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Re-Embracing Indigenous Technical Knowledge Systems (ITKS): The Potential Of Wetland Maize Production In Household Food Security. Case of Murinye Communal Area, Zimbabwe

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ABSTRACT

The underperformance of the communal sector, coupled with reduced government subsidies driven by macro-economic instabilities in Southern Africa, has led to persistent food insecurity among communal households. The main objective of this study was, therefore, to assess the potential of wetland maize production in improving food security in communal areas of Zimbabwe. A survey approach was employed. Structured questionnaires, semi structured interviews, and focus group discussions were used for data collection. Multiple regression analysis was used to determine the impact of wetlands on maize yields and gross margin analysis to compare the returns to maize production for wetland farmers and formal irrigators. Wetlands were found to have a significant ($P<0.05$) impact on maize yields. Gross margins for wetland farmers were significantly ($P<0.05$) higher than for irrigators. State and non-state actors can collaboratively intervene in the provision of technical knowledge on sustainable utilization of wetlands to improve household food security.

Key words: ITKS, Wetland, Maize production, Household, Food security.

INTRODUCTION

Background

Zimbabwe's agriculture sector is divided into the commercial and the communal sub sectors. The communal sector is characterized by complex agro-ecological diversity, erratic and unreliable climatic conditions, poor and weathered soils, and limited irrigation agriculture. Though largely traditional, this sector is the main stay of the majority of the people in Zimbabwe (Rukuni and Carl, 2004). The limits to food security and sustainable level of production are set by the availability of land and water resources, as well as by the human capacity to increase the productivity of these resources without depletion or degradation (Nyamugafata, 1993; Rukuni, *et al.*, 2004). With the scarcity of water and land, especially in the communal sector, smallholder irrigation has been used by most governments in developing nations to cushion farmers. However, Barrow (1987) noted that the irrigated agricultural sector has been facing increasing challenges in the face of rapid population growth, decreasing availability of land, and competition for scarce water resources. Rukuni, *et al*, (2004) observed that this has called for the need to come up with locally crafted strategies to improve the productivity and livelihoods of the world's small scale farmers, especially those faced with reduced expenditure by most governments. To ensure significant and sustainable productivity increases, smallholder farmers have designed initiatives, such as rain water harvesting, to reduce the effects of dry spells.

Wetlands and other areas where water is close to the surface have been identified as being well suited to increase crop production for the communal farmers (Owen, Katherine and John, 1995). Wetland farming can intensify crop production and alleviate constraints resulting from short or long-term dry spells and enable enough production, even in drought years. According to Mharapara (1995), communities with livelihood strategies that are anchored on utilization of wetland resources constitute a significant proportion of the population in the small holder farming sector in Africa. In spite of their importance in supporting human welfare, wetlands are increasingly degraded and lost mainly through over exploitation of wetland products and conversion to intensive agriculture. This has mainly been fueled by socio-economic, political, and environmental factors (Matiza, 1992). One of the major constraints to sustainable management of wetlands is the absence of understanding of the factors influencing people's access and decisions on the use of wetland resources.

Owen, *et al.* (1995) observed that agricultural research and extension services, credit, and marketing institutions have not been designed to support wetland farming. There is need to recognize wetland farming as an economic activity and give it an appropriate place in rural development plans. The challenge that decision makers face is on how to make sure that this economic potential is exploited sustainably. International conservation organizations seeking to stem the progressive encroachment onto wetlands strongly promote the wise use of wetlands through treaties, such as the Ramsar Convention on Wetlands of International Importance (Owen, *et al.*, 1995). The study seeks to determine the impact of wetlands on maize yields and hence on the welfare of communal farmers.

Problem Statement

Rainfall is the single most important climatic factor affecting crop production (Rukuni, *et al.*, 2004). The smallholder farming sector has been experiencing decreasing maize yields due to the erratic rainfall patterns, a degrading land base, and a volatile macro-economic environment leading to reduced government spending. This trend has not spared the safety net (smallholder irrigation). Faced with this trap, interest has been developing among various stakeholders to come up with ways to improve the productivity and livelihoods of the world's small-scale farmers (Rukuni, *et al.*, 2004).

Revisiting indigenous knowledge has been identified as one option. According to Andreini, Steenhus and Makombe (1995), wetlands are among the most productive ecosystems in the world reflecting their importance in providing water, food, and increased incomes to the resource poor farmers. There is, however, a dearth of information about wetland cultivation and the outputs generated, making it difficult to evaluate the extent to which it is sustaining the livelihoods of smallholder farmers in Zimbabwe. The study envisages evaluating the socio-economic impact of wetland maize production to enable stakeholders to formulate appropriate intervention strategies towards sustainable utilization of wetlands in the smallholder areas for improved food security.

Research Questions

The research questions guiding the study are:

1. Does wetland farming have a significant impact on maize productivity in communal areas?
2. Do smallholder communal wetland maize producers have higher margins as compared to smallholder formal irrigators?
3. What are the smallholder communal farmers' perceptions on wetland exploitation?

4. What are the factors that influence the smallholder communal farmers' decision to participate in wetland maize production?

Research Objectives

The broad objective of this study is to evaluate the socio-economic impact of wetland maize production on smallholder communal farmers. The specific objectives of the study are:

1. To determine the impact of wetlands on maize productivity for the smallholder communal farmers.
2. To compare the margins for smallholder communal wetland maize producers and smallholder formal irrigators.
3. To characterize the smallholder communal farmers' perceptions on wetland exploitation.
4. To analyze the factors which influence the smallholder communal farmers' decision to participate in wetland maize production.

Justification of the study

Findings from this study will be an addition to the existing literature on wetland exploitation in Zimbabwe. According to FAO (1994), a, would be, formal irrigator faces many challenges in the form of development, operation, and maintenance costs of an irrigation scheme. In contrast, wetland farming is practiced with virtually no investment costs. The study findings will enable farmers and decision makers alike to appreciate the value of sustainable wetland utilization for maize production, basing on the yield levels as well as the margins attained.

Wetlands are an important resource, which has, however, been neglected by policy makers due to the misconception of them being wastelands vulnerable to cultivation or natural resources with no need for management. However, wetland farmers have developed water management strategies that have evolved in response to the socio-economic constraints prevailing in the smallholder communal farming areas. Based on the findings of the study, there is an opportunity to learn from the farmers' experiences on sustainable agriculture incorporating Indigenous Technical Knowledge Systems (ITKS). The lessons and experiences can be integrated into the overall nation policy framework to ensure sustainable utilization of these fragile environments for improved food security.

There is limited empirical work that has been done to understand the factors influencing smallholder communal farmers' decisions on the use of wetland resources in Zimbabwe. Information from this study will reduce this gap in information.

LITERATURE REVIEW

Introduction

This section focuses on the deliberation of a spectrum of issues. A conceptual framework guiding the study is first presented. A review of literature on wetland farming, the history, and legislation governing wetland exploitation in Zimbabwe is also done. The chapter then reviews literature on socio-economic aspects of wetland cultivation where related studies done elsewhere in the region are looked at. This review draws potential lessons to this study.

Conceptual framework

Turner and Taylor (1998) stated that various farmer circumstances influence production levels. These range from farmer specific (gender, age and attitudes), natural (climate and soils), as well as institutional (government policies) factors. An interaction of these factors has had a bearing on the livelihoods of smallholder communal farmers (see Figure 1).

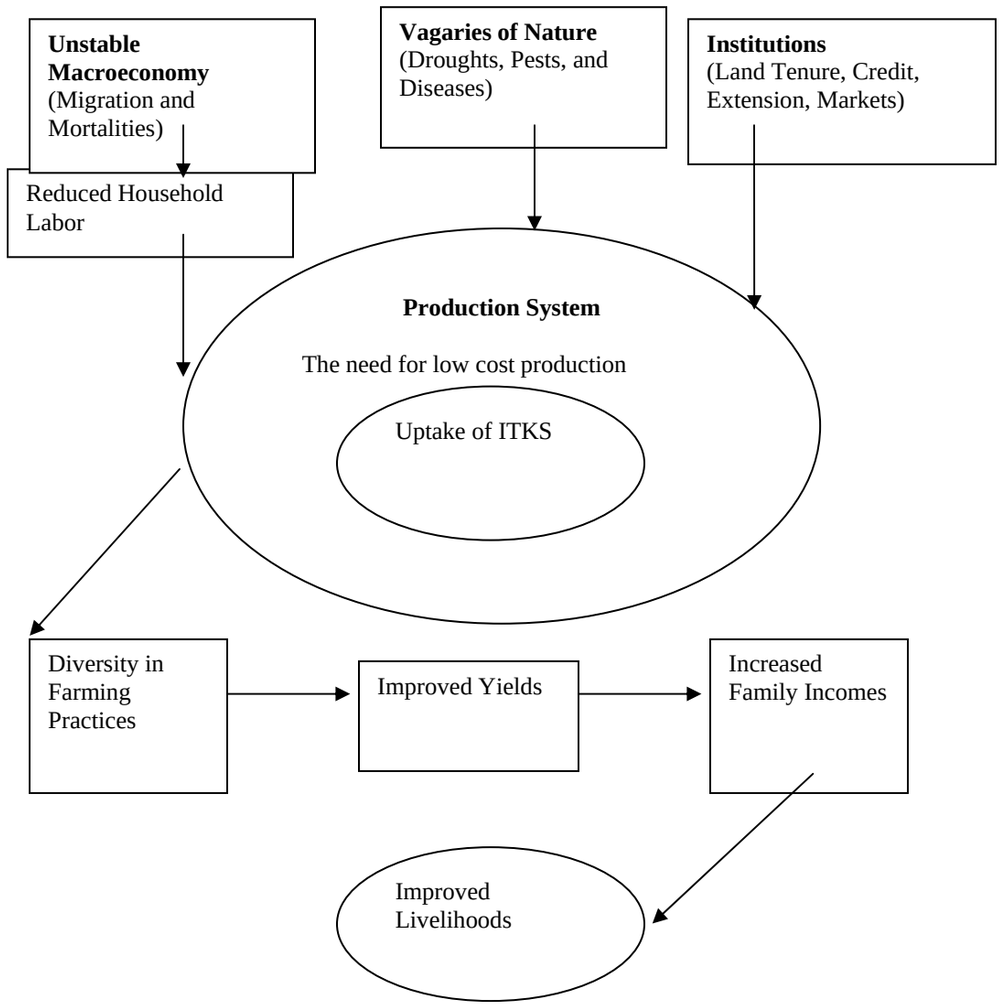

Figure 1: A conceptual model of factors affection production at the farm level

Wetland Farming and Legislation in Zimbabwe: A Historical Perspective

Prior to colonization and the enactment of the Land Apportionment Act, wetland cultivation was a well-established agricultural practice in which communal farmers were involved in all year round cropping. Major crops grown included vegetables, maize, edible rubber (*tsenza*), yams (*madhumbe*), and rice (Whitlow, 1983). The control of the utilization of the wetlands was mainly through taboos and beliefs where areas with excessive water were considered sacred and used sparingly so as not to molest the ancestors. The respect for local norms and values served as an important tool for development that embraced ITKS. The level of sustainable utilization of wetlands, however, began to decline after the creation of reserves that forced the communal farmers to scramble for wetland sites (Sithole, 1995).

Legislations, such as the Natural Resources Act (1952), *amended in 2002*, and The Water Act (1998), currently govern the utilization of these ecosystems seeking to protect them from degradation, particularly through cultivation (Whitlow, 1983; Owen *et al.*, 1995 and Madebwe and Madebwe, 2005). The enactment of these restrictive pieces of legislation was a reaction of the government to the mismanagement of these ecosystems by the settler farmers who sought to cultivate wetlands conventionally for the purposes of growing crops, such as maize, wheat, and tobacco. Since these crops do not grow well in areas with high water tables, drainage lines were installed, which caused drying up of wetlands, soil erosion, and the siltation of rivers and dams. Wetlands were then declared non-arable and were demarcated as grazing areas, a position that has been held to this day (Owen *et al.*, 1995).

Re-evaluating legislation: Correcting the "myths"

According to Whitlow (1983), there is no significant relationship between measures of pressure on dambos and the incidence of gullying. Contrary to the expectations of conventional knowledge, the most extensively cultivated dambos were associated with a lower incidence of gullying. Several studies in Zimbabwe have shown that dambos left for grazing are more susceptible to erosion than cultivated dambos.

Dambos are not, contrary to the widely held belief, the source of perennial river flow regimes. Bullock and McCartney (1996) proposed that, at the time the legislation restricted the utilization of wetlands was introduced in Zimbabwe, there was no substantial hydrological knowledge to provide a foundation for this under pinning concept. Depletion of dambos is mainly by evapotranspiration rather than by contributions to river flow. This loss of water to evaporation places emphasis on management to optimize this water for agricultural production in a sustainable manner, rather than restricting the use of the dambo to preserve a minimal flow maintenance role. Increased agricultural production would mean improved food security in the communal sector.

Socio-economic importance of wetlands

Wetlands have considerable agricultural potential because of favorable moist conditions, which prevail for most of the year. The importance of wetlands lies in the remarkably higher productivity compared to most upslope areas (Masiyandima, 2004). Empirical findings indicated that some wetlands can produce eight times as much plant matter as an average wheat field. They provide a source of crops for household consumption and cash income through out the year. Although the incomes may be little, they are important for smoothing out the household's incomes. Dambo cultivators in Que-Que received an average of US $14.05 per annum from the sale of wetland produce. A few families received more than US $100 per annum from the sale of wetland produce (Theissen, 1973). Elsewhere, a study conducted in Mutoko revealed that households earned Z $70 to Z $400 per week from the sale of tomatoes and other vegetables from cultivation of wetland (Kundhlande and Muchena, 1995). The income earned from the sale of dambo produce had a multiplicity of functions. It could be used for major household investments, paying school fees, purchase of food items that are not produced on the farm, and farm implements. A substantial number of farmers in this area have invested in brick and asbestos houses. However, unwise cultivation of wetlands can lead to their rapid degradation, decline in soil fertility, and loss of perennial water supply (Mironga, 2005). In 1991/2 droughts, a number of wetland farmers in Chihota Communal Lands in Zimbabwe reported having some grain stocks from the 1992 wetland crop harvest amidst reports of severe malnutrition in many communal areas of Zimbabwe (Kundhlande *et al.*, 1995). A socio-economic and production system study of wetland use in Malawi, by FAO (1994), also

revealed similar trends where farmers, invested in wide range of livestock (pigs, goats, chickens, cattle) which also improved food security. Presently wetlands provide a diverse range of agricultural and non-agricultural benefits to local communities in Tanzania. They produce rice, sweet potatoes, cassava, and vegetables. On average, households in Tanzania consume between 40-60% of what they grow in wetlands and sell the remainder (FAO, 1994).

RESEARCH METHODOLOGY

Study Area Description

The study was carried out in Murinye Ward 15, which is 22 km East of Masvingo Town. The study site consisted of Chenga Wetlands and Nemamwa Irrigation Scheme. The area falls under Natural Region III, which is characterized by nutrient poor soils and moderately average rainfall of 600-700 mm per annum. Semi-intensive farming is practiced and the risk of mid season droughts is fairly high. The major crops grown include maize, groundnuts, bambara nuts, and a variety of small grains.

Sampling Methodology

From 35 farmers in Chenga wetlands, simple random sampling (the lottery technique) was used to select 15 respondents. Random sampling ensured that each farmer had an equal probability of being selected. All the 15 farmers from Nemamwa Irrigation Scheme were selected.

Data Collection Methods

The study used a blend of qualitative and quantitative methodologies. Primary data on household livelihood activities and patterns of wetland and irrigated land utilization was collected using a combination of a structured questionnaire, focus group discussions, and participatory observations. Interviews and Focus Group Discussions provided room for probing, noting of non-verbal responses, and the capture of immediate responses. Observations provided a simple approach to the study of attitudes, values, beliefs, and motives. Key informants, such as the extension worker, the elderly, and the local headmen, were also consulted in the process.

Data Analysis

Quantitative data was coded and analyzed using SPSS. Descriptive, as well as inferential, statistics were employed to summarize the data gathered. A multiple regression model allowed for the establishment of the relationship between the dependent variable (maize output) and several independent variables affecting the maize yields. Although the gross margin budget is not an indicator of profitability, gross margin analysis was employed to generate the margins (an indicator of returns) for the wetland farmers as well as the irrigators. The one sample t-test allowed for the comparison of mean gross margins for wetland farmers to that of formal irrigators. For perception ranking, Friedman test, which yielded mean ranks for the perceptions depending on responses based on a predetermined scale, was used. The dependent variable (participation) was a dichotomy. The outcomes were coded as (Y =0 for non-cultivators) and (Y = 1 for wetland cultivators). Since the response was qualitative, the logit model was used.

RESULTS AND DISCUSSIONS

Impact of wetlands (participation) on maize yield

In assessing the impact of wetlands on maize productivity, a dummy variable (participation) was introduced into the multiple regression model. Coding was done to reflect the responses of farmers where 0 was for formal irrigators (non participators) and 1 was for wetland farmers (participators). Results of the analysis are in Table 1.

Table 1: Relationship between maize yield and independent variables

Variable	Coefficient	Significance
Constant	1.213	0.064
Age	0.227	0.030
Participation	1.732	0.047
Gender	0.004	0.025
Agricultural Training	-0.607	0.712
Labour	-0.095	0.003
Fertilizer	0.004	0.000
Education	0.013	0.752
R Squared	0.830	----
Adjusted R Squared	0.754	----

From the results, age, participation, gender, labor, and fertilizer have a significant ($P<0.05$) impact on maize production levels. The coefficient for participation is 1.732, meaning that the wetland farmers have maize yields up to almost double those of their counterparts. The *ceteris paribus* effect of fertilizer use on maize yields is given by the coefficient of level of fertilizer use. This means that a unit increase in level of fertilizer use leads to a 0.004 unit increase in maize output. Given the cost of fertilizers, it is not worth an incentive to invest in fertilizer use. Older farmers have significantly higher yields. This is supported by studies carried by Neil and Lee (2001) which revealed that older farmers generally tend to have higher yields than their young counterparts. In the model, 83% of the variation in maize yield is due to the identified factors. The adjusted R-squared, which takes into account the possibility of inclusion of some spurious variables, is 0.754.

Gross Margin Analysis

Gross margin results for wetland maize producers and formal irrigators are as in Table 2.

Table 2: Gross margin results for formal irrigators and wetland maize producers

	Wetland Farmers	Formal irrigators
Target Yield (t/ha)	2.8	1.6
Selling Price	80	80
Gross Income	224	128
Total Variable Costs	66.5	75
Gross Margin	**157.5**	**53**

Source: Survey results, 2008

On average, a farmer has gross earnings as shown by the gross margin analysis in Table 2. A wetland farmer yields, on average, 2.8t/ha, as compared to the formal irrigator who yields on average 1.6t/ha. The gross margins for maize are US $157.50 and US $53 for wetland farmers and formal irrigators, respectively. Although these values do not show profits, they reflect positive returns to maize production.

Perceptions of farmers on the costs and benefits of wetland exploitation

Study findings on the benefits and costs associated with wetland exploitation as perceived by the farmers are in Tables 3 and 4.

Table 3: The ranking of benefits

Benefits	Higher yields	Low production costs	Early planting	Low leaching	Low soil degradation
Mean rank	1.77	2.53	1.92	3.45	4.72
Benefit rank	1	3	2	4	5

From Table 3, the greatest benefits from wetland use are the high yields that are generated from the activity. Farmers view the reduced degradation of the soil as the least benefit. However, there is interaction of all the identified benefits culminating in the overall high yields and higher returns for the farmer.

Table 4: The ranking of costs

Costs	Water logging	Low germination rates	Weed infestation	Rigidity of crops
Mean rank	2.37	3.34	1.36	4.41
Cost rank	2	3	1	4

Results in Table 4 show that farmers perceive weed infestation as the major problem in wetland farming. This was followed by water logging. With training on water harvesting, these farmers can, however, benefit from the high water tables and use the water during times of water shortages or to water the uplands, which are usually drier.

Determinants of wetland maize cultivation

After having ascertained whether participation in wetland farming had a significant impact on the maize yields and determined the perceptions of farmers on wetland utilization, it became imperative for the study to explore the factors that influence farmers' decisions to exploit the wetlands. Participation was measured as to whether a farmer participated in wetland maize production or not. The results are shown in Table 5.

Table 5: The relationship between participation and independent variables

Variable	Constant	Agricultural Training	Dependency Ratio	Education	Age	Gender
Coefficient	0.384	0.189	-0.014	0.365	0.088	-0.791
Significance	0.956	0.046	0.942	0.499	0.043	0.003

From Table 5, the logit model can be operationalized as:

Z_{ii} = 0.384 + 0.088 (Age) – 0.014 (Dependency Ratio) + 0.189 (Agricultural Training) + 0.365 (Education) – 0.791 (Gender)

Results in Table 5 show that age, gender, and training have a significant ($P<0.05$) effect on the decision to participate in wetland maize production. The effect of age has the expected positive sign. This means that the odds of participating in wetland cultivation increases as the farmer gets older. This is mainly because the practice of wetland exploitation is viewed by most young farmers as 'ancient' and is left to the elderly who have the experience to sustainably exploit the resource. Trained farmers have higher chances of participating in wetland production than untrained farmers. These farmers are aware of the benefits of sustainably exploiting the wetlands and are usually early adopters who want to get the advantages first (Rogers, 1995). The dependency ratio was included as a surrogate variable for the labor that is available in the household. The variable had an insignificant ($P>0.05$) effect. This reflected the low labor requirements for wetland farming as compared to formal irrigation.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Wetland maize production plays a significant role in food security and incomes in Murinye as is with most smallholder communal areas in Zimbabwe. This is evidenced by the higher yields and gross margins for wetland farmers as compared to formal irrigators. However, it is also important to capacitate the farmers on sustainable utilization of these wetlands for long term benefits. Furthermore, training will enable the farmers to turn around what they are currently viewing as costs, for example water logging into benefits, therefore further improving the food security status.

RECOMMENDATIONS

- Wetlands are fragile ecosystems which require an integrated approach to their planning and sustainable use. Policy and technical tools are needed to counteract lack of appropriate information and intervention (mainly institutional) failure which causes wetlands to be used unsustainably.

- Re-embracing ITKS involves the concerted efforts of both the public and private sectors. Extension services need to be strengthened and extension workers need to be trained in sustainable wetland farming practices.

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