Bantering the Factors Determining Participation in River-Bed Irrigated Gardening Among the Communities of Namibia

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ABSTRACT: *This paper investigates the socio-economic benefits associated with the irrigated gardens among the communities of Namibia. The main theoretical aspect of this paper was centered on the practices of understating factors determining participation in river bed gardening among the rural communities of Kavango East Region. A quantitative method was used in a case study design. Data was gathered from grassroots the community's experiences and understanding towards the factors determining participation in river bed irrigated gardening among the communities.*

Informed by this investigation and based on the Kavango East Region case study, there are factors determining participation in river-bed irrigated gardening among the communities of Namibia. The barriers seems to be related issues such as limited labour (23.1%), lack of access to land (33.7%), lack of time (5.5%), lack of water (4.5%), poor soil (3.0%), lack of seeds (18.1%), distance garden (5.5%) and other reasons (2.0%), such as it was not their choice of life.This is due to the fact that leadership of the Kavango East Region does not promote the establishment of irrigated gardens by communities alongside market development, in order to enhance food availability and socio-economic benefits.

The issue of using irrigated gardens to produce food and making market availability for irrigated garden produce to enhance the food availability and socio-economic situation of irrigated gardeners in Kavango East Region should be addressed in order to fight poverty in Namibia.

Keywords: *Irrigated garden, food availability, Socio-economic, rural community, poverty*

I. INTRODUCTION

There were 852 million chronically hungry people (chronically 90% and acutely 10% undernourished) in the developing countries including Namibia; this number includes 37 million people living in industrialized countries under extreme poverty conditions (Food and Agriculture Organization [FAO], 2013). The FAO has highlighted a rise in the total number of undernourished over the past years which raise doubt regarding the proudly pronounced Millennium Development Goal No: 1 to halve, between 1990 and 2015, the proportion of people who suffer from hunger. This does not include the 2 billion people who suffer from hidden hunger (micronutrient deficiencies), primarily women with anaemia and iron deficiency, as well as 250 million children affected by iodine deficiency, the most common cause for mental retardation, or 250 million children suffering from sub-clinical Vitamin A deficiency, which decreases their capacity to fight disease and can lead to blindness (FAO, 2013).

According to the Government of the Republic of Namibia (2013), the Kavango East region is facing insufficient food for most of its community, especially in the rural areas since 2012. The same report indicates that this is attributed to climate change which induces in most cases drought and flood. The Government of the Republic of Namibia has been assisting climate change affected rural communities by distributing food consignment, to minimize the negative effects. This program is costly to the national budget and is done at the expense of other development priorities.

According to the Government of the Republic of Namibia (2015), food availability in Namibia is mostly affected by climate change. Farmers lack the resources to invest in irrigation or drought-resistant seeds. The lack of alternative income sources keeps the peasants in this risky activity. The lack of rain leads to harvest failure, which may result to food shortages. Some food assistance or other safety net measures were established, but these are often irregular and inadequate (Government of the Republic of Namibia, 2016). Availability of food means the possibility of feeding oneself and one's family, this can be directly from productive land (agriculture, animal husbandry, horticulture, fruit growing) or other natural resources e.g. fishing, hunting, and food gathering; or from fresh or processed food obtained in markets and stores coming from sites both nearby and far from its production. Mendelsohn (2009), reports that results

from the 1994 Income and Expenditure survey shows that only 17% of all Kavango farmers relied entirely on food that they produced themselves under dryland farming. However, low rainfall over the past years has made it very difficult for Kavango farmers to produce enough food.

Although the Government of the Republic of Namibia has been distributing food consignment to the climate change affected rural communities in the Kavango East Region, many communities have been complaining that the food consignment distributed to them is never enough, hence hunger and starvation still prevail (Government of the Republic of Namibia, 2016). Hunger can be defined in the context of energy-protein deficiency and vitamin-mineral deficiency. Lack of access to one or both of these is food insecurity. Food security has four pillars, which are: food availability; access to food; stability of food supply; and food utilization. However, this study only focused on food availability through irrigated gardening. The results of the study will be used to develop a base of knowledge from which regional and local leaders could assess the role of a garden in filling the food gap left by the rain-fed harvest in the Kavango East Region. The study will assist regional leadership to understand the mode of support needed by rural communities in order for their gardens to play a meaning food role in filling the food gap in Kavango East Region and other regions in Namibia.

Statement of the problem

According to Kawana (2016), rural communities of Kavango East Region have resorted to planting irrigated gardens along the Kavango River due to poor harvest experienced from their rain-fed crops for the past years. Some small villages such as Shighuru have established 101irrigated gardens. However, up to date, there is no scientific study conducted to investigate factors determining participation in river bed gardening among the rural communities of Kavango East Region.Since rain-fed harvests have been falling over the past years in the Kavango East Region, irrigated gardens along the Kavango River could be used as alternative sources of food for the rural drought-affected communities. According to Mendelsohn and Obeid (2006), Namibia viewed the river as a passing resource to be exploited. Thus, the river is perceived as a source of water for irrigation. A number of lodges and campsites have been developed by private individuals and companies, and some conservancies, but the leadership has paid little attention to encourage rural climate change affected communities to use water in the Kavango River to address food availability.

According to the Government of the Republic of Namibia (2016), harvest prospects for 2015/2016 indicates significantly below average production as drought conditions intensify. The five years' average maize output was 64, 300 Metric Tonne, while the year 2016 maize output was 42, 700 Metric Tonne, which translates to the percentage reduction in the year 2016 to 34%. While the five years' average pearl millet output was 48, 000 Metric Tonne, while the percentage year 2016 maize output was 33, 000 Metric Tonne, which translates to the percentage reduction in the year 2016 to 32%. According to the above-stated report, the communal maize harvest is still expected to decrease by 38 percent below the five-year average of 64,300 MT next year 2017. However, Namibia has the capacity to meet its deficit through commercial imports, which makes it difficult for many rural communities to afford. This has influenced rural communities of Kavango East Region to resort to manual irrigated gardens as a strategy to produce food to compliment the inadequate yield from rain-feed (Government of the Republic of Namibia, 2016).

When combining the four pillars of food security, it gives us two which are an ability food production through own production; and accessibility to markets and ability to purchase food items (Bonti-Ankomah, 2001). Self-sufficiency in food production can be improved through gardening. Gardening refers to small scale cultivation of a range of food plants in gardens (van der Veen, 2005). This study focused mainly on food availability which is the first pillar of food security.

These are a number of regular behaviour responses that people apply to manage household food gap. The higher the index, the more food insecure a household is and as it goes lower this is indicative of an improvement in the household food security.

Research Objectives

The main objective of this paper was to investigate the role of gardens in the attainment of food security in the Kavango East region of Namibia.

The sub-objectives of this paper is:

- To investigate factors determining participation in river-bed irrigated gardening among the communities of Kavango East Region.

Significance of the study

The study will contribute to the body of knowledge on the role played by gardens in enhancing food availability among climate change affected rural communities of Kavango East Region. In addition, the study will provide solutions on questions/issues, constantly asked by both the academics and policymakers regarding best practices on addressing hunger caused by climate change in the rural areas of Kavango East Region, and can be used as a base to assess basic food availability methods.

Limitation of the study

Lack of baseline data on statistics of gardens' harvests for the past years in the rural areas of Kavango East Region. To overcome this, the researcher, requested data from the Ministry of

Agriculture, Water, and Forestry, Head Office. Many community members in the Kavango East Region were unable to express themselves in English, while the questionnaire was structured in English. To overcome this, the researcher used the local vernacular to communicate with the communities.

Delimitation of the study

Irrigated gardens play a role in the lives of all 14 regions in the Republic of Namibia. It can also influence the socio-economic of the inhabitants of Kavango East Region, which is a prevailing problem at the moment. The scope of the study, therefore, was that it covers the Kavango East Region. The participants of the study are located along the Kavango River, and they were taken from 20 villages.

II. Literature Review

Food Security situation in Namibia

Many households in various parts of Namibia were reported to be facing food insecurity as a result of associated with the 2015/2016 El Niño effect which negatively impacted on the livelihoods and quality of lives. The whole agricultural production and water supply are affected by the drought. For the past 5 years, the total cereal production trend has been declining in the Kavango East Region, says the Government of the Republic of Namibia (2016).

Food Security situation in Kavango East Region

According to the Government of the Republic of Namibia (2016) since the start of the 2015/2016 rainfall season, the country received poor and below normal rainfall performance which was also the case in the previous season. The report further revealed that a significant delay in the onset of the rainfall season, erratic and insufficient rainfall patterns, as well as prolonged dry spells, was observed in the season before the rainfall ended abruptly. The report further said that crop estimates showed a slight improvement on the last season's harvest but were still below the average production. The aggregate coarse grain indicated that the country noted a slight improvement in the harvest of 18% higher than the last season, but 31% below the average production. The slight improvement came as a result of a small increase in the harvest from most of the major crop producing regions, except the Zambezi and Oshana which were the regions most affected by drought during the year. Household food security remained weak in various parts of the country, as the recent agricultural production was too small to provide a significant improvement in the ailing food security.

The importance of irrigated gardens

FAO (2010) reported that a well-developed irrigated garden has the potential, when access to land and water is not a major limitation, to supply most of the non-staple foods that a family needs every day of the year, including roots and tubers, vegetables and fruit, legumes, herbs and spices, small animals and fish. Roots and tubers are rich in energy and legumes are important sources of protein, fat, iron and vitamins. Green leafy vegetables and yellow or orange-colored fruit provide essential vitamins and minerals, particularly folate, and vitamins A, E and C. Vegetables and fruit are a vital component of a healthy diet and should be eaten as part of every meal. Meat, chicken, and fish are good sources of protein, fat, and micronutrients, particularly iron and zinc (FAO, 2010).

Hussain and Clay (1999) said that the maintenance of this form of production, in the long run, is essential for its economic and nutritional merit. Again, the importance of gardens is further affirmed by the fact that in times of emergency, societies have had to return to the use of gardens to improve food security, as, for example, Irish potato gardens during the Great Depression (Hussain & Clay, 1999). Household food availability can be improved by engaging in food gardening like community gardening and irrigated gardening. Food gardening is an age-old tradition that is widely practiced although it is repeatedly undervalued and resisted by generations of public officials. Food gardening can provide a long-term solution to the dietary diversity of less privileged communities (United Nations Development Program [UNDP], 1996). Irrigated gardening is an affordable, sustainable long-term strategy to complement supplementation and food fortification programmes and nutrition education (Faber *et al*., 2007). Irrigated gardening produces crops for household consumption to improve the quality, diversity and nutrient content of diets (Faber et al., 2007).

The vegetables provide immediately accessible sources of micronutrients as they can be cultivated throughout the year, providing vitamins, trace elements and other bioactive compounds (Chadha & Olouch, 2003). Vegetables are a vital dietary component, not just as a side dish to add flavor to meals, but they release and make available bound micronutrients in some staple crops for effective absorption and utilization (Chadha & Olouch, 2003). Seasonal malnutrition accentuates already existing malnutrition. Gardens can help overcome the seasonal fluctuations in the availability of nutrients by staggering the planting of a mixture of early, average and late-maturing varieties. Garden projects need to be complemented with other interventions such as nutrition education and promotion and other development initiatives and basic hygiene (Sikhakhane, 2007).

Irrigated gardens can create income and improve food availability for the poor, but only if participants are fit enough to farm. The surplus harvest can be sold for income to purchase other foods to supply multiple nutrients (Faber *et al*., 2007). Chadha and Olouch (2003) added that irrigated gardens enable households to direct the savings towards other needs, such as health care, education, and housing. Pain and

Pinero (1999) showed that irrigated gardening raises income among those with low income by 50 percent in rural and informal settlements in Southern Philippines. The impact of increased income on household consumption is important in estimating the benefits of increased income on consumption (Hendriks, 2003).

Irrigated gardens empower households to take ultimate responsibility for the nutritional quality of their diets by growing their own nutrient-rich food and making informed consumption choices (Faber *et al*., 2007). Irrigated gardening assists in lifting people out of poverty by improving their health and nutrition (Faber *et al*., 2007). The process of households producing their own food empowers households and makes them self-reliant (Ruel & Levin, 2000). Hartivegsen and A'Bear, (2004), recommend irrigated garden interventions as they are independent of external financial support and, therefore, more sustainable. According to Hartivegsen and A'Bear, (2004), even to the poorest homestead, unutilized marginal land is often the only resource available to the communities. Gardening can turn this land into a productive source of food and even provide economic security. Most irrigated garden systems are organic-based ensuring availability of fresh pesticides and chemical-free vegetables, mainly because they use a few purchased inputs as they are primarily for household consumption. Therefore, irrigated gardening involves little risk because of the low capital investment in technology and the cultivation of a variety of crops. The variety of crops planted also ensures household access to fresh produce throughout the year and it means that they are able to rely on other crops in the event that one crop fails thereby improving household food security (Hartivegsen and A'Bear, 2004). Harper (2014), emphasises food Production increases in smallholder agriculture as a possible solution to the food insecurity challenges in rural areas. This was based on a study conducted in the rural areas of the Limpopo Province in 2012/13. Hamper, further said that, overall, research has shown that no country can assure food security for its population if rain-fed agriculture is not coupled with significant investments in manual irrigation farming. However, it is worth noting that, advantages of community gardening are usually countered by the constraints such as poor leadership; knowledge and skills; insecure land tenure and poor water supply (Milburn and Vail, 2010).

Access to water for manual irrigation is expected to enable rural households to gain access to more food. In general, access to manual irrigation farming allows poor people to intensify food production. Food production through farming plays an important role in ensuring access to food for poor rural households (Baiphethi & Jacobs, 2009). Benson (2015) stated that irrigation farming increases output per unit area food production, leading to an improvement in food availability and accessibility. In a study in Zimbabwe, Maroyi (2009) found that home gardens produce, supplements staple crops and also serve as a source of income for several families. Home gardens enable year-round production of different products, reducing the risk of product failure.

Marsh (1998) asserted that traditionally, gardeners would feed their families first and then sell, barter or give away surplus garden produce. In certain contexts, however, income generation may become the primary objective of the home garden. In any case, it is counterproductive to impose the nutrition objective to the exclusion of the income generation objective, since in most gardening contexts, they are linked and compatible. Hendriks and Msaki (2006) in a study in KwaZulu-Natal, South Africa found that involvement of smallholders, in agriculture yielded positive effects on food diversity, consumption patterns, and food intakes because an increase in income resulted in an increase in food expenditure. However, they concluded that it cannot be conclusively stated that smallholder commercialization can alleviate hunger or solve malnutrition. Irrigated gardening serves as a source of fresh, affordable food that helps to improve family nutrition. Furthermore irrigated gardens are a viable tool that links up directly with four of the major cornerstones of community development which are; health, education, training, economic development and job creation (Cothron, 2009).

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

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

Irrigators were able to strengthen food security further through asset accumulation.

According to the International Food Policy Research Institute (2016), the world is moving toward more comprehensive or systems level thinking as we look at issues of poverty, hunger, and malnutrition and come to a greater understanding of their complexity. The world's food system includes all of the activities and elements: the environment, people, inputs, processes, knowledge, infrastructure, and institutions involved in getting food from farms to consumers' plates. Just as important, it includes the outputs of these activities, such as socioeconomic and environmental outcomes. Due to the fact that the food system reaches into so many areas, it has a large part to play in people's prosperity, food security, and nutrition. Not only does the food system generate the calories and nutrients that people require for good health, but it is also the basis for the livelihoods of millions of the world's poorest people. Creating a world food system that operates for the well-being of people, as well as the planet on which we all depend, is a major challenge. We need a food system that can help us reach a whole range of SDGs by 2030. What would such a food system look like? How close have we come to achieving it? These questions remain unanswered until today.

The impact of climate change on food availability

Climate change threatens to exacerbate existing threats to food security and livelihoods due to a combination of factors that include the increasing frequency and intensity of climate hazards, diminishing agricultural yields and reduced production in vulnerable regions, rising health and sanitation risks, increasing water scarcity, and intensifying conflicts over scarce resources, which would lead to new humanitarian crises as well as increasing displacement (Intergovernmental Panel on Climate Change [IPCC], 2007). Climate change is expected to affect all of the components that influence food security: availability, access, stability, and utilization.

The overall availability of food is affected by changes in agricultural yields as well as changes in arable land. Changes in food production, together with other factors, could impact food prices, which would affect the ability of poor households to access food markets and could reduce dietary diversity. Extreme weather effects disrupt the stability of food supply as well as people's livelihoods. In extreme weather, such as floods and drought, as a result of climate change, would exacerbate this trend and could have a negative impact on livelihoods that depend on climate-sensitive activities such as rain-fed agriculture and livestock rearing (Schmidhuber & Tubiello, 2007).

The impact of climate change on food availability in Africa and SADC

The challenge of reaching sustainable food security and delivering on it through 2050 is daunting with an awkward starting point, in 2010, a world with unacceptable levels of poverty and deprivation, as is clear from the 2010 report on the Millennium Development Goals (Nelson *et al.*, 2010). Climate change will affect all four dimensions of food security: food availability, food accessibility, food utilisation and food systems stability with direct impact on human health, livelihood assets, food production, and distribution channels, as well as changing purchasing power and market flows (FAO, 2008). Farmers in developing countries are already seeing the effects of climate change daily with erratic weather patterns that directly affect food production (Trobe, 2002). In 1991 and 1992, cereal production in the Southern African Development Community (SADC) region was almost halved as a result of drought, and around 20 million out of 85 million people suffered food shortages (United Nations Environmental Programme [UNEP], 1999) Rural households tend to rely heavily on climate-sensitive resources such as local water supplies and agricultural land; climate-sensitive activities such as arable farming and livestock husbandry; and natural resources such as fuel-wood and wild herbs. This implies that climate change can reduce the availability of these local natural resources, limiting the options for rural households that depend on natural resources for consumption or trade (Hunter, 2011). Droughts and floods can also directly impact on health, where polluted water may be used for drinking and bathing, and this could spread infectious diseases such as typhoid, cholera, and gastroenteritis (Trobe, 2002).

Presently, there is little awareness about climate change and its impacts, and climate change issues are given a low priority in the face of competing and urgent priorities (Mitchell & Tanner, 2006). Information about the impacts of climate change on important sectors and systems in developing countries such as agriculture, forestry, fisheries, water resources, human health, human settlements, and ecological systems is inadequate for understanding key vulnerabilities and planning appropriate adaptive strategies (Leary & Kulkarni, 2007). Adaptation will include learning about risks, evaluating response options, creating the conditions that enable adaptation, mobilizing resources, implementing adaptations, and revising choices with new learning (Leary *et al.*, 2007). While climate change is seen as a relatively recent phenomenon, individuals and societies are used to adapting to a range of environmental and socio-economic stresses. In many parts of the world, and especially in semi-arid lands, there is an accumulated experience with phenomena such as drought and the flood.

As climate extremes are predicted to increase in frequency and intensity in future, it is important to understand and learn from relevant past adaptations and indigenous knowledge systems (Intergovernmental Panel on Climate Change [IPCC], 2007). However, changes in climate variability and mean values will bring additional complications to many, especially those dependent on food systems that are particularly vulnerable to these additional stresses (Guijit, 2007).

Meteorological droughts (resulting from insufficient rainfall) are expected to increase in duration, frequency, and intensity (Burke & Kuylenstiema, 2006). Droughts result in agricultural losses and are a major driver of food insecurity. Similarly, drought has been the primary cause of interannual yield variations in some regions of the world (Hlavinka *et al*., 2006). Globally, the areas sown for the major crops (barley, maize, rice, sorghum, soya bean and wheat) have seen an increase in the percentage of area affected by drought since the 1960s, from approximately 5–10% to approximately 12–25% (Li, Ye, Wang & Yan, 2009). This is especially problematic in the context of population growth. For example, in Africa alone, 650 million people are dependent on rain-fed agriculture in the environment that is affected by water scarcity, land degradation, recurrent droughts and floods, and this trend is expected to exacerbate under climate change and population growth (FAO, 2008).

Climate change affects food production in complex ways. Direct impacts include changes in agro-ecological conditions; indirect impacts include changes in economic growth and distribution of incomes, which in turn affect demand for agricultural produce. Empirical evidence suggests that increases in temperature in the period 1980–2008 have already resulted in average global maize and wheat yield reductions of 3.8% and 5.5% respectively, compared to a non-climate scenario (Lobell *et al*., 2011). To date, climate trends have been largely offset by gains derived from technology, carbon dioxide fertilization, and other factors (Lobell *et al.*, 2011). Future changes in climate patterns coupled with population dynamics could result in a higher vulnerability.

Climate change adaptation as a way of surviving

The climate change community uses the term adaptation to refer to the process of designing, implementing, monitoring, and evaluating strategies, policies, and measures intended to reduce climate change-related impacts and to take advantage of opportunities (Smit *et al.*, 2007). The IPCC (2001) further adds that adaptation as an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities. This definition acknowledges that adaptation is a continuous sequence of activities, actions, decisions, and attitudes that inform decisions about all aspects of life, and that reflects existing social norms and processes (Chikozho, 2010). Defining adaptation to climate change is complicated because agents adapt to a number of different pressures at the same time, not just to climate change. Adaptation to climate change risks will need to take place at the individual, family, community, and government levels (Kristie & Semenza, 2008). Adger *et al.*, (2005) argues that individual adaptation actions are not autonomous because they are often constrained by institutional processes such as formal regulatory structures, property rights and social norms associated with rules in use. Elements of effectiveness, efficiency, equity, and legitimacy are important in judging successful adaptation. Research carried out by IFPRI has revealed that one of the most important obstacles to adaptation in Africa is lack of access to credit, information on climate, as well as limited options for adaptation (IFPRI, 2006). Some of the literature on climate change argues that with adaptation, farmers' vulnerability can be significantly reduced (Odekunle *et al.*, 2007). However, the available information on the vulnerability of specific communities to climate change and potential adaptation measures is still insufficient (Chikozho, 2010). Adaptation is widely recognized as a vital component of any policy response to climate change and without adaptation, climate change would be detrimental. However, with adaptation, the vulnerability can be significantly reduced (Gbetibouo, 2008).

People, property, economic activities, and environmental resources have always been at risk from climate and people have continually sought ways of adapting, sometimes successfully and sometimes not. The long history of adapting to variations and extremes of climate with respect to water includes crop diversification, irrigation, construction of water reservoirs and distribution systems, disaster management and insurance (Adger *et al.*, 2007). Rural economies, which are based upon and dominated by agricultural, pastoral and forest production, are highly sensitive to climate variations and change including the livelihoods and food security of those who participate directly in these activities, supply inputs to them, or use their outputs to produce other goods and services (Abuo-Hadid, 2006). Due to the effects of climate change, the responses to climate change will depend on the local context, including geographic, demographic, social, economic, infrastructural, and other factors, many adaptation options were more effective if designed, implemented, and monitored with strong community engagement (Kristie and Semenza, 2008).

Determinant factors for participation in river-bed irrigated gardening

If the irrigated gardens are properly managed, the chances of their being sustainable will be good. In

order to look at the participation of irrigated gardens, it is important to look at outside influences that affect decision-making within the irrigated gardens. Chikozho (2010) noted that factors affecting the participation of irrigated gardens are the responsible management of land to meet the needs of the irrigated garden households and the landowner, security of tenure for garden households, participation rates and administration of the irrigated garden.

Sustainable irrigated gardens can provide a continuous supply of fresh vegetables, which would form an important part of the diet of the garden members. The diet of people living in rural areas consists predominantly of maize, supplemented with small and irregular quantities of meat and vegetables (Laing, 1996). The main crops planted in irrigated gardens are onions, spinach, cabbage, and potatoes. Cabbage is the staple vegetable in the diet of most black South Africans, in both the urban and rural populations, mainly because of its high nutritive value and because it keeps without refrigeration (Laing, 1996). For irrigated gardens to be sustainable and able to maintain good production of vegetables, training of members should be provided. According to Heim (1990), training should start with an overview of the activities regarding management and administration.

Challenges faced by irrigated gardeners in rural areas

It is worthy to note that irrigated gardens face many challenges that limit their production and interaction between members. Lack of irrigation equipment undermined the ability of poor households to raise their agricultural incomes and made them even more vulnerable to frequent droughts. Power relations are an impediment to the success of gardens. These relations determine the controls of irrigated gardens (Moyo & Tevera, 2000). There are also illegitimate forms of transferring land or selling of land or expansion of plots which is common in peri-urban gardens.

According to Moyo and Tevera (2000), irrigated gardens in rural areas face management challenges. Most of the participants in irrigated gardens lack gardening skills. Irrigated gardens attracted members who are politically motivated and they tend to influence decision making. According to Moyo and Tevera (2000), there are conflicts between national institutions and local people, for example, national institutions restrict the cultivation of irrigated gardens using national institutions.

Lack of extension service is another challenge. Extension Officers, according to Crosby *et al.* (2000), not only teach people to grow vegetables but help to plan gardens. Successful gardens very often have a committed extension officer who is easily accessible and available, trustworthy and knowledgeable (Crosby *et al.*, 2000). Female Extension Officers advise on matters such as the cooking of vegetables and home economics (Crosby *et al.*, 2000). Extension staff sometimes also provides transport to buy inputs. They act as a link between the garden and the KZNDAEA (Crosby *et al.*, 2000). It has become increasingly evident that extension systems have grown in size and complexity and have ceased to be controlled by the farming community (Scarborough *et al.*, 1997). The personnel of such systems feels more accountable to their employers or professions than to their farmer clientele (Scarborough *et al.*, 1997).

III. Research Methodology

Research Design

This quantitative study made use of the case study design to assess the role of gardens in filling the food gap in the Kavango East Region. The study entailed a detailed and intensive analysis of a single case. The study was a single location (one Region) study. A quantitative method was used to assess the numeric part of the study. The data was collected in May 2019, which was just a few weeks after the community of Kavango East Region has completed harvesting from their rain-fed harvest.

Population

The population of this study consisted of 140 villages in the Kavango East Region.

Sample

The sample consisted of 20 randomly selected villages out of the 140 villages. Stratified random sampling was done to form two strata, one comprises of households without irrigated gardens while the other one comprises with irrigated gardens. For each village, there were five households of community member without manually irrigated gardens and five households with manually irrigated gardens i.e. 200 households, were selected and from which data were collected.

Research Instruments

The research made use of the Household Food Insecurity Access Scale (HFIAS) and Diet Diversity Score (DDS) which were developed by Food and Nutrition Technical Assistance (FANTA) (2005), in order to measure the food insecurity prevalence. This allowed the researchers to explore the factors that determine food security in the villages of Kavango East Region. The instrument is a structured questionnaire as a research instrument for data collection.

Research Procedure

The researcher requested approval from Kavango Regional Council, informing Regional Leaders that he was in the region to conduct research. After that, a meeting was held with the village headmen to explain to them about the research and its processes was convened and then make appointments with selected households on different dates and time at the 20

randomly selected villages interviews; participants were asked questions concerning the role of gardens in filling the food gap in the Kavango East Region. The standardized open-ended and closed-ended questions had 16 sub-questions to answer the three research objectives.

Data analysis

After the households' interviews, the quantitative data were coded, on which the data dictionary was created to explain the meaning of each code. Then the Data was entered, using Statistical Packages for Social Scientist (SPSS). Bivariate and multivariate analysis were used to test associations and relationships. The analysis included both parametric and non-parametric techniques such as correlation, Chi-square Tests, Independent sample T-tests and Kruskal Wallis H-Tests. The parametric techniques such as Chi-square and T-Tests made a number of assumptions about the population from which the sample was drawn, such as normally distributed scores and an interval level scale or continuous data. While, non-parametric techniques like the Kruskal Wallis H-Test, do not have such stringent assumptions, and were more suitable techniques for the categorical data measured at the ordinal (ranked) level (Pallant, 2010).

Multiple regression analyses were conducted to predict relationships. Logistic regression was used for the multiple regression test, as the dependent variable is categorical. Since Logistic regression tests, the predictive power of a set of variables and assesses the relative contribution of each individual variable. The logistic regression model was thus used to determine the variables that determine participation in river-bed irrigated gardening among the communities of Kavango East Region. After this was done then the data were interpreted, in the form of a report.

Logistic regression

According to Moran *et al.*, (2012), logistic regression was developed in the early 1950s by David Cox. Many sectors have used the models in trying to predict the probability of occurrence of a certain condition or issue. Logistic regression is the appropriate regression analysis to conduct when the dependent variable is dichotomous (binary) (Moran *et al.*, 2012). The binary logit was used to find the determinants of participating in river-bed irrigated gardens using the number of months a household consumed vegetables it produced as a proxy for food security.

The logistic regression model is specified as follows:

$L_n = \beta_0 + \beta_1 X_1 +$ e

Where Ln = 1 if a household is participating in irrigated garden or 0 if households are not participating in an irrigated garden, e is the error term, $\beta_1 X_1$ are parameter estimates (coefficients) and are independent variables.

Research ethics

Permission to conduct the study was sought from the Kavango Regional Council and the Ministry of Agriculture, Water and Forestry. The researcher applied for ethical clearance from the University of KwaZulu-Natal on which it was granted. The researcher ensured that all questionnaires were accompanied by a statement of intent, where the researcher assured the respondents that the information and data collected was to be used solely for the research and the respondents were accorded open access to results once published. Informed consent after the explanation from the respondents was finally sought before the necessary information was collected. During the entire investigation, anonymity and confidentiality was maintained by not recording any names and not disclosing any information between participants. The data is being stored in a locked cabinet and will be destroyed by shredding and burning after 5 years.

V. Results and Discussions

Factors leading to people not to have an irrigated garden

The section describes the factors leading to the respondents not having a garden, as a way to understand the constraints affecting the participation in irrigated gardens. The findings indicated different reasons, why the respondents from household without gardens were constrained from participating in the irrigated garden in Kavango East Region. The factors include problem related issues such as limited labour (23.1%), lack of access to land (33.7%), lack of time (5.5%), lack of water (4.5%), poor soil (3.0%), lack of seeds (18.1%), distance garden (5.5%) and other reasons (2.0%), such as it was not their choice of life.

Table 1: Reason for not having an irrigated Garden

Reason	Count	Percent
Lack of access to land	67	33.7
Lack of time	11	5.5
Lack of water	9	4.5
Poor Soils	6	3.0
Lack of seeds	36	18.1
Limited Labour	46	23.1
Distant Garden	11	5.5
Other	4	2.0
Total	**190**	**95.4**

Factors determining participation in river-bed irrigated gardening among the Communities of the Kavango East Region

Pallant (2010) noted that Logistic regression allows one to assess how well a set of predictor variables predicts or explains your categorical dependent variable. The determinants of participating in river-bed irrigated gardens used having an irrigated garden as the binary dependent variable (DV). The dependent variable was recoded to Yes (1) and No (0) in line with the requirements of logistic regression. The model contained ten independent variables can distinguish between respondents who reported and did not report having a garden. The model as a whole explained between 49.8% (Cox and Snell R square) and 66.8% (Nagelkerke R-squared) of the variance in irrigated garden status, and correctly classified 85.0% of cases. The model had a -2 Log likelihood value of 136.372 indicating how well the model fits the data. With a smaller −2 log likelihood values mean that the model fits the data better, where a perfect model has a −2 log likelihood value of zero. Table 2 presents the results.

Table 2: Determinants of having a garden

Variable	B	Wald	Sig.	EXP(B)
Household Members	0.050	1.392	0.238	1.051
Food Purchasing	3.690	18.708	***0.000***	40.495
Food from Harvest From Dry Land	2.605	10.309	***0.001***	13.958
Food Aid/Donations	-1.522	7.317	***0.007***	0.221
Time to Consume Dry Land Harvest [Est Months]	-0.010	0.021	0.886	0.990
Formal Employed Household Members	0.388	1.590	0.207	1.474
Monthly Amount Spend N$ Food	0.000	0.024	0.876	1.000
Monthly Amount Spend N$ Other -	0.190	0.000	1.000	1.210
Total Monthly Income	0.042	0.088	0.767	1.042
Dry Land Harvest, Meals Consumed Per Day [Times](1)	-7.139	15.439	***0.000***	0.001
Dry Land Harvest, Meals Consumed Per Day [Times](2)	-6.647	13.263	***0.000***	0.002
Dry Land Harvest, Meals Consumed Per Day [Times](3)	-7.898	15.568	***0.000***	0.000
Constant	-4.148	6.623	0.010	0.014

-2 Log likelihood = 136.372,

Table 2 results show the variables in the logit equation and information about the contribution or importance of each of our predictor variables. The logistic regression uses the Wald test statistics for each predictor to determine the variables that had a statistically significant ($p<0.05$) predictive contribution to the model. Table 2 shows four significant variables (Food Purchasing, p =000; Food from Harvest from Dry Land, p = .001; Food Aid/Donations, p =.008). Therefore, the major determinants to whether a person reports having an irrigated garden are sources of food with the Food Purchasing, Food Aid/Donation and Food from Harvest from Dry Land. As well as, the number of meals consumed per day from Dryland harvested food. As more meals would mean that the food stored will finish quicker and less meal may lengthen the time it takes to finish the store of the Dry Land Harvest.

The results show regression beta (B) values. With, the positive or negative B values showing the direction of the relationship or which factors increase the likelihood of a yes answer (having a garden) versus factors which decrease it (do not have a garden). The negative B values indicate that an increase in the independent variable score will result in a decreased probability of the case recording a score of 1 in the dependent variable (indicating those without gardens). Table 2 showed a significant variables negative B value included, Food Aid/Donation (–1.508, p = 0.008) and the number of meals consumed per day from Dryland harvested food (-6.49 to -7.686, p = 0.000 to 0.002). The negative B values indicating that the more the farmers rely on food aid/donation or consume more food per day, the less likely, they will report having a garden.

For the two other significant categorical variables (Food Purchasing, Food from Harvest from Dry Land), the B values are positive (3.701, 2.636). This suggests that farmers sourcing their food through purchasing or from the dryland harvest are more likely to answer yes to the question of whether they consider they have a garden. As the surplus from gardens harvest can be sold for income to purchase other food to supply multiple nutrients. Low-income households in the Kavango East Region, relying on dry land harvested food are more likely to benefit from a garden. This is because gardens will bring both food security and financial security as they may start selling their produce.

Findings in Table 2 also shows the results for the exponent of the B values (Exp(B)) and represents the odds ratios (OR) for each of the independent variables. Tabachnick and Fidell (2007), notes that the odds ratio represents 'the change in odds of being in one of the categories of the outcome when the value of a predictor increases by one unit' (p. 461). As such, the odds of a farmer answering Yes, they have a garden is 40.495 times higher for those purchasing food for consumption than for a person who does not have a garden, all other factors being equal. Thus, food purchasing is a significant predictor (p=.007), with the odds ratio of 40.495, followed by Food from Harvest from Dry Land (odds

ratio=13.985) and Food Aid/Donations (odds ratio = 0.221).

The reason behind this is that household in the Kavango East Region, which are having gardens have food security and diversity, as they are able to sell their vegetables and use the money to buy other food to diversify their dietary intakes resulting in diverse sources of food, from purchasing, dryland harvest and irrigated gardens. Hussain and Clay (1999), agree with this finding, saying that, the maintenance of this form of production, in the long run, is essential for the household's economic and nutritional merit. Again, the importance of gardens is further affirmed by the fact that in times of emergency, societies have had to return to the use of gardens to improve food security, as, for example, Irish potato gardens during the Great Depression. This is also in line with, Faber et al. (2007), who found that irrigated gardens can create income and improve food availability for the poor.

VI. Conclusions and Recommendations

In a study conducted by Mendelsohn and Obeid (2006), they found that while the focus of Botswana's use of the Kavango has been on its tourism, Namibia viewed the river as a passing resource to be exploited before it exits at Muhembo. Thus, the river is perceived as a source of water for irrigation and provision of water for domestic and industrial needs in the Central Regions. A number of lodges and campsites have been developed by private individuals and companies. The leadership has paid little attention to the creation of wealth and jobs through the use of water in the Kavango River.

In addition to the Mendelson study, the problem identified by Kawana (2016), is that, the rural communities of the Kavango East Region have resorted to planting gardens along the Kavango River, due to poor harvests experienced from their rain-fed crops for the past few years. Some small villages such as Shighuru have established 101 gardens.

However, up to date, there has been no scientific study conducted to investigate the factors determining participation in river bed gardening among the rural communities of Kavango East Region. In order to examine the role of irrigated gardens in filling the food gap left by the rain-fed harvest in the Kavango East Region as a case study, the research pursued the following objectives:

- To investigate factors determining participation in river-bed irrigated gardening among the communities of the Kavango East Region. The researcher consulted the grassroots people in the villages of the Kavango East Region. Interviews were conducted to obtain this information and further information was obtained from World Archaeology, through literature review.

Many rural households in developing countries are often the victims of poor health due to poor nutrition and hunger. These households often consume staple-based diets, low in nutrients. Such staple-based diets can be rectified through household vegetable production (gardening). Irrigated gardening can directly enhance food availability, accessibility and utilisation of nutritious foods through the provision of a diverse range of fresh food. Irrigated gardening activities can also enhance the socio-economic condition of rural folks by bringing in income for households to buy other types of food which the households do not produce or use the income to create wealth. Irrigated gardening is an age-old tradition that has been passed on from generation to generation and throughout history, gardening has proved to be a reliable source of food for the impoverished.

It could be said that the constructivism approach, which obviously informs some theoretical assumptions for this study, shares an interesting point of commonalities with the conclusions of this study. Therefore, informed by the problem and objectives stated above, and based on the Kavango East Region case study, this study arrived at the conclusions as covered in the next section.

Conclusions

In contextualising this very important study, it was very difficult to identify another study conducted in the Kavango East Region investigating aspects of the role of irrigated gardens in filling the food availability gap left by the rain-fed harvest in the Kavango East Region, as well as the socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region.

There is lack of exploitation of the socio-economic benefits associated with the irrigated gardens, which may contribute to socio-economic development in the Kavango East region. It was found that while the focus of Botswana's use of the Kavango has been on its tourism, Namibia viewed the river as a passing resource to be exploited before it exits at Muhembo. Thus, the river is perceived as a source of water for irrigation and provides water for domestic and industrial needs in the Central Regions. Private individuals and companies have developed a number of lodges and campsites. A single conservancy has also been established in addition to the irrigated gardens whose support for food security is yet to be exploited to the full.

Supported by several reports, the problem identified by Kawana (2016), is that, the rural communities of the Kavango East Region have resorted to planting gardens along the Kavango River, due to poor harvests experienced with the rain-fed crops for the past years. Some small villages such as Shighuru have established 101 gardens.

Recommendations

Irrigated gardening contributes to filling the food availability gaps left by the rain-fed harvests in the Kavango East Region, in other words it contributes to the food security of the households having gardens. Irrigated gardens compliment the dietary intake of the households, at the same time enhances their income, and reduces expenditure on food, since food is available from the irrigated gardens. However, there is a need for the gardeners operating irrigated gardens to adopt commercial vegetables that they can grow throughout the year and sell for more income. Some traditional pumpkin leaves are good, but, not good enough for commercial purposes, since they are only cultivated seasonally.

The households with irrigated gardens in the Kavango East Region are recommended to decrease their level of reliance on external stakeholders for job opportunities and use their irrigated gardens for self-employment and to enhance socio-economic benefits associated with irrigated gardens. On food security perspectives, leaders of the Kavango East Region, should motivate, and provide leadership and support to the inhabitants of the Kavango East Region to use gardens to fill the food availability gaps left by the rain-fed harvest, in this way the level of food insecurity in the Kavango East Region would be mitigated.

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