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Meeting Maize Requirement Production Targets through Utilisation of Potential Irrigable Area: Case of Zimbabwe

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Authors' contributions

This work was carried out in collaboration between all authors. Authors LM and PM performed the principal investigator. Authors CG and JC were collaborating researchers. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Zimbabwe, the once bread basket country of Southern Africa is experiencing recurring food shortages as a result of poor maize harvest. Researchers and politicians have blamed recurring droughts coupled with and lack of timely planting as the main cause of poor yields. This paper assessed whether Zimbabwe could meet its maize requirement if it revamp irrigation infrastructure and utilise its potential irrigable land for maize production. Data for the 8 rural provinces of Zimbabwe on potential irrigable area for the year 2013 was obtained from Ministry of Agriculture, Mechanisation and Irrigation Development. The study assumed four scenarios of average maize yields namely 0.8 tonnes, 2 tonnes, 5 tonnes and 10 tonnes per hectare.

From the analysis it was found out that Zimbabwe has a total of 374 598 hectares of potential irrigable area in its 8 rural provinces of which the majority is occupied by A2, ARDA and Large Scale Commercial Farmers. Of the potential irrigable land, Manicaland Province has the largest area (117 163ha). Assuming that the maize output for the 2013/14 agricultural season of 1.2 million metric tonnes is maintained in the next coming agricultural season, the use of potential irrigable

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land for maize production of an average yield of 0.8 tonnes will result in a shortfall of a 0.6 million metric tonnes. At an average yield of 2 tonnes per hectare, a shortfall of 0.2 million metric tonnes will be experienced. All the other assumed scenarios, 5 tonnes and 10 tonnes per hectare, will result in Zimbabwe producing surplus maize. In order to insure that all the potential irrigable area is used for maize production the study recommended the issuing of maize starter packs for all those owning potential irrigable area, subsidisation of maize inputs by the government as well as setting of price floors for maize production and ensuring ready and reliable maize markets.

Keywords: Drought; irrigation; maize production; markets; subsidy.

1. INTRODUCTION

Zimbabweans have grown maize for years and the country was known as the bread basket of Southern Africa and the richest commercial farmer only grew maize as a cash crop. But in the past decade most farmers in Zimbabwe have failed to meet the national maize requirement resulting in Zimbabwe being food insecure. Most farmers have opted to grow tobacco because it has better cash returns when compared to maize. Zimbabwe started to experience continuous and severe grain shortage since the drought of 1992 and this situation was exuberated in the year 2000 when Zimbabwe implemented the fast track land reform programme. However, after the fast track land redistribution programme of 2000, Zimbabwe experienced heavy reduction in maize yield and output at farm level that led to a shortfall of 70%, resulting in a failure to meet annual food requirements [1].

Recurring droughts coupled with input (seed and fertilizer) shortages and overpricing, and a resultant lack of timely planting, led to very poor harvests in 2008 and 2009 of 0.6t/ha from 2t/ha [2]. According to a Zimbabwe Vulnerability Assessment Committee (ZimVAC) Report [3], the number of households consuming three meals a day declined from 54% in 2006 to 23% in 2009, and many households had to sell their assets, including livestock, to purchase food. Lower food production and failure of agriculture led to dependency on food aid. Areas under cultivation decreased substantially between 1999/2000 and 2007/8. Maize planted area reduced from 850,000ha to 500,000ha, soya planted area from 220,000ha to 60,000ha and tobacco from 180,000ha to 60,000ha [4]. In the beef sector, Zimbabwe has failed to meet its export quota to the EU for a number of years [1].

Since the 2011/2012 agricultural season, Government of Zimbabwe (GoZ) has also failed to incentivise maize production by not paying farmers promptly for maize delivered to the Grain Marketing Board (GMB). Maize by its nature is a low viability crop. It costs US$1235-US$1815 (2012/2013 agricultural season) to grow a hectare of maize under irrigation and if one achieves a yield level of less than 2.5 tonnes per hectare, maize production will not be profitable. According to [5] the inability by GMB to pay farmers promptly has driven most to deliver to private buyers, who pay US$ 200 to 240 per tonne floor price instead of US$395 set by the Government for year 2013/2014 agricultural season. The producer price being offered to maize farmers is disheartening and discouraging that in year 2015 onwards farmers will opt to grow other cash crops instead maize thus worsening grain shortage in Zimbabwe.

According to [6] the Government of Zimbabwe has recognised the role of irrigation development in these communal areas as a crucial drought mitigation measure and as a strategy to increase output per unit area. Lower maize yields being experienced by most farmers are a result of erratic, low and unpredictable rainfall [2]. Access to reliable irrigation can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming [7]. In addition, irrigation development enhances household and national food security and opens up new employment opportunities, both on-farm and off-farm, and can improve income, livelihoods, and the quality of life in rural areas through reducing vulnerability caused by the seasonality of agricultural production as well as external shocks. According to the Ministry of Agriculture, Farm Mechanisation and Irrigation Development, Zimbabwe requires 2.1 million metric tonnes of maize per annum. It is against this background that prompted the investigation of the national food security status of Zimbabwe if the government invest in irrigation development and promote the production of maize crop. The main objective of the study was to determine the whether Zimbabwe will meet its maize

requirement through utilisation of potential irrigable area. The study also recommends strategies for promoting maize production in Zimbabwe.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

Zimbabwe is a landlocked country in the Southern Africa region with an area of over 390 000 km^2. It is bordered by Zambia, Mozambique, South Africa, Botswana and Namibia (Fig. 1). According to [8] it is situated between latitude 15° and 22° south of the equator and between 26° and 34° east of the Greenwich Meridian. The cultivated area was estimated at 3.35 million ha in 2002, of which 3.22 million ha arable land and 0.13 million ha permanent crops [9]. About 70% of the country's soils are derived from granite and are often sandy, light textured and of limited inherent agricultural potential [10]. Rainfall reliability decreases from north to south and also from east to west [11]. Climatic conditions are largely sub-tropical with one rainy season, between November and March. According to [12] Zimbabwe has been divided into five broad Natural Regions (NRs) in which the dominant partitioning factor is rainfall (Fig. 1).

Natural Region I is a specialized and diversified farming region. Rainfall in this region is high (more than 1000 mm per annum in areas lying below 1700 m altitude, and more than 900 mm per annum at greater altitudes), normally with some precipitation in all months of the year [13]. Temperatures are normally comparatively low. Afforestation, fruit and intensive livestock production are the main agricultural activities practiced in this region [8]. In frost-free areas, plantation crops such as tea, coffee and macadamia nuts can be grown. Where the mean annual rainfall is below 1400 mm, supplementary irrigation of these plantation crops is required for top yields. Smallholders occupy less than 20% of the area of this region [13].

In Natural Region II flue-cured tobacco, maize, cotton, sugar beans and coffee can be grown. Sorghum, groundnuts, seed maize, barley and various horticultural crops are also grown. Supplementary irrigation is done for winter wheat. Animal husbandry like poultry, cattle for dairy and meat, is also practiced in. Rainfall is confined to summer and is moderately high (750-1000 mm). Natural region III is a semi-intensive farming region. According to [14], rainfall in this region is moderate in total amount (650-800 mm), but, because much of it is accounted for by infrequent heavy falls and temperatures are generally high, its effectiveness is reduced [11]. Smallholders occupy 39% of the area of this region. Large-scale crop production covers only 15% of the arable land and most of the land is used for extensive beef ranching [8]. Maize dominates commercial farm production. The region is subject to periodic seasonal droughts, prolonged mid-season dry spells and unreliable starts of the rainy season. Irrigation plays an important role in sustaining crop production [13].

Natural region IV is a semi-extensive farming region. This region experiences fairly low total rainfall (450-650 mm) and is subject to periodic seasonal droughts and severe dry spells during the rainy season. The rainfall is too low and uncertain for cash cropping except in certain very favourable localities, where limited drought-resistant crops can afford a side line. The farming sector which is favourable in this region is livestock production. Livestock production in this agro-ecological region can be intensified to some extent by the growing of drought-resistant fodder crops. Communal farmers occupy 50% of the area of Natural Region IV [8].

Natural region V is an extensive farming region. The rainfall in this region is too low and erratic for the reliable production of even drought-resistant fodder and grain crops, and farming has to be based on the utilisation of veld alone. The extensive form of cattle ranching or game ranching is the only sound farming system for this region. According to [8] included in this region are areas of below 900m altitude, where the mean rainfall is below 650 mm in the Zambezi Valley and below 600 mm in the Sabi-Limpopo Valley. Communal farmers occupy 46% of the area of Natural Region V.

About 80% of the rural population lived in Natural Regions III, IV and V where rainfall is erratic and unreliable before the Fast Track Land Reform Program of 2000, making dry land cultivation a risky venture [8,13]. The success rate of rain fed agriculture in Natural Regions IV and V has been known to be in the order of one good harvest in every four to five years.

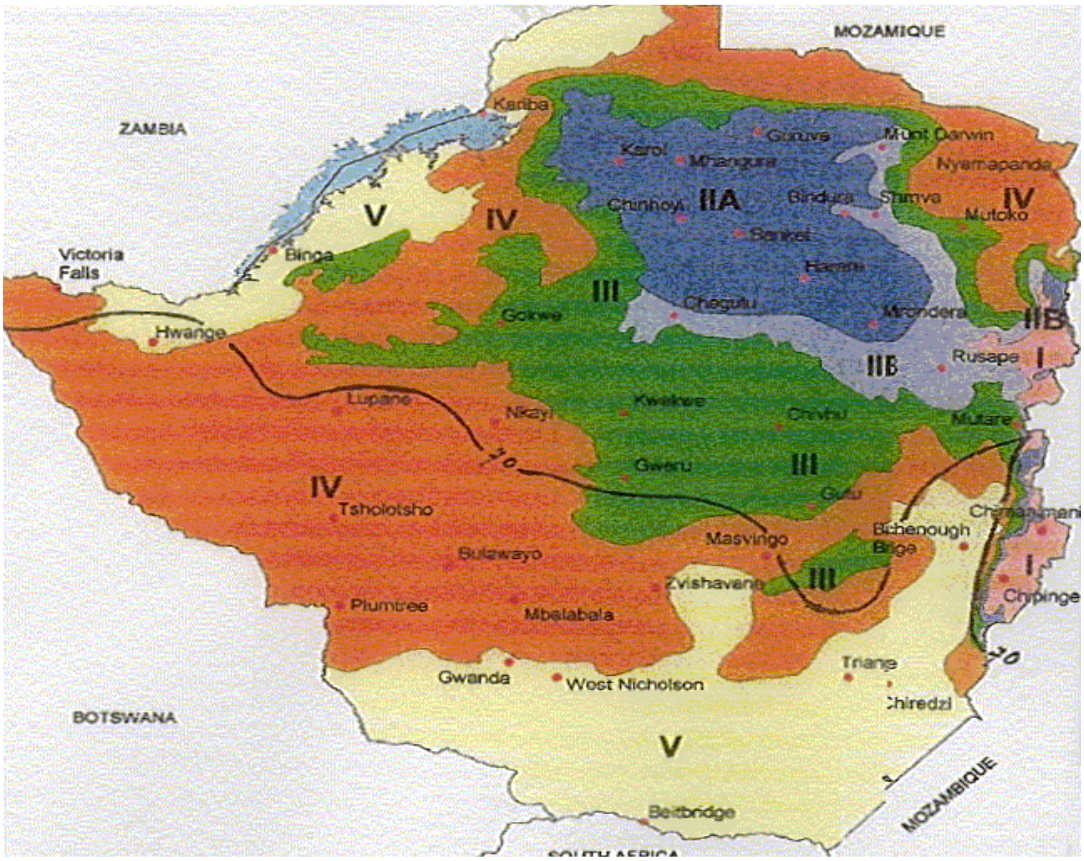


Fig. 1. The five natural regions of Zimbabwe (Source: [15] citing surveyor-General, 1984)

2.2 Farming Systems in Zimbabwe

Zimbabwe inherited a thriving agro-based economy upon independence in 1980 characterized by duality and a racially skewed land ownership pattern. This unequal access to use land forced the government of Zimbabwe to adopt land reform and a resettlement program premised on land acquisition and redistribution [16]. According to [17] the main long standing objectives of this program have been to address the imbalances in land access while alleviating population pressure in the communal areas, extend and improve the base for productive agriculture in the smallholder farming sector, and bring idle or under-utilized land into full production. The first phase of land resettlement programmes was launched by the Zimbabwean government in September 1980. The Government of Zimbabwe acquired 3 498 444 hectares of land and resettled 71000 families under this first phase of land reform programme in the period between 1980 and 1998. The programme provided crop packs and tillage services for half a hectare to each family in the first year of settlement. Commendable progress was achieved in providing infrastructure for the settlers in the early stages of resettlement. The majority of settler families experienced real increases in incomes, which exceeded those of their counterparts in communal areas [16].

The Government of Zimbabwe and all land reform stakeholders who include, farmer organizations (including CFU) industrial and financial organizations, the Land Task Force of the National Economic Consultative Forum (NECF) and civic organizations based on the lessons of the first phase launched the second Phase of the land reform and Resettlement Programme in September 1998 which whose main objective was to redress the inequities in land resource allocations and providing a more efficient and rational structure for land. Phase II of the Land Reform and Resettlement Programme commenced in October 1998 with a two year inception phase where farms covering 2.1 million hectares were to be acquired for resettlement [16]. Infrastructure and farmer

support services were to be provided using Government of Zimbabwe and Donor Community resources. The white commercial farmers contested acquisition of most of the identified farms. Disappointed with the slow pace of land redistribution, the people of Zimbabwe responded, bringing pressure to bear on Government by resorting to the vigorous protests and land occupations. Having lost two years with little activity between October 1998 and June 2000, Government of Zimbabwe resolved to implement the second Phase of the Resettlement Programme, kick-starting the Phase II Resettlement with an accelerated pace, code-named “Fast Track”. This “Fast Track” is an accelerated phase where activities, which can be done quickly, was done in an accelerated manner. This phase expected to cover the period July 2000 to December 2001. The fast Track approach to resettlement also termed jambanja or the Third Chimurenga in Zimbabwe was officially launched on 15 July 2000 to speed up the pace of land acquisition and resettlement, under the provisions of which 1 million hectares would initially be acquired to resettle 30,000 households.

Thereafter another 4 million hectares would be expropriated to accommodate about 120,000 households within three years. However, the target of the programme soon grew exponentially, from 5 million hectares to 9 million and then to 11 million in the following two years [18]. It was now predicted that altogether 300,000 households and 51,000 black commercial farmers received land under the A1 and the A2 models by 2003, respectively.

Model A1 is intended to decongest communal areas and was targeted at land-constrained farmers in communal areas. This model was based on existing communal area organization, whereby peasants produce mainly for subsistence. A1 models are an individual family farm of six hectares plus a common grazing land for livestock. The communal farmers live in villages and have areas for cropping and common grazing lands. Model A2 on the other hand is a commercial settlement scheme comprising small, medium and large scale commercial settlement where crop and livestock production is carried out within the farm, intended to create a cadre of black commercial farmers. This model was, in principle, targeted at any Zimbabwean citizen who had farming experience and/or resources [19]. Large scale commercial farms have average size of about 2 249 hectares as at 2003. The number and area of large-scale commercial farms has been decreasing during the past twenty-two years mainly due to the Government's land redistribution programme. Small scale commercial farming areas have an average size of 148 hectares. In reality, however, only about 127,000 households and 7,200 commercial farmers had been allocated land by mid-2003 [16]. By July 2003, the amount of land used for large-scale commercial farming had shrunk to 2.6 million hectares, from 11.8 million in 1999 [16].

About 11 million hectares changing hands within a three-year period, it was the largest property transfer ever to occur in the region [16]. Although the government announced that the programme would be complete by August 2002, the fast track land reform did not come to an end. Land occupations continued until mid-2003, and then on a diminished scale in 2004. Although the government began to instil some order and regulation into the fast-track process from mid-2003, intermittent occupations of farms and evictions of farmers continued, even into 2014.

A total of 11.8 million hectares of land was occupied by black large scale commercial farms while the communal area occupied a total of 16.4 million hectares of land at June 2000 [16]. Following the implementation of the Fast Track Land Reform Programme a new picture emerged with regard to land ownership patterns as shown in Table 1.

2.3 Data and Data Sources

The study used data that covered the 8 rural provinces of Zimbabwe namely; Manicaland, Midlands, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matebeleland North and South. Data on potential irrigable area for Zimbabwe was obtained from Ministry of Agriculture, Mechanisation and Irrigation Development, Department of Irrigation. The potential irrigable area is defined as the arable land under study for which amenities essential for sustained irrigation are considered to be provided. The data was collected by the Ministry in 2013 contained name of the farm, its location (the province and district), area in hectares of potential irrigable land and source of water for irrigation. The source of water for irrigation did not contain information of the amount of water available for irrigation.

Table 1. Land ownership patterns after the fast track[1] (as at 31 July 2003)

Category	Area (million hectares) as at 31July 2003	% of total land area
A1	4.2	11
A2	2.2	6
Old resettlement area	3.7	9
Communal	16.4	41
Large scale commercial	2.6	6
Small scale commercial	1.4	4
National parks and urban	6.0	15
State land	0.3	1
*Other	2.8	7
Total land area	39.6	100

(Source: [16,18])

2.4 Data Analysis Procedures

Data pertaining to the average maize yield for irrigation area was obtained from International Environmental Technology Centre (IETC) annual report for agricultural season 2012/2013 (2014). Four scenarios of maize yields were used and these were 0.8 tonnes, 2 tonnes, 5 tonnes and 10 tonnes per hectare. Data was analysed using SPSS version 20.0. Descriptive statistics was applied to the basic characteristics of the data. This includes the use of means to describe potential irrigable land in each province and across the type of settlement. Potential yield was obtained by multiplying potential irrigable areas by the potential maize yield per hectare. The average grain shortage in the past 5 years was used as the maize target. Assumptions which were used in the study were that all the potential irrigable areas in Zimbabwe are suitable for maize production under an irrigation farming system.

3. RESULTS AND DISCUSSION

3.1 Distribution of Irrigable Area

Most of the crops grown in Zimbabwe are rain-fed and there is no supplementary irrigation. From the survey conducted in Zimbabwe. Table 2 indicates that Manicaland has the highest potential irrigable area.

Table 2. Distribution of irrigable area by province

Province	Potential irrigable area (ha)	Distribution by province
Manicaland	117 163	31%
Mashonaland central	28 935	8%
Mashonaland east	78 236	21%
Mashonaland west	39 770	11%
Masvingo	67 894	18%
Matebeleland north	3 393	1%
Matebeleland south	16 128	4%
Midlands	23 079	6%
National total	374 598	100%

Source: Government of Zimbabwe (2013)

This province has all the five agro-ecological zones, I, II, III, IV and V, though the largest area is under agro-ecological zone I. The province with the least potential irrigable area is Matabeleland North. In this province the most common agricultural practise is game farming and ranching. All the potential irrigable area have reliable water sources and can irrigate all year round. The potential irrigable area can be equipped with the proper irrigation system to be able to grow cash crops all year round resulting in the farmers' becoming food secure and also reduce poverty among the farmers.

After the fast track land reform programme a new group of farmers emerged which included the A1 and A2. The data in Fig. 2 indicates the potential irrigable land from the various sectors. A2 farmers occupy most of the potential irrigable area with 112578 ha closely followed by LSCF who occupy 117840 ha of potential irrigable area. ARDA occupy 105529 ha of potential irrigable area. The communal, institutions, SSCF and A1 occupy 190, 1878, 1987 and 24 996 hectares of potential irrigable area respectively. Communal farmers occupy the least potential irrigable land. The information excludes land that already has irrigation and is being utilised.

[1]***Please Note:*** *Data on land ownership patterns after the Fast Track as at 2014 was not available hence the latest available data of 2003 was used.*

[*] *Other refers to land that has been acquired for resettlement under Model A1 and A2 but has not yet been taken up by those allocated to the plots.*

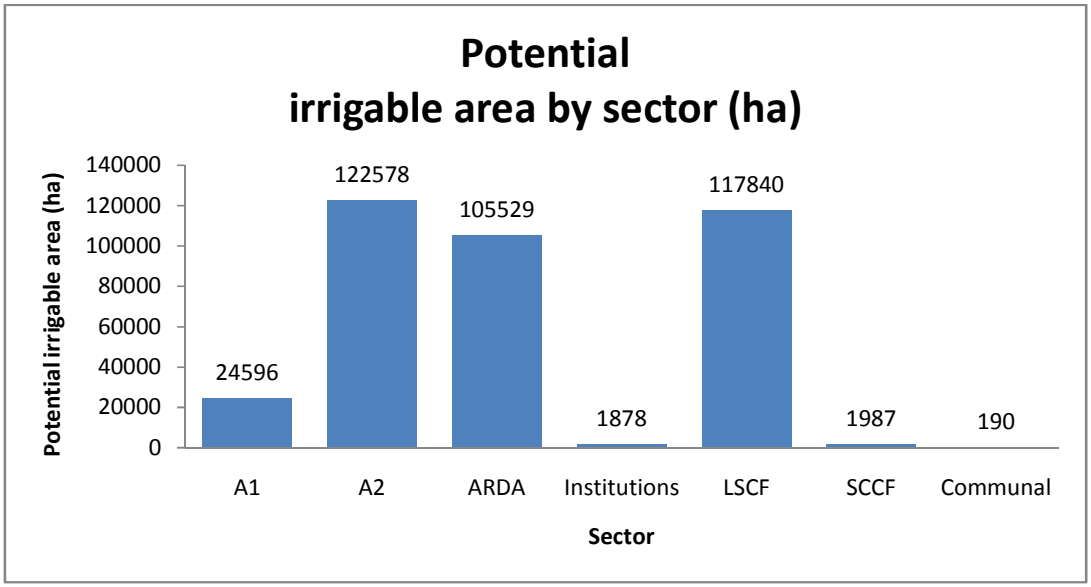


Fig. 2. Potential irrigable area by sector

The A2, Agricultural and Rural Development Authority (ARDA) and Large Scale Commercial Farmers (LSCF) have higher percentage distribution of potential irrigable land of 32.7%, 28.2% and 31.5% respectively as shown in Fig. 3. The potential irrigable land has an advantage in that the potential irrigable lands have water sources within the proximity of the farms and this reduces pumping costs. Information that is not available is the status of the availability of the source of energy required to pump the water from the source to the potential irrigable land and type of pumping equipment required.

According to the Ministry of Agriculture, Farm Mechanisation and Irrigation Development, Zimbabwe requires 2.1 million metric tonnes of maize per annum. Fig. 4 above shows us that if potential irrigable land is used for the sole purpose of maize production and farmers get a minimum yield of 0.8 tonnes per hectare as currently being witnessed in Zimbabwe, only a total of 299 684 metric tonnes will be produced from 374 598 ha against the required 2.1 million metric tonnes. Assuming that all other land is not used for maize production, a shortfall of 1.8 million metric tonnes of maize will be experienced. By taking into account the current maize production for the agricultural season 2013/14 of 1.2 million metric tonnes of maize, a shortfall of 0.6 million metric tonnes will be experienced in Zimbabwe if potential irrigable area is utilised for maize production at a yield of 0.8 tonnes per hectare. This shortfall can be met through importation from neighbouring countries such as Zambia and South Africa which are producing excess maize. At 2 tonnes of maize per hectare a shortfall of 0.2 million metric tonnes will be experienced if Zimbabwe continues to produce 1.2 million metric tonnes on its dry land area and achieve average maize yields of 2 tonnes per hectare on its potential irrigable land. This shortage can be however turned into a surplus if a maize yield of 5 tonnes per hectare is achieved on potential irrigable area. A surplus of 1 million metric tonne of maize can be produce and this can be stored, exported or processed.

Using irrigation, complemented with all the required inputs such as best management practices and correct quantities of fertilizers, maize yields can go up to more than 10 tonnes per hectare. And when farmers can achieve such a yield of 10 tonnes per hectare on potential irrigable area, a total yield of 4.9 million metric tonnes of maize will be produced (including the 1.2 metric tonnes from dry land) resulting in Zimbabwe producing excess maize hence bouncing back as the Africa's bread basket.

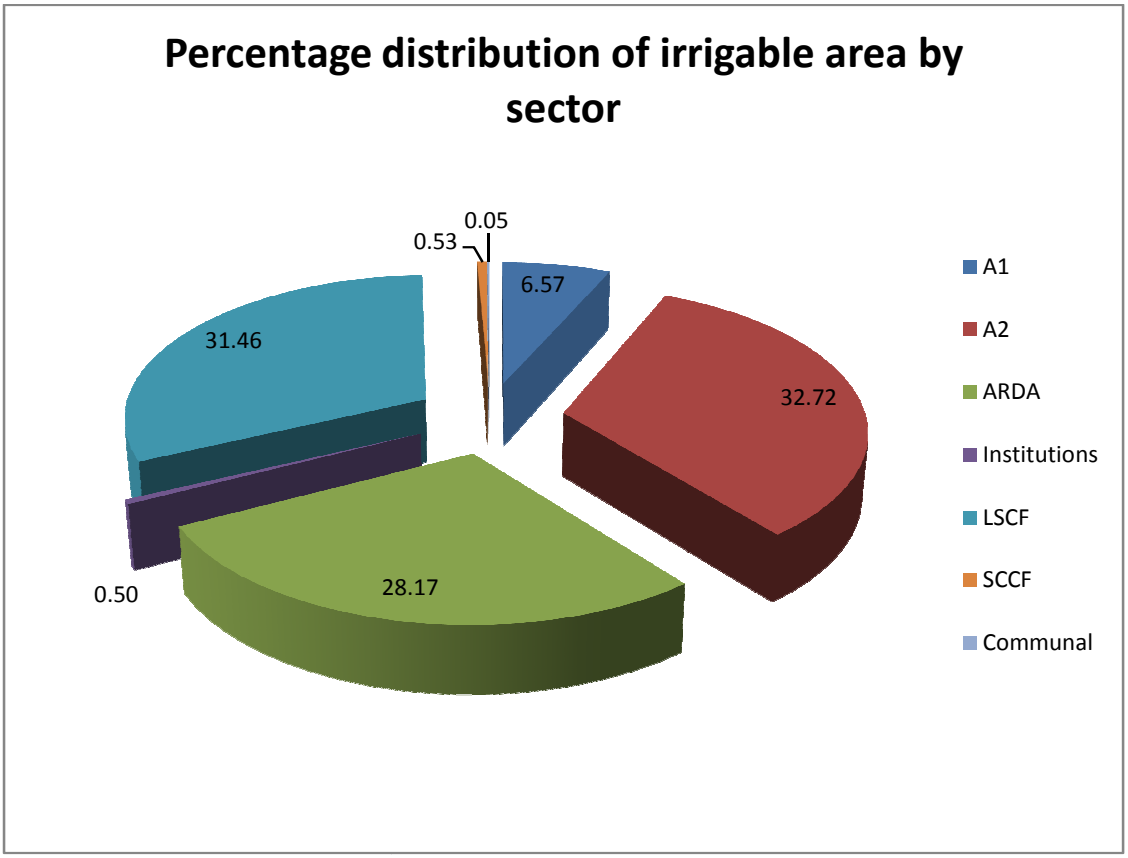


Fig. 3. Percentage distribution of irrigable area by sector

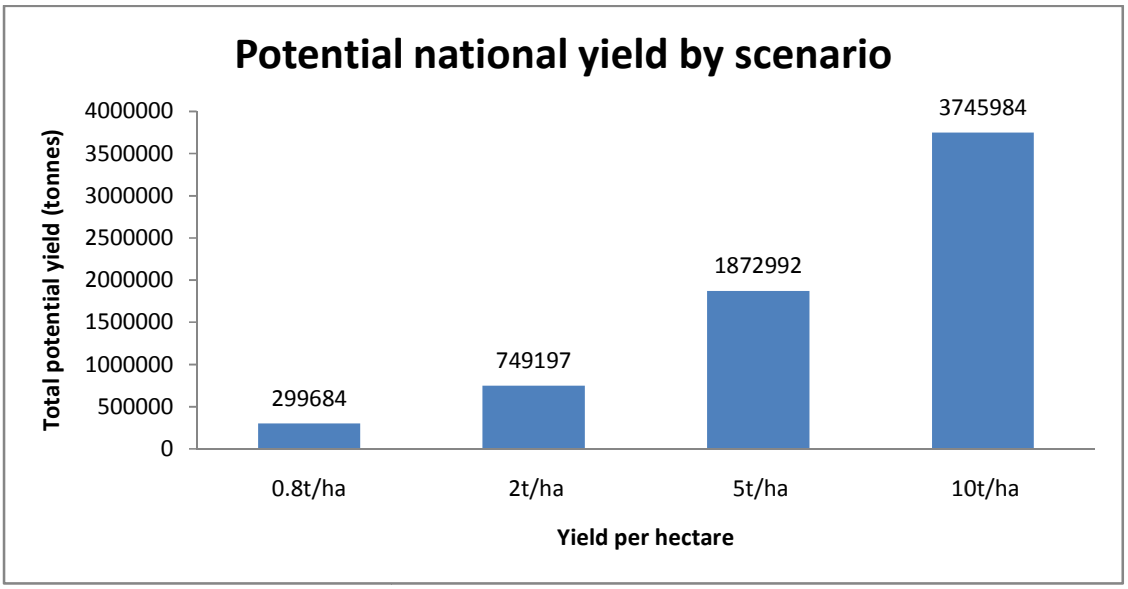


Fig. 4. Potential national maize yield by scenario

The information in Fig. 5 shows the potential yield maize for the different scenarios by province. According to Fig. 5 below, Manicaland Province has the greatest potential in producing the highest tonnage of maize and this is chiefly attributed to the potential irrigable area it has. The least province in terms of contribution to maize yield is Matebeleland North Province closely followed by Matebeleland South Province.

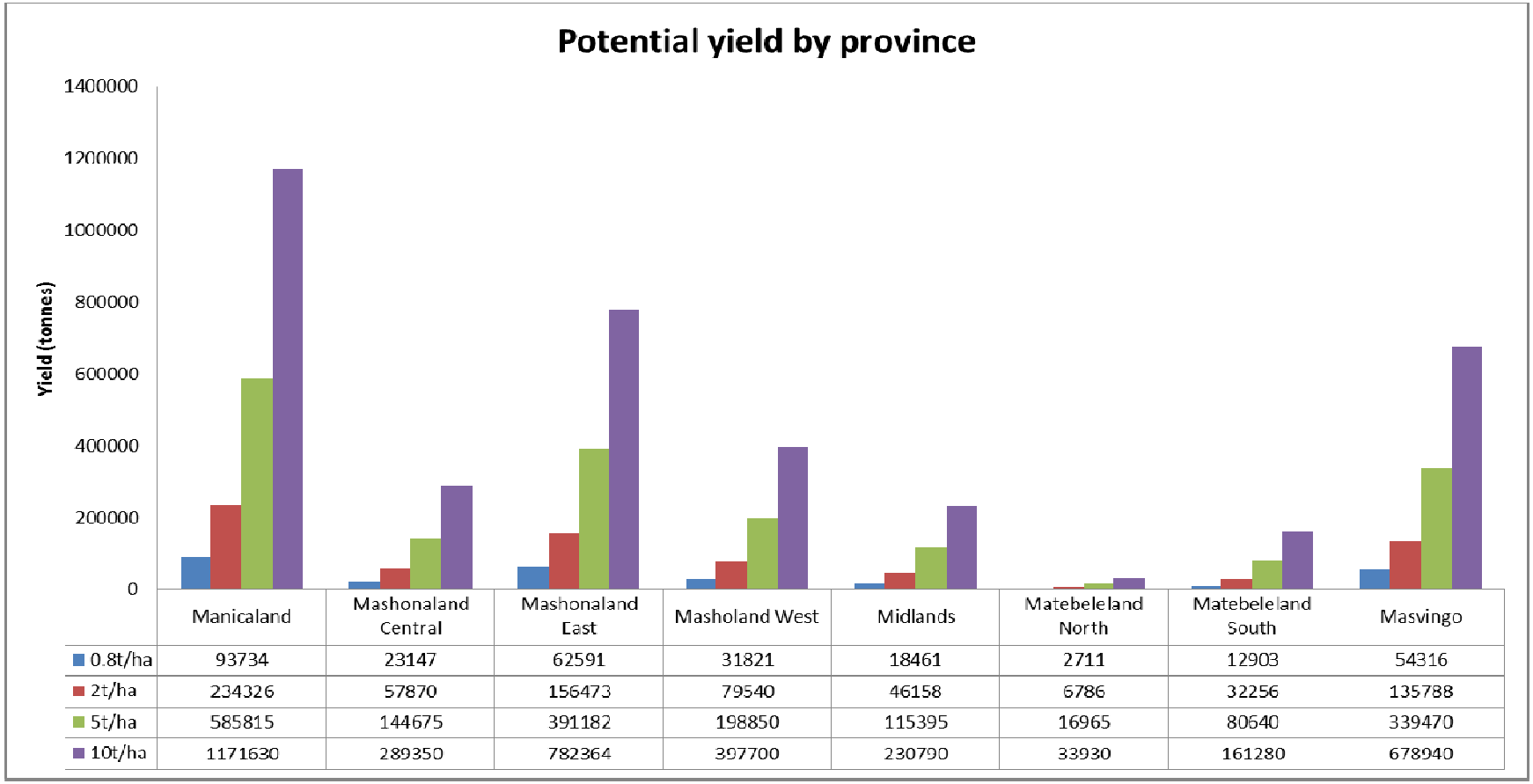
Large scale commercial farms are likely to contribute more towards meeting maize requirement for Zimbabwe if they utilise potential irrigable area for maize production as shown in Fig. 6. At a yield of 10 t/ha, LSCF can produce an aggregate of more than 1.1 million metric tonnes closely followed by ARDA farms which can produce just above 1 million metric tonne of maize when they produce an average yield of 10t/ha. Communal, A1, A2 and Institutions will have the minimum contribution of maize if their potential irrigable areas are utilised. The government should therefore start by investing irrigation infrastructure in A1, A2, ARDA and institution farms if it is to achieve significant gains in maize output from potential irrigable areas. The institutions mentioned above are the youth training centres, agricultural colleges, university farms, research centres and prison farms.

3.2 Strategies for Promoting Maize Production in Zimbabwe

The continual growth of state intervention has been a prominent part of irrigation development around the world [20]. According to [21] the intervention of the government in irrigation development will bring in irrigation technology and also secure the food security of the nation. If the Zimbabwean Government and private organisations invest in irrigation development for A1, A2, ARDA and institution farms, it can put in place rules and regulations that will ensure that all the beneficiaries practise maize production. Such a policy can be complemented with a policy that allow for leasing of the irrigable area for the purpose of maize production. This will result in full use of the irrigable area for maize production as those without resources could be able to lease the land to those with resources and want to utilise the land for maize production.

According to [22] one of the main advantages of leasing is the ability to get on with farming without the enormous capital investment required to purchase land. In addition, though, some farmers like short-term arrangements because they experiment with new climatic conditions without a long-term commitment. This flexibility is particularly useful for start-up farmers. A short-term lease can enable a farmer to test whether the farm plans are financially feasible or whether relationship with the landlord is good. Long-term leases have several distinct advantages and disadvantages also. Compared to short-term leases, they offer farm more security. A longer lease gives the operator time to build the business as well as the soil, and establish markets as well as community relationships. It is possible to borrow against a long-term lease, and to participate in conservation programs. Leases have disadvantages, too. Foremost among them is insecurity of tenure with shorter-term leases. This can lead to disruption of the operation and difficulty in making long-term business plans or personal decisions [22]. Leasing will therefore result in the utilisation of irrigable area to its full potential.

In the past years, Government of Zimbabwe helped farmers to grow maize through several programmes such as a programme code named “Operation Maguta” where land reform beneficiaries and communal farmers were given agricultural inputs for maize production [23]. In related programmes, the government of Malawi, in partnership with NGO’s, introduced the Starter Pack Programme to their farmers [24]. The “starter pack program,” was initiated in 1998/99 by Malawi’s Ministry of Agriculture in collaboration with donor agencies. According to [24] the program distributed “starter packs” to all farming households, containing small packs of hybrid maize seed, fertilizer, and either groundnuts or soybeans. The potential of the starter pack program as an effective formal safety net, however, may not be reflected in its ability to increase household disposable cash income, but rather in its ability to improve household food production, both during the time period of free inputs and in subsequent years [24]. The Starter Pack Programme could also be introduced in Zimbabwe to farmers occupying the potential irrigable land. The extension of such a programme to farmers occupying potential irrigable area could result in the farmers venturing into maize production. According to [25] a record contribution of 66% was made by smallholder farmers in the 1996 marketing season in which Zimbabwe produced 2.045 million tonnes of maize. During this year, 2014 the smallholder farming sector achieved average yields of 1,459 kg/ha. This achievement was made against a backdrop of favourable weather and a government input support programme.



	Manicaland	Mashonaland Central	Mashonaland East	Masholand West	Midlands	Matebeleland North	Matebeleland South	Masvingo
0.8t/ha	93734	23147	62591	31821	18461	2711	12903	54316
2t/ha	234326	57870	156473	79540	46158	6786	32256	135788
5t/ha	585815	144675	391182	198850	115395	16965	80640	339470
10t/ha	1171630	289350	782364	397700	230790	33930	161280	678940

Fig. 5. Potential yield by province

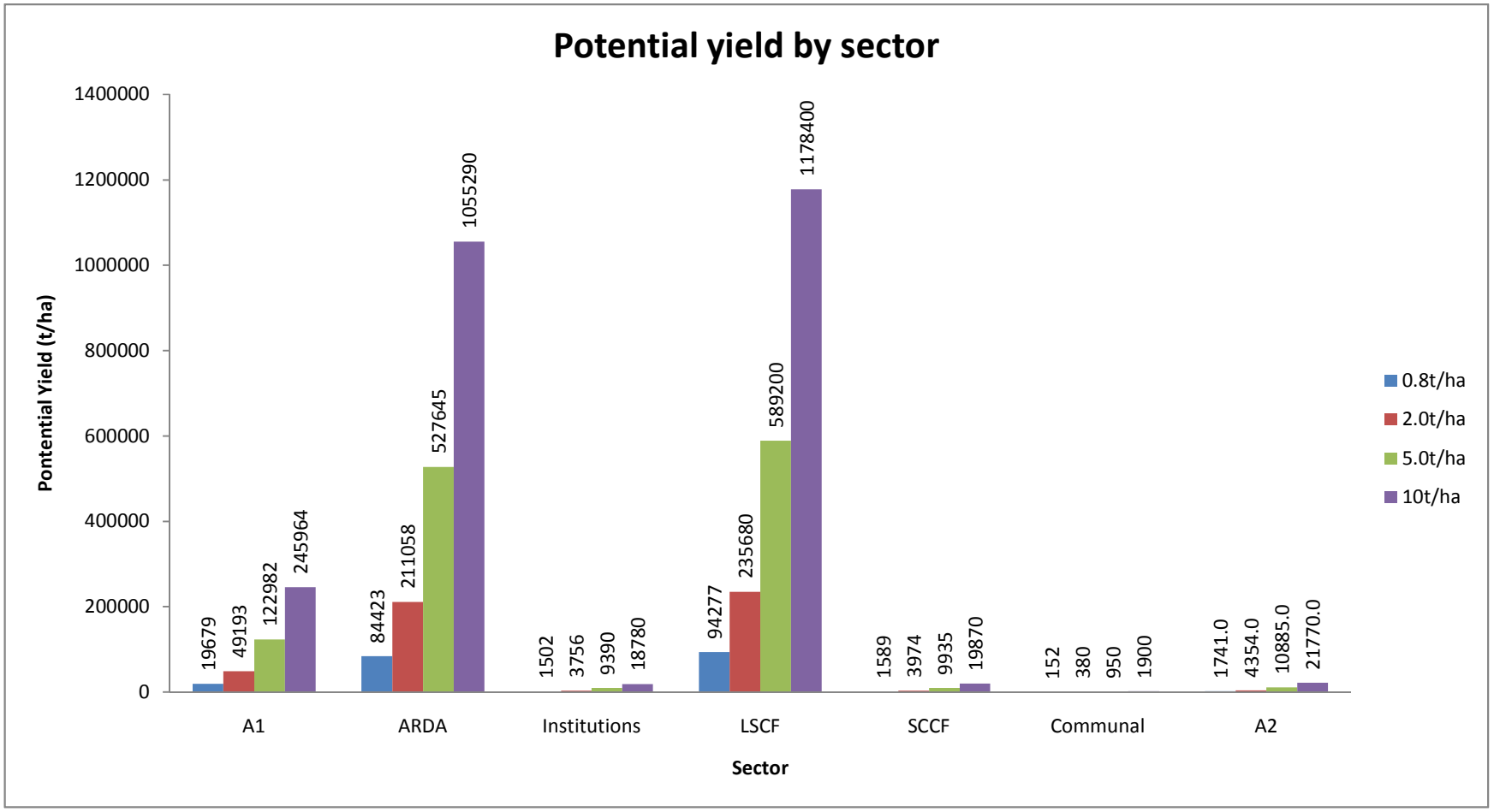


Fig. 6. Potential total yield by sector

Currently the problem is the source of income for government to purchase the production inputs such as seed, fertilisers and other chemicals since Zimbabwe is facing some economic challenges. The alternative way the government can get such money to finance irrigation activity is from NGOs such as FAO, USAID and other organisations. A clear proposal may be written by responsible authorities or even with the farmers themselves to NGOs with clear objectives, budget and benefits of this programme. Very few farmers occupying potential/ irrigable area have the cash needed to purchase even small amounts of the required inputs for maize production. According to [26] giving farmers maize "Starter Packs" can be the best bet technology to jump-start maize production. This would simultaneously improve food security of all food-deficit households owning potential irrigable areas, and sharply increase the marketed surplus available to urban consumers. For this strategy to work farmers need to be trained on the best maize production methods depending on the areas that they are located. Educating farmers can be done by extension officers on the ground since they are well seasoned with maize production, and the training can be complemented with an extensive radio extension campaign. Other essential services may include packaging inputs for sale in small quantities and maize inputs for work program.

The promotion of maize contract farming for farmers on potential irrigable area can result in farmers willing to produce maize since farmers would be assured of a market before they produce. Contract farming involves agricultural production being carried out on the basis of an agreement between the buyer and farm producers [27]. Sometimes it involves the buyer specifying the quality required and the price, with the farmer agreeing to deliver at a future date. The farmer undertakes to supply agreed quantities of a crop or livestock product, based on the quality standards and delivery requirements of the purchaser [28]. In return, the buyer, usually a company, agrees to buy the product, often at a price that is established in advance. The company often agrees to support the farmer through, supplying inputs, assisting with land preparation, providing production advice and transporting produce to its premises.

According to [25] contract farming arrangements between companies and smallholder farmers can be advantageous to both partners because they reduce the risk of transactions at the informal marketplace. Farmers without secured markets face the risk of selling produce at a loss due to market oversupply whilst companies without guaranteed supply may not be able to keep their factories running [29,30]. Farmers may also benefit from embedded services supplied by the company including access to input loans and credit, provision of extension and technical advice, use of appropriate technology and company management systems [31]. Contract farming has been identified as a system capable of stimulating agricultural production in Africa, at one stage being given a central role in the New Partnership for Africa's Development (NEPAD) strategy to revive the continent's agriculture. According to the 2008 World Development Report, contract farming is one of the options for improving input and output markets, as well as raising agricultural productivity [32].

During the 2011/2012 and 2012/2013 agricultural seasons, Government of Zimbabwe failed to incentivise maize production by not paying farmers promptly for maize delivered to the Grain Marketing Board (GMB). The Ministry of Agriculture, Farm Mechanisation and Irrigation Development acknowledged that the GMB owed farmers more than US$6 million as of January 2014 [33]. The Minister of Agriculture, Farm Mechanisation and Irrigation Development, reported that his ministry was "battling with treasury" and hoped that the finance ministry would "assist, so that farmers get the money they needed to finance their operations. Hence if farmers on potential irrigable area venture into contract farming, they will be assured of getting income from their crop hence willing to plant maize.

If a ready market is complemented with a price support, many farmers will be willing to grow the crop. According to [34] price support may either be in the form of subsidy or a price control, both with the intended effect of keeping the market price of a good higher than the competitive equilibrium level. In this case, the price control will be in a form of a price floor. The government may introduce a price floor where the market price of maize is deemed to be 'too low'. However, at this price, there will be excess supply and the quantity of maize exchanged in the market will be lower than the equilibrium amount. To ensure that the regulated price is effective in the market, the government may act as a 'buyer of last resort', taking any surplus maize supplies offered at that price [34]. In this case there will be no incentive for suppliers to try to circumvent the regulated price. The black market problem will therefore be replaced by the

problem of disposal of government stocks of the supported commodity. According to [34] the government can store the surplus and use it during the times of scarcity. Alternatively the government could use the excess maize for its welfare programmes such as school feeding schemes and aid.

The provision of maize production and marketing information to farmers occupying potential irrigable area can enhance their willingness to venture into farming. The use of demonstration sites during training could enhance better understanding of farmers to good practices that could result in them getting better yields and hence income from agriculture though maize farming. If demonstration sites could achieve yields of at least ten tonnes per hectare, farmers will be convinced to venture into maize production. Onsite demonstration sites should be set in each area/district by stakeholders who may include seed and fertiliser companies for easy access. Improvement in agriculture is possible with the adoption of new and modern farming agro-techniques. According to [35], Governmental as well as non-governmental organizations have realized this to boost up agricultural production.

Extension methods like demonstration plots, seed multiplication programme and field days etc., are some of the major weapons for introducing the findings of modern research in agricultural practices to increase agricultural production in particular and uplift of the rural masses in general [36]. According to [37], demonstration plots and seed multiplication are one of the best methods to improve yield. These methods are used as tools by extension workers to effect desirable changes in behaviour of rural masses, arrange the best learning situations and provide opportunities in which useful communication and interaction take place between extension workers and farmers. In a study conducted in Pakistan by [37], post-demonstration yields are higher compared to pre-demonstration yields.

Extension officers could also play a role in training farmers on best maize production practices that enhance maize yields. Researchers and scientists could also assist in coming up with low cost seed varieties which are resistant to diseases and area specific. This will enhance productivity of maize hence farmers' willingness to grow maize will be enhanced.

Irrigation infrastructure can be financed by banks or government in order to encourage farmers to farm. But irrigation has its limitations which include salinisation, cost of pumping water, availability of water for irrigation and high initial investment cost depending on the type of irrigation system used. Salinity is an important concern especially in semi and arid regions. This problem normally takes a relatively long time to develop and is not likely to occur in areas that receive enough rainfall at a given time to wash out the salts down the soil profile. Water quality used for irrigation develops a danger of developing soil salinity.

4. CONCLUSION

Maize production requirement targets can be achieved in Zimbabwe, through utilisation of potential irrigable area if the government start to invest in irrigation infrastructure especially in the LSCF and ARDA. The maize output from potential irrigable areas can further be enhanced through issuing of maize input starter packs, seeking budgetary support from the donor community, farmer training, contract farming and government price support.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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