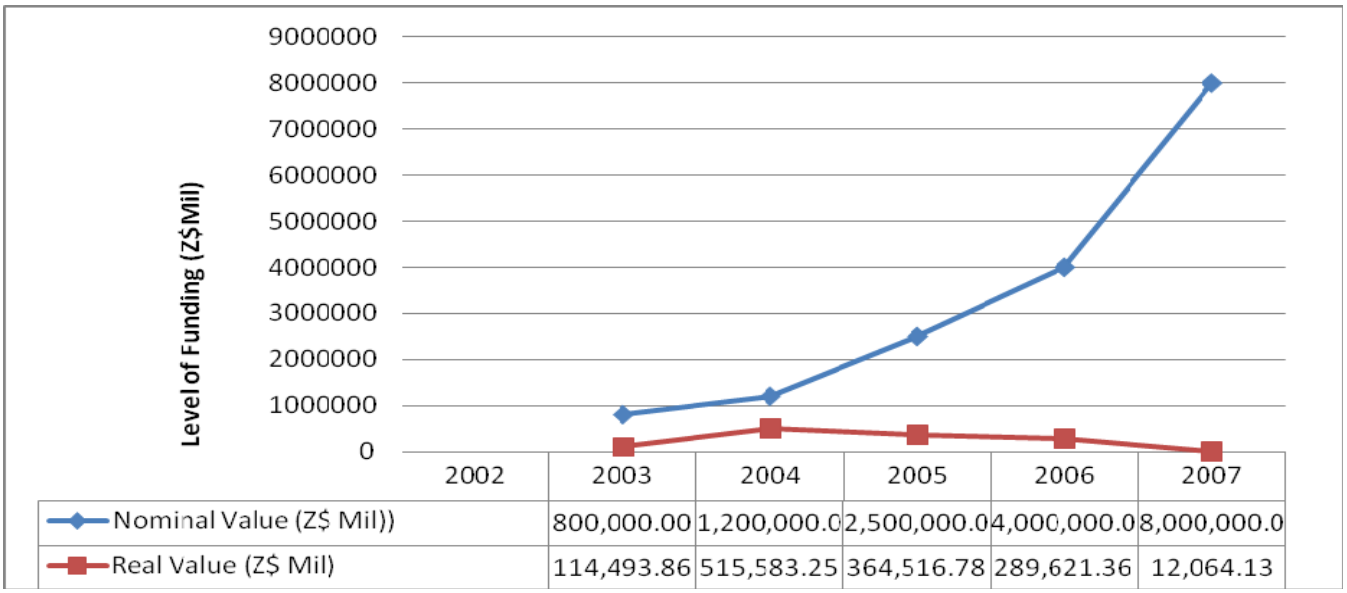


Figure 1: Trend Analysis for Level of Irrigation Funding

Source: Survey Data

The trend analysis in Figure 1 above shows an increase in level of funding in terms of nominal value, but a downward trend in real terms, implying loss of value for availed funds. This above trend suggests inadequate irrigation funding. This is attributed to the hyperinflationary environment in Zimbabwe, which makes it difficult to promote irrigation development. Results concur to Thompson (2001) who highlights that potential financiers seem to lose confidence in financing irrigation development initiatives due cost and time overruns in irrigation projects. Lack of adequate funding for irrigation development can also be explained by the fact that most irrigation funding comes from public sector investment programmes, as put forward by Mara (1990). This is because the government also has to address financial needs of other economic sectors.

An analysis was done on the accessibility of irrigation funds and farmers' responses were analysed as below;

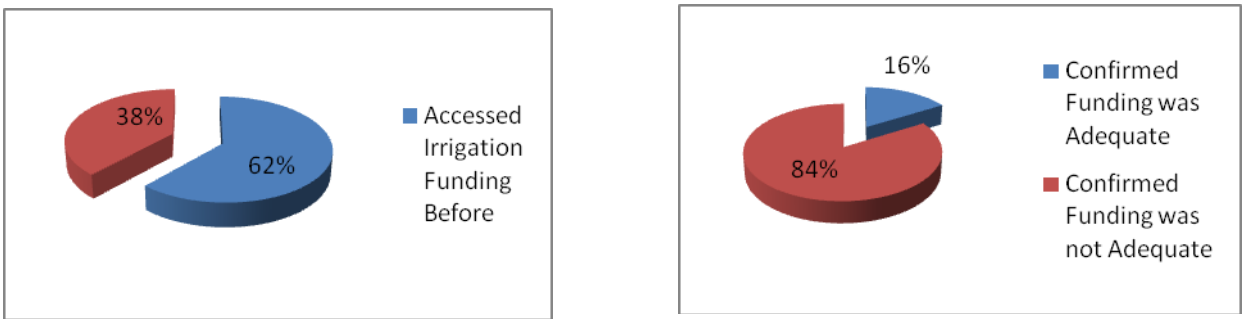


Figure 2: Accessibility of Irrigation Funding by Farmers

Source: Survey Data

Figure 2 shows that 62% of the farmers have accessed irrigation funding before with 38% confirming they never accessed irrigation funding. Sixteen percent of the farmers who accessed irrigation funding indicated that the funds they received were adequate and the rest (84%) indicated funding was inadequate. This can be attributed to the fact that their schemes needed minor equipment for rehabilitation while the other famers had major requirements for their systems. The farmers who confirmed funding was inadequate were further probed on why they indicated funding was inadequate.

Most farmers highlighted the expensiveness of irrigation equipment beyond the reach of most farmers. This results concur to a study by FAO (1997b), stating that high cost of capital investment in irrigation works, especially considering that the communal farmers are resource poor, hampers irrigation development in Zimbabwe. Farmers also highlighted inflation as another reason as the funds they would have received lost its value. Lastly, the farmers stated that most schemes still remained non-functional despite having received funding. A study by Denison *et al* (2007) revealed that many of the smallholder irrigation schemes have collapsed or still remain non-functional despite more funding being poured into their investments.

The farmers highlighted major coping strategies as reduction in area under irrigation as the irrigation equipment at their disposal cannot sustain the total irrigable area at their farms, wait for funds allocation and also apply for loans from banks. However, most of these farmers lacked collateral security and some did not meet the funding criteria as required by the banks.

The farmers who never accessed funding before indicated they have applied and are still awaiting allocation of the funds for irrigation development as they cannot access any funding from any other sources other than the government. The poor resource base of the farmers, fragmented and small size of land holdings, unsecured or lack of land titles and high interest rates as highlighted in FAO (1997b) report explains why farmers fail to apply for funding from other funding agents. In addition, the cost of irrigation development continues to rise due to several factors, with the development of a hectare of land estimated at US$2,000 – US$3,000, yet Zimbabwe is faced with an acute shortage of foreign currency (Rukuni, 2006). This has affected the costs of raw materials that are procured from outside the country.

4.3 IRRIGATION INFRASTRUCTURE

The irrigation system that exists on the farm has an impact on irrigation development. Ideally, too complex irrigation systems might be difficult to operate for some newly resettled farmers. An analysis of existing systems at the schemes was done and the results were as presented in Figure 3 below.

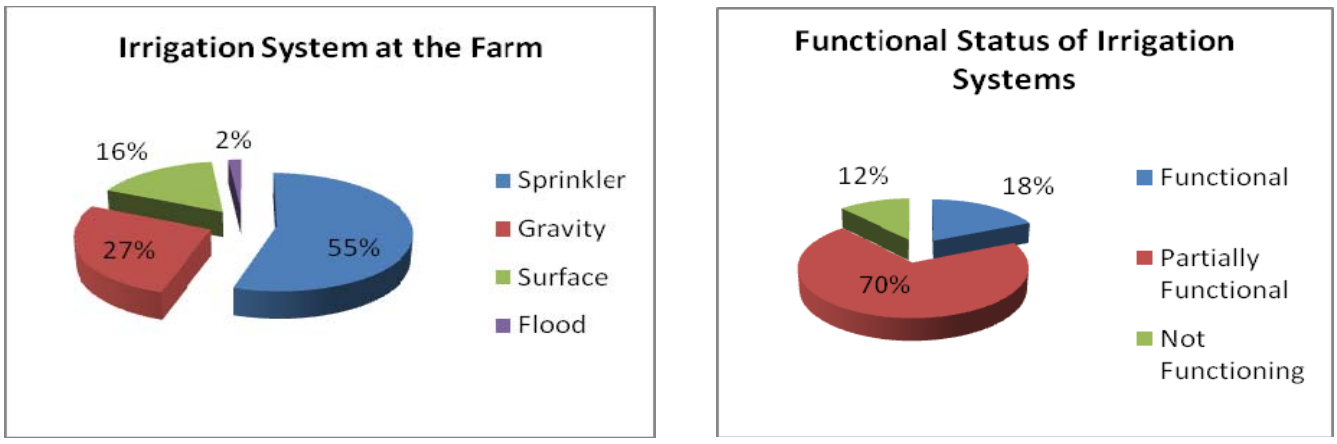


Figure 3: Irrigation System at the Farm and Functional Status

Source: Survey Data

The results in Figure 3 show that the most common type of system at the farms is sprinkler system (55%). This can be attributed to the fact that most irrigation systems were sprinkler before the prior to FTLRP. Gravity is the second major system with 27% of the share. Most farmers seem to be resorting to development of gravity schemes as is cheaper and user friendly. This could be the reason why it is also common. Other systems are surface irrigation system, and flood irrigation system.

With regards to irrigation status, 70% of the irrigation systems are partially functional while 18% are functional. Twelve percent of the schemes remain non-functional or incomplete. As such, efforts to increase the area under irrigation and productivity are compromised. Farmers therefore reduce area under irrigation. Viability of irrigation enterprises is also compromised and the profitability of irrigated production is critical in justifying both short term and long term viability of an irrigation enterprise (Rukuni, 2006). In a way, farmers are unable to service their loans, to repair, operate and maintain their irrigation systems. This results in total collapse of the irrigation system and jeopardise on the sustainability of irrigation systems in the long run.

Moreover, the launch of the FTLRP has resulted in some farms designed for individual being allocated to multiple farmers. As a result, some farmers ended up sharing irrigation infrastructure, ranging from water sources to irrigation pipes, particularly buried pipes that convey water from the source to the fields and electricity infrastructure at the farm. This has impacted on the irrigation development and management due to conflicts that arose. An analysis was done to get an overview on the sharing of irrigation infrastructure, and the responses were as below:

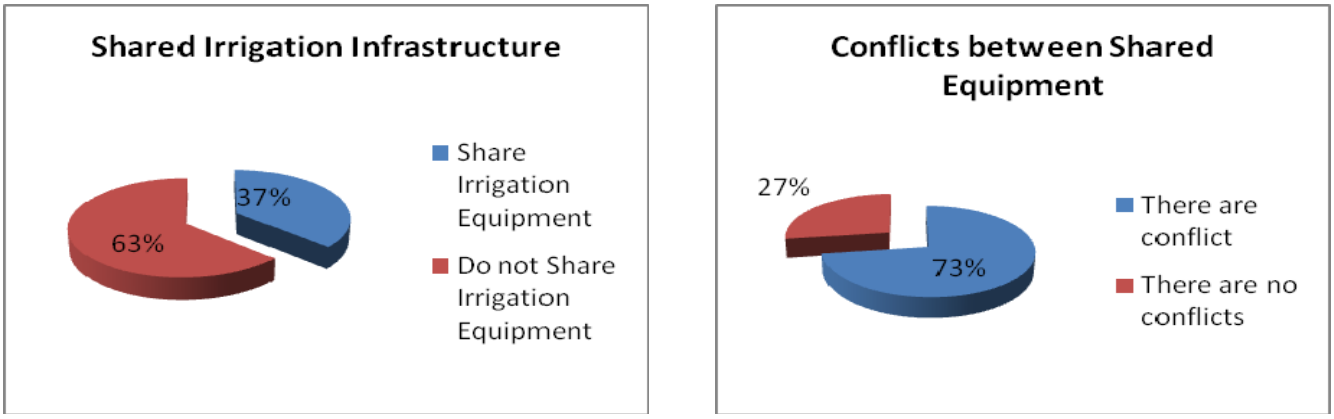


Figure 4: Irrigation Infrastructure Sharing

Source: Survey Data

Figure 4 shows that 37% of the farmers share irrigation infrastructure and of these farmers, 73% have acknowledged existence of conflicts amongst them. The conflicts arose from sharing of irrigation infrastructure at their disposal. The conflicts were mainly reported on difficulties on how to share irrigation infrastructure and water resources, particularly allocation of water to each farmer. Other conflicts arose from paying of electricity charges to those farmers who shared electricity. The reason cited were that some farmers would argue that they only irrigated a smaller piece of land compared to farmers who irrigated larger pieces of land. These conflicts have a negative impact on efforts of increasing area under irrigation and productivity, hence reduced crop yields, thus impacting on viability of the irrigation enterprise.

4.3.1 Type and Status of Title Deeds

The type of title deeds held by farmers has an impact on the level of investment that can be done on irrigation schemes as farmers can make decisions to invest on the farm. Title deeds can act as collateral security and enable

farmers to access irrigation development loans from funding agencies. An analysis was done to assess the type of title deeds held by the farmers and results are shown below:

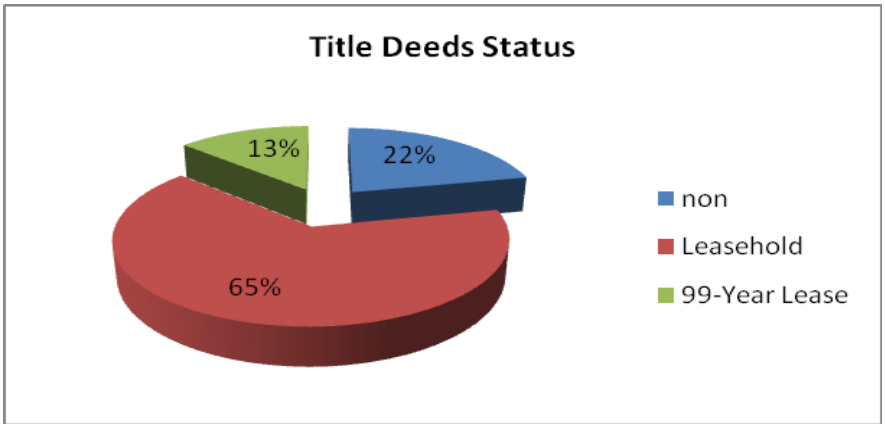


Figure 5: Type and Status of Title Deeds

Source: Survey Data

Results in Figure 5 indicate that 65% of the farmers are entitled to leasehold deeds from the government. Twenty-two percent do not hold any title deeds. Unsecured or lack of land titles affect the capacity of farmers to invest and manage irrigation projects in Zimbabwe (FAO, 1997b). This has kept the area under irrigation low in Zimbabwe. Thirteen percent of the farmers have 99-Year Lease title deeds from the government. The farmers holding 99-Year leases have the passion to invest as they are guaranteed to be that land for a longer period. This will result in increased irrigation development in Zimbabwe, provided all other mechanisms, inclusive of funding, expertise, inputs among others are in place.

4.4 IRRIGATION PRODUCTIVITY

The hypothesis that low irrigation productivity has led to low irrigation development in Zimbabwe was analysed through a Gross Margin Analysis. A further analysis incorporating the *Business Coefficient Expansion Factor* (BCEF) is carried out to measure the return per dollar variable cost invested in irrigation production.

Table 7: Irrigation Productivity of Major Crops at Irrigation Scheme

Item	Green Mealies	Wheat	Cabbage	Potatoes	Tomato
Average Area (Ha)	4.6	3.1	2.0	2.2	2.5
%age of Av. Operational Area	31.9%	21.5%	13.9%	15.3%	17.4%
Expected Average Yield[4]	***135,000 to 160,000 cobs/ha***	***4 – 7 tonnes/ha***	***30,000 to 35,000 heads***	***25 – 30 tonnes/ha***	***25 – 30 tonnes/ha***
Average Yield (Past 3 Seasons)	97,816 cobs/ha	3,1 tonnes/ha	17,016 heads/ha	11 tonnes/ha	14,8 tonnes/ha
Average Yield (2007/08 Season)	76,766 cobs/ha	2,2 tonnes/ha	12,525 heads/ha	10,6 tonnes/ha	12,7 tonnes/ha
Average Price (Z$)	150,000	300,000	250,000	400,000	200,000
Average Gross Income (Z$)	15,514,900,000	960,000,000	3.131,250,000	4,240,000,000	3,540,000,000
Average Total Costs (Z$)	4,856,000,000	456,000,000	1,339,074,520	1,297,598,100	1,341,062,500
Average Gross Margin (Z$)	10,658,900,000	504,000,000	1,792,175,480	2,942,401,900	2,198,937,500

Source; Survey Data

Results show that green mealies utilises 31.9% of the area, and is the major crop that farmers grow at the scheme. Green mealies have a larger share of the average total area. Maize is the staple crop in Zimbabwe and the most common crop that most farmers have knowledge on its production. This explains its dominance over other crops. However, it cannot be considered to be a crop that farmers can rely on with regards to income generation, as farmers get little returns from maize production.

The second major crop grown is wheat as represented by 21.5% utilisation, as shown in Table 7. Wheat is the second major crop grown on the schemes as represented by 21.5% utilisation of land. In contrary, wheat seems to enjoy higher producer price per tonne compared to maize. This means farmers can capitalise on wheat production and realise higher returns than maize, thus raising more funds to cater for irrigation development and operation. The low yields for wheat can be due to the fact that farmers often sow wheat way after the planting dates. This means that when wheat is due, often on the onset of summer rains in Zimbabwe, the crop becomes vulnerable to damage by rainfall. Low yields can also be due destruction by birds. These factors lead to lower yields for the crop and consequently compromise on the returns per dollar invested for the farmers.

Tomato, potato and cabbages make up the list with 17.4%, 15.3% and 13.9% land utilisation respectively. However, these crops are not as important as maize and wheat. The explanation might be that these crops have a higher production cost outlay compared to maize and wheat, and also need extra care in their production. Practically, these crops give farmers a higher return on their investments and boost farmers' capacity to service their loans and participate in cost recovery activities. Mupawose (1984) advocated for introduction of cost recovery in irrigation schemes to improve efficiency and enhance viability. In a way, this reduces pressure on the fiscus. This would also mean the government will be able to serve other sectors of the economy. As argued by O'Mara (1990), he states that the bulk of irrigation funding is mainly derived from public sector investment funds.

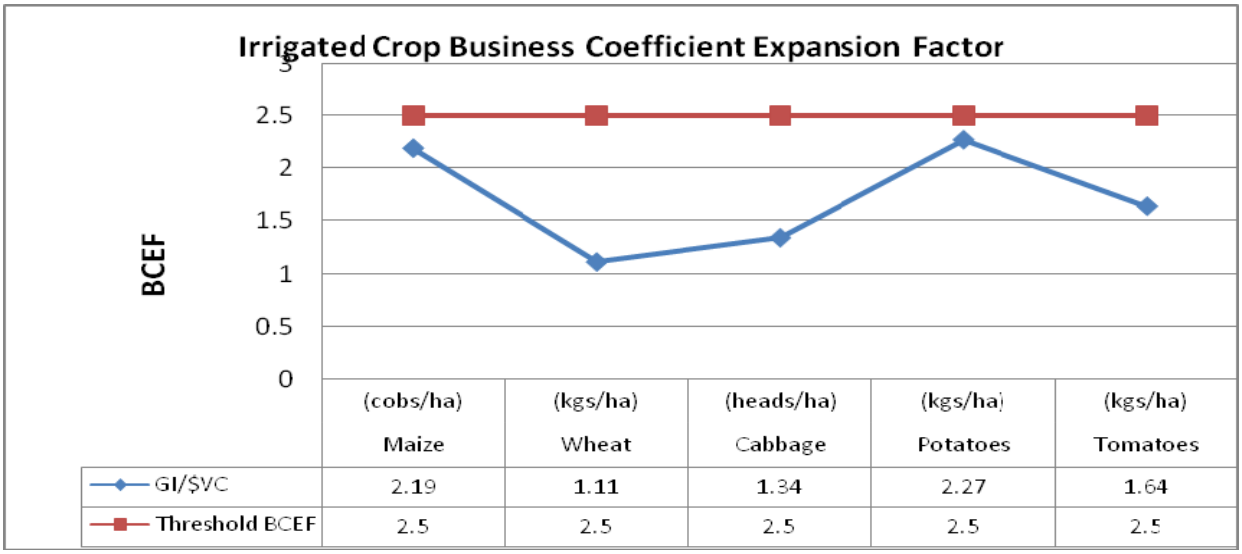
[4] *Expected Average Crop Yields obtained from Agricultural Research and Extension Records*

The production trend depicted in the table 4.8 shows a downward trend in crop production for the past 3 seasons The yields have significantly gone down also in the last 2007/2008 season. The implication of decline in productivity being that irrigation schemes are not viable as they will not be able to cover production costs, thus compromising on sustainability of the irrigation system. This has an overall effect on operation and management of these schemes, thereby negatively impacting on irrigation development initiatives. However, reduced productivity does not always imply reduced profitability; therefore, a further Gross Margin Analysis via the Business Coefficient Expansion Factor was done and is shown in the section below.

4.4.1 Business Coefficient Expansion Factor (BCEF)

The Return/$VC Invested Approach:

The Return / $VC invested in irrigation agriculture gives the business coefficient expansion factor, (BCEF), which is the rate at which the business expands as it operates. Any positive figure is by default ideal, but for serious commercial production an expansion factor equal or above 2.5 is considered most ideal, to send profit signals in favour of any crop that enjoys such an expansion factor (Johnson, 1992). Expansion factors of irrigated crops as weighed against the commercial threshold are as shown in the graph below;



	(cobs/ha) Maize	(kgs/ha) Wheat	(heads/ha) Cabbage	(kgs/ha) Potatoes	(kgs/ha) Tomatoes
GI/$VC	2.19	1.11	1.34	2.27	1.64
Threshold BCEF	2.5	2.5	2.5	2.5	2.5

Figure 6: Return/$VC Invested in Irrigated Crops

Source: Survey Data

Key: BCEF: - Business Coefficient Expansion Factor

GI: - Gross Income; VC: - Variable Costs

Figure 6 depicts the Business Coefficient Expansion Factors for the five major crops grown in schemes. With reference to section 4.4.1, a positive BCEF, by default is ideal, but for commercial purposes, a BCEF of at least 2.5 is acceptable. Potato enjoys a higher BCEF as it is grown as a cash crop and has a higher yield per unit area compared to other crops. Maize also enjoys a higher expansion factor because most farmers are knowledgeable on its production, thus increasing their chances of getting higher yields. Moreover, use of manure also reduces the cost of production, thus farmers maximise their returns. Wheat has the lowest expansion factor. This could be due to the fact that most farmers sow their seeds well beyond the planting date. This makes wheat more vulnerable to damage by rainfall and birds, resulting in lower yields, thus poor returns. However, these Expansion Factors are below the BCEF threshold of 2.5, implying that the crop enterprises are not viable. This compromises farmer's

ability to service loans, repair, operate and maintain their schemes. Irrigation is expensive and profitability of irrigated production is critical in justifying both short-term and long term viability of an enterprise (Rukuni, 2006).

Low irrigation productivity can also be explained in terms of challenges and constraints affecting these farmers. The production constraints as highlighted by farmers include input shortages, inadequate funding, and irrigation infrastructure, labour shortages, lack of irrigation infrastructure and dilapidating equipment. Infrastructure development alone is unlikely to succeed, rather, all the activities that make up irrigation enterprise, such as markets, finance, inputs, institution-building and crop production information are needed for success (Denison *et al,* 2007). Moreover, irrigation development and productivity has been slowed by relatively high cost of irrigation development inadequate physical infrastructure and markets, poor investments in irrigation, lack of access to improved irrigation technologies, lack of cheap and readily available water supplies (FAO, 1997b). Smallholder schemes have failed and are under-utilised due to poor management, lack of inputs and irrigation experience by farmers (Mupawose, 1984).

4.5 COST RECOVERY

Paying back the loans implies that money will revolve in the system for irrigation development thereby releasing pressure on the fiscus. An analysis was done to ascertain whether farmers participated in cost recovery and the results are as presented below.

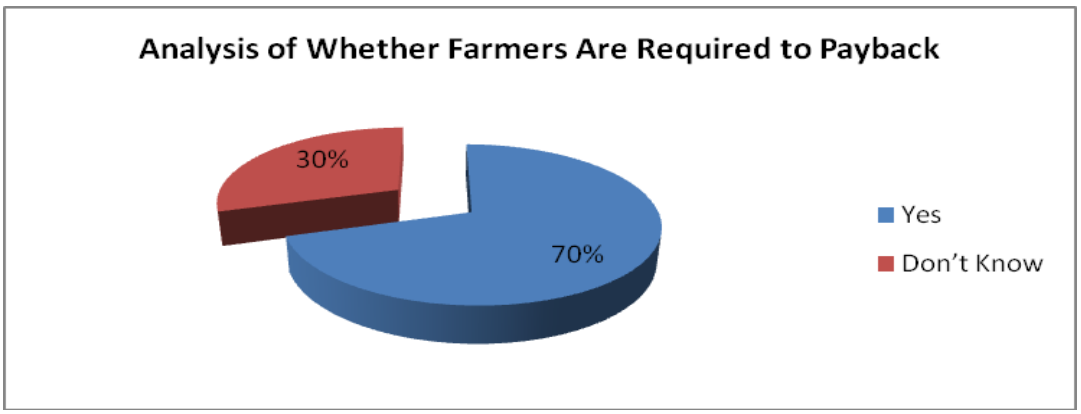


Figure 7: Analysis of Whether Farmers Payback Irrigation Loans

Source: Survey Data

Figure 7 indicate that 70% of the farmers who accessed loans are aware they are required to pay back, while 30% were unaware they were required to pay back. Lack of awareness of paying loans back is due to lack of adequate information amongst farmers on the existing cost recovery mechanisms. Lack of sound cost recovery mechanisms mean lack of funds to promote irrigation development. Irrigation development has become expensive and some form of cost recovery should be employed in irrigation schemes to increase efficiency (Mupawose, 1984).

4.6 ACCESS TO IRRIGATION SERVICES

Irrigation services play a major role in irrigation development. Some of these services include training on agronomic practices, operation and maintenance of irrigation systems, record keeping and irrigation scheduling among others. These are important for the sustainability of irrigation systems to promote effective development and management of irrigation schemes.

Few farmers indicated they had access to irrigation training services from institutions like the Department of Irrigation, Agricultural Research and Extension (AREX). The services accessed by farmers included irrigation training service on agronomic practices and these practices ensure effective irrigation productivity, thus leading to high profitable irrigation enterprises. The other important training service is on record keeping. Irrigation is a business and record keeping is important as it enables farmers to account for inflows and outflows of funds in the scheme, implying farmers can prioritise activities that need critical financing at a given time. The farmers have also indicated they receive irrigation scheduling and operation and management training. This training promotes water use efficiency and management of irrigation systems respectively; therefore ensuring sustainability of irrigation schemes.

Most farmers however indicated they did not have access to irrigation services and attributed this to unawareness of the irrigation services at their disposal, channels they are supposed to take to access the relevant irrigation services and institutions to approach for these services. Lack of farmer empowerment compromises on irrigation development and management as farmers will lack commitment to participate in irrigation activities. Farmers highlighted that they need to be appraised on the available irrigation services, service institutions should be visible on the ground and farmers needed awareness campaigns on channels and relevant institutions available to offer the irrigation training services.

Lack of irrigation training services negatively impacts irrigation development and FAO (2003) report suggests that irrigation-sector institutions need to link their central task of providing irrigation services to agricultural production and to integrate their water demands and uses. Moreover, lack of decentralised service companies to give back-up irrigation services hamper irrigation development in Zimbabwe (FAO, 1997b).

4.7 CHALLENGES FACED BY FARMERS

The challenges faced by farmers in irrigation development and management have a negative impact on irrigation development, its operation and management. These challenges impact on the efficiency and operation of irrigation schemes, hence their development.

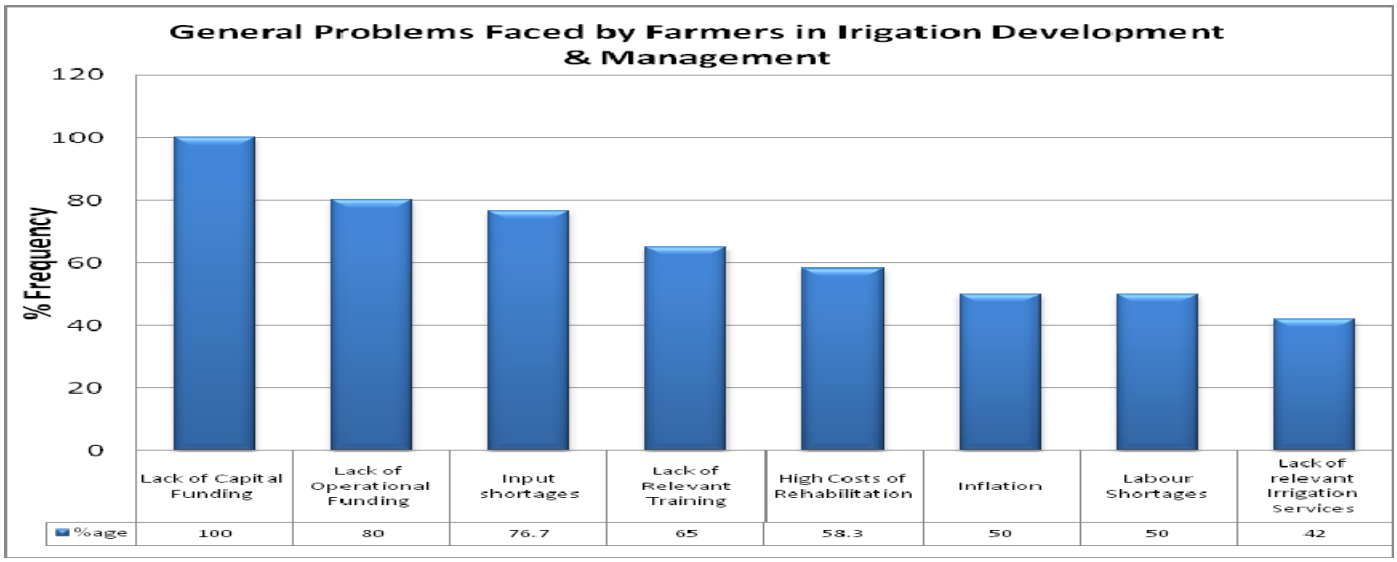


Figure 8: General Problems Faced by Farmers

Source: Survey Data

Figure 8 depicts the general problems faced by farmers. Generally, funding was highlighted as the major challenge faced by farmers. FAO (1997b) mentioned relatively high cost of irrigation development and poor irrigation

investments as hampering irrigation development. Farmers also mentioned input shortages, lack of relevant training, expensive irrigation development works, high inflation, labour shortages and lack of relevant irrigation services as challenges affecting them.

5.3 MAJOR FINDINGS OF THE STUDY

5.3.1 IRRIGATION FUNDING

- There was a downward trend in irrigation funding due to a hyperinflationary environment that prevailed in Zimbabwe.

5.3.2 IRRIGATION INFRASTRUCTURE

- Sprinkler and gravity were the common types of systems at most irrigation schemes.
- Most systems were found to be partially functional while others were non-functional.
- Sharing of irrigation equipment has contributed to partial or non-functionality of irrigation schemes.

5.3.4 IRRIGATION PRODUCTIVITY

- The main crops grown at irrigation schemes included green mealies, wheat, cabbages, potatoes and tomatoes.
- The Gross Margin Analysis indicated that farmers generally performed below average for all crops in the irrigation enterprise as they are produced below average production levels.
- A further Gross Margin Analysis modelled via the Business Coefficient Expansion, showed that none of the crops enjoyed a BCEF of at least 2.5, suggesting the irrigation enterprise were less profitable.
- Irrigation production constraints included input shortages, inadequate irrigation funding, and irrigation infrastructure, labour shortages and dilapidating irrigation infrastructure.

5.3.5 COST RECOVERY

- Farmers who accessed funds from the government acknowledged they were required to pay back the loans, with most farmers indicating they were unaware they were required to pay back.

5.3.6 ACCESS TO IRRIGATION SERVICES

- Most farmers were not able to access irrigation services as they were not aware of available irrigation services, appropriate channels to follow to access the services and were not well-appraised on the institutions offering the irrigation services.

5.3.7 CHALLENGES FACED BY FARMERS

- Major challenges included funding, input shortages, lack of relevant training and expensive irrigation equipment. Other challenges included an inflationary environment that eroded the value of irrigation funds, labour shortages and lack of relevant irrigation services.

5.4 POLICY INSIGHTS

- Inadequate irrigation funding has resulted in poor irrigation development.
- Poor operation and maintenance practices have led to poor irrigation productivity, hence, the collapse of irrigation systems.
- Sharing of irrigation infrastructure resulted in conflicts, hence, low irrigation productivity and development.

- Poor cost recovery and repayment mechanisms imply failure to raise sufficient funds for further irrigation development.
- Type of title deeds farmers hold has impacts on irrigation development.
- Lack of awareness and appraisal on service availability hampers irrigation development.

Based on the above policy insights, it is therefore to take note that increased irrigation funding, coupled with relevant irrigation service provision, sound cost recovery mechanisms and sustainable operation and management of irrigation schemes positively impacts on irrigation development. This has positive economic impacts at national level through increased agricultural growth, increased foreign currency earnings, employment creation, food security and income level.

6.0 RECOMMENDATIONS

Since the launch of FTLRP in 2003, irrigation development has been low despite government efforts to develop and promote irrigation development. This was attributed to challenges and constraints as revealed by the research paper. It is therefore recommended that governments, in partnership with public and private institutions work together in defining and implementing comprehensive strategies for irrigation development. Such strategies should include the following components:

- Review of existing regulations and policies that influence irrigation development since the FTLRP introduced new farmers into the irrigation industry.
- Increased national budgetary allocations for irrigation infrastructure development.
- Develop a legal framework to ensure land rights of farmers. This motivates farmers to invest in irrigation.
- The establishment of an adequate governance and institutional framework for service delivery, implying the need of integrated development approaches to provision of critical irrigation services, that is, widening the knowledge base with regard to irrigation service provision and accessibility.
- Institutionalisation of public–private partnerships in irrigation development, i.e. encouraging private investment in irrigation through provision of credit and financial incentives.
- Capacity building programmes for farmers to strengthen, support, and enlighten farmers and encourage farmer participation in irrigation development.
- Crop diversification to enhance farmers' incomes and viability levels and promote cost recovery from users, adequate to cover operation and maintenance costs
- Promote well-harmonisation of scheme-wise development supported by economically sound, technically appropriate, sociologically sustainable, environmentally friendly and institutionally reliable medium.

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