DETERMINANTS OF ADOPTION AND ECONOMIC EFFICIENCY OF CRISIS MODIFIER MECHANISMS FOR FOOD SECURITY: A CASE OF ZIMBABWE RESILIENCE BUILDING FUND (ZRBF) IN NYANGA

A dissertation submitted in partial fulfilment of the requirements for the Master of Science Degree in Food Security and Sustainable Agriculture

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Bindura University of Science Education

Faculty of Agriculture and Environmental Science

Department of Agricultural Economics, Education and Extension

KENNIAS SARIRENI
B0320126

Name of Supervisor: Mr. N. Mafuse

June 2019

RELEASE FORM

Name of Candidate: Kennias Sarireni

Reg Number: B0320126

Degree: Master of Science Degree in Food Security and Sustainable Agriculture

Project Title: Determinants of adoption and economic efficiency of crisis modifier mechanisms for food security: A case of ZRBF in Nyanga

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Name of supervisor: N. Mafuse

Signature:

Date:

DECLARATION

I hereby declare that the research project entitled **"DETERMINANTS OF ADOPTION AND ECONOMIC EFFICIENCY OF CRISIS MODIFIER MECHANISMS FOR FOOD SECURITY: A CASE OF ZRBF IN NYANGA"** submitted to Bindura University of Science Education, Department of Agricultural Economics, Education and Extension is a record of an original work done by me under the guidance and supervision of **N. MAFUSE** and this work is submitted in partial fulfilment of the requirements for the award of a Master of Science Degree in Food Security and Sustainable Agriculture. The results embodied in this thesis have not been submitted to any University or Institute for the award of any degree of diploma.

Author: Kennias Sarireni
Reg Number: B0320126
Signature:
Date:

DEDICATION

This work is dedicated to my beloved family and dependants.

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ABSTRACT

Adopting strategies to counter the effects of access to production factors, declining productivity and compromised household and national welfare are important especially in smallholder farming areas. In Zimbabwe, stakeholders including Non Governmental Organisations have taken significant steps towards redressing the afore mentioned challenges. Crisis Modifier Mechanisms have become one important intervention point in the 21st century towards improving the smooth functioning of agricultural value chains. Mixed methods including a structured questionnaire and key informant interviews were used to collect cross-sectional data from 185 small scale farmers. Desk reviews were done with Agricultural Technical and Extension Services agents and Zimbabwe Resilience Building Fund project officers for triangulation of data and exploring stakeholders' perceptions about the crisis modifiers used by farmers. Three categories were isolated across the farming communities namely non project farmers, bio-fortified maize, horticulture pack and cow peas mechanism; sorghum, horticulture pack and cow peas. Economic efficiency for the three project clusters was 79 %, 63 % and 48 % respectively. Household specific factors of age of household head, education level and household income influenced ($p<0.05$) the economic efficiency levels. Data shows that the bio-fortified maize, horticulture pack and cow peas mechanism was the most preferred by farmers with 49 % of farmers adopting the innovation. About 38 % of surveyed farming households used the sorghum, horticulture pack and cow peas innovation, while 13% were not part of the project. Of the 10 variables that had been hypothesised to have an influence on adoption of crisis modification mechanisms, 9 had the expected effects. A number of factors affected ($p<0.05$) the choice of specific mechanism. These included age of household head, household income and number of extension visits. Participatory stakeholder thematic analysis was used to determine the relationships, constraints and opportunities among stakeholders. The major constraints across the mechanisms were identified as inefficient extension services and unreliable markets for the produce. There is strong link between farmers and the Non Governmental Organisation's extension agents but weak networking between farmers and markets as well as research institutions.

Key words: crisis modifiers, adoption, efficiency, small holder farmers, diversification

LIST OF ACRONYMS AND ABBREVIATIONS

AGRITEX	Department of Agricultural, Technical and Extension Services
CSF	Critical Success Factor
ESAP	Economic Structural Adjustment Programme
FAO	Food and Agriculture Organisation of the United Nations
FEWSNET	Famine Early Warning Systems Network
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GMB	Grain Marketing Board
GOZ	Government of Zimbabwe
MDG	Millennium Development Goals
MLACRR	Ministry of Lands, Agriculture, Climate and Rural Resettlement
MNL	Multinomial Logit Model
NGO	Non-Governmental Organisation
OLS	Ordinary Least Squares
PROGRESS	Program for Growth and Resilience
SADC	Southern African Development Community
SDG	Sustainable Development Goals
ZIM-ASSET	Zimbabwe Agenda for Sustainable Socio-Economic Transformation
ZIMVAC	Zimbabwe Vulnerability Assessment Committee
ZRBF	Zimbabwe Resilience Building Fund

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CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture sector is the backbone of Zimbabwe's economy, contributing 15-20 % of Gross Domestic Product (GDP) (Maiyaki, 2010, Mutami, 2015). About 70 % of Zimbabwe's population is directly or indirectly employed in the agribusiness sector. It therefore becomes inevitable for strategies which help attain resilience building and food security especially among smallholder farmers to directly focus on own production systems (Alumira and Rusike, 2005; Pazvakavambwa, 2009). In Zimbabwe, food security is synonymous with availability and accessibility of cereals. This has been supported by Food and Agricultural Organisation of the United Nations, FAOSTAT (online) when it was noted that there has not been much diversification from cereals as the dominant source of food security. Climate change patterns however demand diversification of crop and livestock enterprises among smallholder farmers to cushion against extreme hunger (World Bank, 2015).

In more recent times, weather forecasts for the 2018/19 farming season has shown that there is likely to be El Nino induced drought. The Famine Early Warning Systems Network (FEWSNET, 2018) has warned that there is an increased probability of drought inducing El Niño weather conditions recurring in Southern Africa including Zimbabwe for 2018/2019 agricultural season. This kind of weather is associated with prolonged dry spells, erratic rains and average to below average rainfall (Thomlow, 2007, Ndiritu, Kassie and Shiferaw, 2014). Resilience building against shock and stress from such whether characteristics leads to food security. To achieve food security under such unfavourable weather conditions, there is need to activate systems that strengthen communities' access to food through resilience building mechanisms. In light of El Nino, chances of increased vulnerability to category B1 farmers are very high. This has been noted from the El Nino weather condition of 2016. According to the Zimbabwe Vulnerability Assessment Committee (ZIMVAC) (2016), there was wide spread hunger due to El Nino and 42 % of the rural population were food insecure.

Building on the efforts during the Millennium Development Goals (MDGs) era, Zimbabwe is working out strategies to meet the United Nations' Sustainable Development Goal number 2 (SDG-2). According to www.un.org/sustainabledevelopment.goal SDG-2 is focused on ending hunger, achieve food security and improved nutrition and promote sustainable agriculture

among smallholder farmers who are the most active players in primary production. FAO (2015) noted that food self-sufficiency has remained a problem in Zimbabwe since 2001. Strategically, produce meant directly for food security are low value cereal crops i.e. maize and small grains. Services to promote resilience building projects are classified as public goods and the mandate to support these is with the central government and the donor community. Private entities and food chain players avoid venturing in these projects due to the low market value and high chances of crop failure due to low investment and weak or missing markets.

According to www.odi.org/sites/odi.org.uk, since independence, the Ministry of Lands, Agriculture, Climate and Rural Resettlement (MLACRR) has been responsible for developing agricultural strategies related to food security. Most of the strategies were developed in response to concerns expressed by the politicians or actions called for by the cabinet with minimal reflections on the problems prevailing in farming communities. Due the declining performance of smallholder agriculture and the underperforming national economy, Non-Governmental Organisations (NGOs) are also coming up with strategies and projects that promote sustainable food and income security. Through Zimbabwe Resilience Building Fund (ZRBF), Program for Growth and Resilience (PROGRESS) came up with a Crisis Modifier project so as to improve resilience of farming communities against residuals caused by recurrent El Nino weather patterns. Such weather patterns increase vulnerability of B1 category farmers to shocks, stresses and ultimately extreme hunger. The aim of Crisis Modifier was to protect the productivity and food security gains made by the main project (PROGRESS) as a cushion from the devastating effects of the anticipated unfavourable weather patterns going into the future.

In building the resilience of the communities, Crisis Modifier project distribute seed packs of sorghum, short season bio-fortified maize, cow peas and garden packs. The project also embarked on capacity building of farmers and other partners on agronomic practices that can strengthen the communities' resilience in anticipation of drought. Maiyaki (2010) noted that there was low productivity in Zimbabwe due to inadequate production inputs of which the Crisis Modifier project provided farmers with vouchers to purchase seeds of their choice from a package of sorghum (macia), cow peas, bio-fortified maize and nutritional garden seeds. Horticulture pack includes tomatoes, rape, covo and onion. This research is going to focus on determinants of adoption and production efficiencies of selected packs. NGOs do their evaluations at the end of each project they implemented and they are accountable to the funders,

NGOs do have their own targeted indicators of the project. Under this scenario, there is a research gap on performance of each enterprise under the project. There are a lot of literature on performance of sorghum in semi-arid regions (Rukuni, Tawonezvi, Eicher, Munyuki-Hungwe and Matondi, 2006) and few is known on bio-fortified maize in semi-arid region of Zimbabwe.

1.2 Problem Statement

Crisis modifier mechanisms have been taken up to varying levels among smallholder farming areas of Southern Africa. From inputs distributed under the ZRBF programme in Nyanga, 90 % of farmers prefer a combination of bio-fortified maize, horticulture pack and cow peas as to sorghum, horticulture pack and cow peas, whereas horticulture pack's uptake difference were not significant. The drivers of adoption of the packs with improved variety and production efficiencies of the improved maize and sorghum varieties in the packs is not known but its acceptability is very high in areas where it is new. Therefore this study seeks to identify the determinants of adoption and the associated production efficiency levels in Nyanga district of Zimbabwe.

1.3 Objectives

1.3.1 Main objective

The aim of the study was to explore the factors which influence the decision by a farmer to participate in the ZRBF crisis modifiers project and evaluate the implications on productive efficiency among small scale farmers of Nyanga district in Zimbabwe.

1.3.2 Specific objectives

The specific objectives for the study were to:

1. Evaluate the production efficiency levels of selected crisis modifier mechanisms among small scale farmers.
2. Determine the factors influencing the uptake of selected crisis modifier mechanisms by small scale farmers.
3. Identify stakeholders and their roles on selected crisis modifier mechanisms.

1.4 Research questions

1. What are the economic efficiency levels of selected crisis modifier mechanisms among small scale farmers?
2. Do social, economic and institutional factors influence the uptake of selected crisis modifier mechanisms by small scale farmers?
3. Who are the stakeholders and what are their roles on selected crisis modifier mechanisms?

1.5 Hypotheses

The hypotheses were:

1. There are no significant differences in economic efficiency levels among the selected crisis modifier mechanisms for small scale farmers.
2. Social, economic and institutional factors influence the uptake of selected crisis modifier mechanisms by small scale farmers.
3. There are multiple stakeholders involved and they have varying and overlapping roles for the selected crisis modifier mechanisms.

1.6 Justification

This study will present qualitative and quantitative data on performance of a project meant to build resilience and food security to households during an anticipated el nino. This helps in providing a better understanding of the fundamental aspects of successful agriculture intervention in rural communities. It also aids in providing a framework for the development of a strategic plan to improve the performance of food security intervention programs. Practitioners in food security and agriculture extension are going to benefit from knowledge generated by this research in order to improve intervention performance in most communities of Zimbabwe. Food security intervention is very important to farmers, urban population, other production and processing industries as well as the nation at large as this provide basic foundation and successful remedy on poverty alleviation. The fact that bio fortified maize seed is going to be produced for the first time, it is of paramount important to measure its economic efficiency and also coming up with factors which affects efficiency helps to increase performance of the production of the enterprise.

1.7 Scope/delimitations and limitations of study

The broader delineation of the study was ZRBF's project packs which were disseminated in Nyanga District of Zimbabwe in the country's Eastern Region. The study was then narrowed to the domain of the selected three packs of interest which included new sorghum and maize varieties whose performances in situ still needs to be explored. The governing dimension was to determine the factors which affect the selection of a particular pack by small holder farmers. Focus was also on the economic efficiency, marketing challenges and opportunities currently being experienced by the farmers and other stakeholders who participate in various activities of the project. It was also important to look at farmers producing the crops outside the project since the comparison in terms of performance and benefits from the new varieties is an important ingredient to influencing decision making processes by current and potential actors. This is so done especially to encourage non participants to take up the initiative and those currently producing to expand hectares (and support services) under the crops.

Since there is reliable data on yield levels and prices for the produce in the project area, the study experienced challenges related to data for non-project sampling units. The timeframe needed to conduct the study also posed challenges to the breath demanded by the study. Due to resource limitations especially in terms of time and finances, it was not possible to critically examine all the intricate issues and processes in the project stakeholders platform. Economic analyses entailed the use of estimates and as with any other income data collection practice, there were challenges with accessing financial information and records from the respondents. This was further compounded by the reliability of these data especially for small enterprises where record keeping was poor, if it existed at all. However secondary data sources and triangulation processes helped reduce the risk posed by these drawbacks.

1.8 Outline of dissertation

The dissertation is divided into six chapters. Chapter one presents the foundation to the study in the form of the introduction and background information that guides the study. Chapter two outlines a comprehensive review of literature on the complex relationships in the uptake of crisis modifiers, the marketing methods, challenges and the potential options for extracting real value from the products. Chapter three develops a framework for data collection and examines the analytical framework for implementing the methodology. The study results and discussion

of the findings are presented in Chapters four and five. Finally, the summary, conclusion and recommendations drawn from the study findings are presented in Chapter six of the dissertation.

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter presents cases of previous work and studies that have been done on the adoption on packs supported by NGOs and other stakeholders based on the theoretical underpinnings and empirical studies of other authors in the same or similar area of study. Rukuni *et al*. (2006) reported that over time, there has been significant investment in research towards how the smallholder farmers can be integrated in mainstream agribusiness structures through availing appropriate innovations to them. This section also provides a summary of and commentary on the state of knowledge and available information on the several innovation adoption discussions. These pertain to how innovations are designed, diffused and impact on increasing productivity. The literature review places emphasis on essential topics including the importance of innovations, innovation adoption determinants and the coordination (or fragmentation) of activities in the effort to enhance efficiency of innovation in small scale farming contexts.

2.1 Importance of agricultural innovations among small scale farmers

Agricultural innovations are an important resource in sustaining agricultural production, processing and marketing systems. According to World Bank (2008), agricultural innovations are specific instruments designed to facilitate efficiency economic and physical productivity. It is a set of coordinated actions that are formulated and designed to ease or improve pre-existing means of agricultural production. Literature shows that there are two distinct drivers of successful agricultural innovations in developing countries (Hoddinott and Quisumbing, 2010; Alegado and Visser, 2017). The primary element is the availability and affordability of the innovations which makes them easily adopted by the lower spectrum of stakeholders. Another important dimension is the farmer expectations that adoption will remain profitable. These two are interconnected and they simultaneously determine the extent to which farmers are risk averse. There are a number of factors which drive the above expectations, ranging from availability and size of land, family labour, prices and profitability of agricultural enterprises (Namara, Nagar and Upadhyay, 2007; Thomlow, 2007)

2.2 Factors affecting adoption of agricultural innovations

A number of social, economic and institutional factors affect the farmer's decision to take up an innovative practice or not (Feder and Zilberman, 2006; Baudron, 2001; Neil and Lee, 2001 and Rogers, 1995). These factors are hypothesised to have an influence on the likelihood of farmers to adopt and use a pack with an improved variety from ZRBF (viewed as an innovation in this study) by farmers in Nyanga.

2.2.1 Proportion of non-farm income

Agriculture is perceived as a practice for the poor households in most parts of Southern Africa (World Bank, 2008). Studies have shown that on average, well-to-do farmers who have a significant proportion of off-farm income are less likely to participate in low spectrum agricultural innovation adoption especially with low value crops such as maize and sorghum production. Thomlow (2007), in his study on conservation agriculture in Zimbabwe noted that this is due to their social status which discourages them from being associated with technologies viewed to be of low status.

2.2.2 Experience in agricultural practices and extension contacts

The experience of the farmer in agricultural activities significantly influences their decision to adopt innovative practices expecting to increase productivity and incomes. Hassan and Nhemachena (2008) argued that this mainly so in societies which depend on agriculture for livelihood. With more years of experience, farmers are likely to have access to various information sources which help them to make informed decisions regarding the costs and benefits of the innovation. These farmers have tested multiple innovations and know the chances of possible failure in each different case.

2.2.3 Age of the farmer as main decision maker

The farmer's age negatively influences the likelihood of adopting and innovation (Namara *et al*., 2007). Younger farmers are more market oriented and are more willing to adopt new practices compared to their older counterparts within similar contexts. This view is also supported by Rukuni *et al*. (2006) who argued that older farmers are more conservative and more risk averse thus resisting change especially in smallholder farming communities. Kilima,

Mbiha, Erbaugh and Larson (2010) had a different view and observed that chances of participation in adoption of innovations increased with age because youths have little appreciation on the importance of agricultural activities in most rural set ups and will take marginal effort to utilize innovations for market penetration potential.

2.2.4 Arable land holdings

There is a positive and important effect of land size on innovation adoption chances among small scale farmers. Farmers with large arable land holdings have the opportunity to expand into underutilized sections and use them to try out new practices at lesser risk of complete failure. Musara, Musemwa, Mutenje, Mushunje and Pfukwa (2019) argued that large land size also implies that farmers can diversify into other crops and reduce the production risk in agricultural activities. Di Falco, Veronesi and Yesuf (2011) supported this by stating that the size of the land is important because the transactional costs are largely fixed costs that are spread across more potential output on large farms.

2.2.5 Market prices and the reliability of buyers

Price is an important indicator of market efficiency and influences the allocation of limited resources. Rukuni *et al*. (2006) reported that the prevailing and anticipated market prices for crops influence the choice of enterprises in small scale farming area of Zimbabwe. In most cases farmers have shunned traditional cereal crops such as maize and small grains and opted for the cash crops which have higher producer prices tobacco.

2.3 Overview of crisis modifiers in risk mitigation strategies

Crisis modifiers have been taken up internationally as mechanisms for pushing small scale farmers out of extreme poverty and hunger. These include soil, water and physical resource conservation practices e.g. improved seed varieties, rain water harvesting techniques among others. NGOs have take the lead in driving this resilience building set of strategies which revolve around strengthening productivity capacity and facilitating market linkages. This has been reported to be a sustainable alternative agricultural paradigm. It relies on socio-economic-ecological processes that are adapted to local conditions with the aim of sustaining the health of ecosystems including the farmers, financiers, marketers among others. Crisis modifiers have evolved into an socially, ecologically and economically friendly substitutes for conventional

farming systems which have relatively poor performance. The inclusion of for example climatic change adaptable varieties in crisis modifier mechanisms forms the core these mechanisms.

Agricultural performance is determined by the availability of resources (Langyintuo and Mungoma, 2008). However, there is generalised low productivity in most parts of smallholder farming set ups in Africa has been highly associated with low availability of resources for agricultural crops. For example there are low soil nutrients associated with low application of fertilisers which has led to low productivity over the past decades. This has contributed to high food and income insecurity in most African countries including Zimbabwe (Government of Zimbabwe, 2013). Crisis modifiers bridge the gap in resource limitations and increase crop performance. They sustain and restore the livelihood status of farmers and other stakeholders in selected value chains due to their potential to increase yield while enhancing food for human consumption and excess for the markets. This is also supported by Amare, Asfaw and Shiferaw (2014) who reported that strategies for crisis modification aim at increasing soil fertility and enhancing output through improved varieties such as bio-fortified maize which is a short season variety. Bandara and Thiruchelvam (2008) also noted that the uptake of crisis modifier mechanisms is a component of sustainable agriculture which has the potential to improve the food and income security of small scale farmers while providing enough for the multiple markets.

2.4 Stakeholders supporting crisis modifier mechanisms in agribusiness

The adoption of crisis modifiers has been shown to have positive impacts on farm performance and subsequent value chain stability. According to Martinez-Torres and Rosset (2010), an agribusiness is an entity involved in any component of the processes in agriculture. Agribusinesses have benefited from these strategies due to high yield and presence of multiple players in diverse markets. Nang'ole, Mithöfer and Franzel (2011) report that agribusinesses as the industries in the value chain from the supply of inputs, support services such as extension, the producers, processers and agricultural output markets through distribution to consumers have been brought on a common platform. A weak agribusiness system therefore implies fragmented constituent market segments where for example farmers have no access to improved seed varieties and are detached from markets. The strengths, weaknesses, opportunities and threats (SWOT) analysis framework by Ndiritu, Kassie and Shiferaw (2014)

highlight some of the pertinent gender issues which characterize relatively diverse agricultural systems of Southern Africa which have overtime benefited from pseudo crisis modifiers.

Crisis modifier advocates agree with Ortmann and King (2007) who observed that agribusinesses in Southern Africa are being subjected to the international market "unfair competition" as products from economic blocs such as EU and USA are highly subsidized. This market distortion disadvantages farmers from Southern Africa in terms of the low returns they get from high investments they would have made to produce and market agricultural commodities both locally and internationally. In cases where there is potential competitive advantage such as availability of raw materials, there is usually lack of the technical expertise to attract new market participants for the products. The Southern African region has also been reported to face generalized infrastructural inadequacies, top-bottom policy formulation approaches and trade distortions. Pazvakavambwa (2009) proposed integrated approaches to the agribusiness system as an opportune avenue during current times when the value chains are gravitating around integration. Realizing the benefits of the integration process is only achievable if the challenges highlighted above are overcome through the acceptance and scaling up of crisis modifier mechanisms by placing them in the broader policy.

In the wake of the SWOT analyses in most smallholder farmer driven commodity chains in Southern Africa, there is need to establish sustainable linkages by adopting a proactive entrepreneurial approach which accepts the space of crisis modifiers for the success of agribusinesses (Maiyaki, 2009). It has been reported that in today's global economy, entrepreneurship, which involves innovating and risk taking, needs to govern the decisions by stakeholders involved (including farmers and firms) in the chains rather than solely inherently embedded in broader donor-funded projects. This shift in orientation means creating breeding ground for crisis modifier programs so that Southern African Development Community (SADC) countries benefit from their strengths and opportunities and overcome the threats and weaknesses (Rukuni *et al*., 2006). This development trajectory differs from the conventional project approach that has been embraced by most innovative strategists aimed at enhancing agricultural productivity, food security and household incomes in developing economies.

Given the nature of projects advocating for crisis modifiers uptake and learning from Minten and Dukpa (2010), going forward there is need that stakeholders do not necessarily have to

attempt to make changes to the whole value chain as this could lead to loss of competitive advantage. They suggested that it is more advantageous to focus specifically on activities where they have sustainable competitive advantage. Crisis modifier strategists advocates for strategies which aim at generating advantages through products of higher unit value, and volumes of the same value. Innovations such as the introduction of new varieties and product markets, as the case with ZRBF projects in Nyanga, are options to competitive advantage.

2.5 Theoretical framework

The theoretical approach adopted for the study is based on a blend of the innovation approach theory and utility maximisation theory to explain the factors behind the uptake of the crisis modifier strategies and the associated efficiencies.

2.5.1 The innovation theory

According to Namara *et al*., (2007), an innovation system is defined as:

"… a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into social and economic use, together with the institutions and policies that affect their behaviour and performance…".

Generally, an innovation is conceptualized in a more systemic, interactive and evolutionary way in response to the demands and expectations of stakeholders. Innovation can be triggered in many ways by factors that are most likely to stimulate the uptake and success of the innovation. It can for example be an environmental issue (decline of soil fertility), a competitive condition in markets, a new policy (land tenure reform), or an international organization intervention (FAO, 2015). An innovation system is also shown as a dynamic process of interacting embedded in specific institutional and policies contexts.

Multiple adoption categories have been reported in literature. In his ground breaking work on adoption of innovations, Rogers (1995) defined the adopter categories as "the classifications of members of a social system on the basis of innovativeness". This classification includes innovators, early adopters, early majority, late majority, and laggards. In each adopter category, individuals are similar in terms of their innovativeness which was defined by Clapp (1997) as "a relatively-stable, socially-constructed, innovation-dependent characteristic that indicates an

individual's willingness to change their familiar practices". Understanding innovativeness can therefore be viewed as a toolkit in exploring and unpacking the desired and main behaviour in the innovation-decision process. There are critical issues which has been reported with adoption studies and these include awareness about an innovation, processing of the information about the costs and benefits, testing or seeing in situ and then possible uptake of the innovation (Patel, 2009). The current study acknowledges that the process of adoption is not necessarily linear and can be more complex especially in cases where multiple related innovations are introduced at the same time as is the case with the ZRBF crisis modifier packs.

2.5.2 The utility maximisation theory

The theory states that when making a choice, decision makers aim at getting the highest possible value compared to all alternative options available (Hassan *et al.*, 2008). An adopter is defined as a farmer who used a crisis modifier mechanism during the project period. The multinomial logit is selected as the best option for modelling the decision. Guided by the multinomial logit model, the study assumes that for any farmer in Nyanga the unobserved demand for adopting the crisis modifier mechanism of choice is modelled as:

$$D_i^* = \beta' X_i + \mu_i \tag{1}$$

The observed demand for the o crisis modifier mechanism is given as:

$$D_i = \begin{cases} 1 & if\ D_i^* > 0 \\ 0 & if\ D_i^* \leq 0 \end{cases} \tag{2}$$

The probability that a household will effectively adopt and use or crisis modifier mechanism is given based on the random utility intuition. A rational farmer will use the crisis modifier mechanism if the utility for adoption and outweighs that of non-adoption.

$$P(D_1) = \Pr(U_{d1} > U_{d0}) \tag{3}$$

2.6 Conceptual framework

Although agricultural technologies (for instance, high yielding seed varieties adoption) are available to farmers, their adoption has been systematically constrained by several socio-economic factors and institutional factors in various contexts. Generally, these variables and their relationship is presented diagrammatically as given in Figure 1.

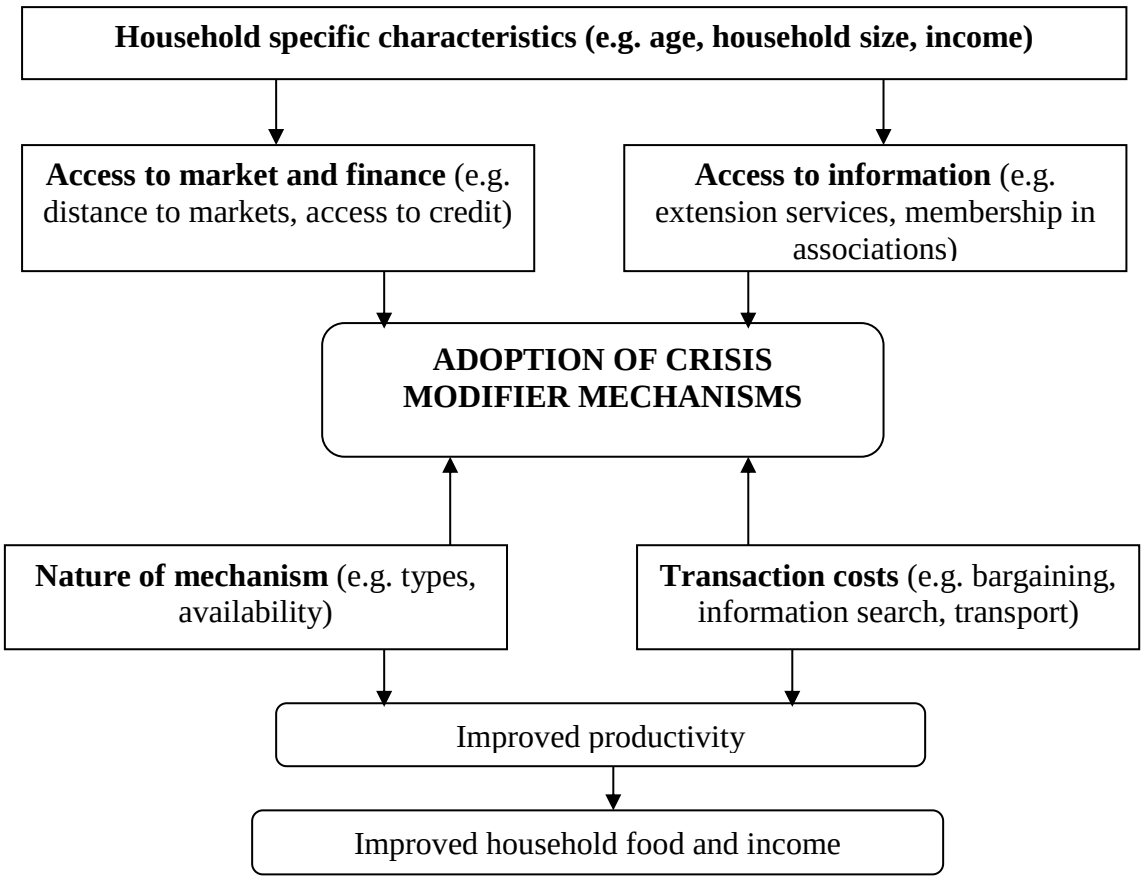

Figure 1 Factors influencing adoption of crisis modifier mechanisms

Source: Adapted from Rogers (1995) and Neil *et al*. (2001)

The study hypothesise that several factors influence crisis modifier mechanisms as in section 2.2. Table 1 summarises the crisis modifier mechanism adoption determinants.

Table 1 Description of crisis modifier mechanisms adoption variables

Variable	Description	Units	Expected Effect
Age	Age of household head	Years	+/-
Land	Size of arable land holding	Hectare	+
PriceM	Average weighted price of maize	Currency	+
PriceS	Average weighted price of sorghum	Currency	-
Membership	Number of affiliations for household members	Number	+
Market	Average distance to the market	Minutes	-
Extension	Number of extension visits per week	Number	+
Training	Frequency of training programmes	Number	+
Income	Proportion of off farm income	Percent	+/-
Experience	Period farmer has been in crop production	Years	+

2.6 Summary of literature review

A number of driving forces behind the adoption of various agricultural technologies were identified in the social, economic and institutional clusters. These factors influenced the adoption decision making processes in different ways based on the specific context being evaluated and the nature of the technology to be adopted. In essence the nature of technology in terms of usability and convenience as well as household specific characteristics and the expected benefits are reported to influence adoption. The theoretical foundation as well as the conceptual orientation was also presented based on the multiple factors aforementioned. This review of related literature helped in refining the objectives and map the way in terms of research design and overall methodology as in Chapter three.

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CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter provides a general description of the methods that were in conducting the research. Description of the study area, research design, population, sample size, sample unit description, formulation and administration of research questionnaires, pre-testing of the instrument and data analysis are also covered in this chapter. The statistical procedures employed in data analyses are also outlined.

3.1 Description of study area

The case site for the study was Nyanga District in Manicaland Province of Zimbabwe with a focus on farmers who participated in the ZRBF project and those who used conventional practices. Commercial farmers are located in natural region I while small scale communal farmers are located in natural region IV and V of the district. According to Mugandani, et. al (2012), the maize, cowpeas sorghum industries plays a very important role in the economy of most small scale farmers in Zimbabwe. The industries generate employment across its numerous sub-sectors thus being a tool for poverty alleviation. In the study area, there have been low yields across the three enterprises because of limited access to improved seed varieties and depletion of soil nutrients without being replenished. However, according to Rukuni *et al.* (2006) soils in Nyanga are generally well drained and can sustain most crops. Nyanga District has both dry land farming and green house based horticulture activities and mainly relies on farming a source of livelihood.

3.2 Research paradigm

This study used a pragmatic research paradigm. Given the nature of the study, this allowed for both qualitative and quantitative approaches to be used. For example quantitative statistical measurement used neutrality, observable events and quantifiable elements to establish the cause effect relationship (Best and Khan, 1995). This study used SPSS version 22 and Microsoft Excel to analyse data. The core methodology of this research was mainly quantitative. Quantitative methodology was chosen to explain the cause-effect relationship

between the adoption decision and various independent variables as alluded to in Figure 1. Quantitative researchers use different tools to gather quantitative numeric data that can be tabulated and analysed statistically. The four types of data that can be gathered in quantitative studies include individual performance, individual attitudes on an affective scale, factual and observation of individual behaviour. This research mainly depended on primary data that were gathered through the administering of questionnaires to the respondents.

3.3 Research design

Basically two research designs were applied to this research, that is, a descriptive design which is meant to explain the characteristics of the subjects under investigation and the explanatory design that was important in explaining facts based on the outcome of the research. The earlier lays foundation from which all the other findings were referred to. The explanatory design dealt with an in-depth understanding of the cause-effect relationship among the variables of interest. In addition, recommendations for policy makers and other relevant stakeholders were drawn based on the explanations from the explanatory design. In other words, this was the main source of solutions to the stated research problem.

3.4 Sampling techniques

Two stage sampling technique was used with purposive sampling to select 2 Wards with the most beneficiaries of the ZRBF project. Systematic stratified sampling was then used in the second stage to select proportionate numbers across the three clusters of adoption status namely bio-fortified maize, horticulture pack and cow peas, sorghum, horticulture pack and cow peas and conventional farming. Systematic sampling was applied since the given sampling units within each cluster were assumed to be homogeneous and random. Best and Khan (1995) emphasised the importance of probability based sampling in quantitative research as a basis of generalisation of research findings. The study considered a sample above 30 % of the population from which cautious generalisations were drawn. As suggested by Best and Khan (1995), since the population number (number of targeted population) was known in the study area, the sample size calculator was used to determine the sample size as 185 farmers split as 90 for bio-fortified maize, horticulture pack and cow peas, 70 for sorghum, horticulture pack and cow peas and 25 for the conventional practices.

3.5 Data collection

This research focused on primary data on household characteristics, market conditions and institutional arrangements with some triangulation based on secondary data on farm performance based on the ZRBF records. A structured questionnaire and key informant interviews were conducted with stakeholders involved in the project in the study area. The questionnaires were developed with sub-sections that enabled for probing the respondents to give as much information as possible to answer the research questions and help in drawing meaningful conclusions about the subject matter. The key sections that were contained in the questionnaire included but not limited to, detailed demand drivers for the ZRBF packs, and stakeholders' perceptions and relationships on the project platform.

Questionnaires have several advantages especially that they have pseudo fixed response questions. This guides the respondent to think within a narrowed framework and then makes data analysis easy and reliable. They can also be easily standardised for specific researches and therefore become more efficient in data collection since data are collected directly from the unit of analysis, for example a household.

Some of the disadvantages are that, questionnaires can be responded to by a wrong person who may have limited information on the subject matter. They are also less interactive which affects the quality of data collected. The question and answer approach does not give room to both the researcher and respondent to think outside the questionnaire's framework. Responses from the respondents are usually limited to the questions asked and this closes out other crucial information that the respondent may have concerning the subject matter. To support the data collected from the field, secondary data, were collected from different published or non-published research journals and reports.

3.6 Data analysis techniques

Both the descriptive and quantitative analyses were employed in this study, based on the objectives stated in Chapter one. Descriptive analyses involved the use of means, percentage, ranges and cross tabulation approaches. Stakeholder analysis and thematic analysis were also used to explore the perceptions of stakeholders, how they relate on the project platform and identify existing and the missing links which are affecting uptake of the innovations. The

quantitative analyses involved the use of multinomial logit regression, multiple linear regression, gross margin analysis, ratio analysis and efficiency analysis matrices. Detailed explanations are presented in Chapters four and five.

3.7 Summary

The Chapter highlighted the research plan that was adopted for the study. The study site where the ZRBF project is being implemented was identified as Nyanga District. The research philosophy was also explained in relation to the objectives of the study. A presentation of the data collection strategies and analytical approaches was also done. This paved way for the results and discussion chapter which follow in this dissertation report.

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CHAPTER 4

FACTORS INFLUENCING THE CHOICE OF SPECIFIC CRISIS MODIFIER PACKS IN NYANGA DISTRICT OF ZIMBABWE

Abstract

Crisis modifiers have been widely promoted by Non Governmental Organisations in Zimbabwe as a panacea to food and income insecurity in the small holder sector. However, the adoption processes have not been well documented with speculations that they are quite slow with limited scope for scaling up and scaling out. This study aimed at identifying the factors that influence the level of adoption of crisis modifier mechanisms which are distributed by the Zimbabwe Resilience Building Fund in Nyanga District, Zimbabwe. A descriptive analysis from results of a household survey administered to 185 farmers clustered as 90 for bio-fortified maize, horticulture pack and cow peas, 70 for sorghum, horticulture pack and cow peas and 25 for the conventional practices. A multinomial logit model revealed that the choice of the crisis modifier pack adopted is positively influenced ($p<0.05$) by farmer's age, household income and number of extension visits. The empirical results suggests that, to promote adoption of a complete package of crisis modifiers, policies that increase access to lines of credit and extension services should make strategic intervention through innovative methods of farmer to farmer extension services. Promotion of longer-term and effective crisis modifiers mechanisms can only be achieved through targeting young educated farmers. It is of paramount importance as well to address the main factors leading to non-adoption and slow adoption such as in ability to cope with the demands of the innovation from a management perspective.

Key words: Adoption, Sorghum, Bio-Fortified Maize, Crisis Modifiers, Multinomial Logit Regression

4.1 Introduction

Agriculture is predominantly one of Zimbabwe's priority sectors since it forms a strong potential base for economic growth prospects (Rukuni *et al.,* 2006). Zimbabwe lags in the production of cereal crops in Southern Africa and is principally a net importer of maize and sorghum from countries such as Zambia and Malawi. As at 2011, agriculture contributed 21.5 % of Gross Domestic Product (GDP) as compared to about 78 % for industrial production and

manufacturing combined (GOZ, 2013). The sector also accounted for 85 % of employment in the country. More specifically, most of Zimbabwe's rural population depends on farming as a major economic and livelihood activity. There is therefore need for the collaboration of state and non-state actors in developing the sector so as to achieve Sustainable Development Goals (SDGs), especially by eradicating extreme poverty and hunger in semi-arid rural farming communities.

In the Eastern region of Zimbabwe, the main challenge is that once preferred crops in the such as cassava and citrus are suddenly not being produced and consumed at their peak levels due to multiple factors. These trends have been mainly due to the preferential treatment rendered to maize by the government through guaranteed pricing, input provision through subsidies and provision of market infrastructure. The prevalence of unbalanced policies has led to inappropriate enterprise choice. As farmers attempted to benefit from the government support, they ended up producing maize even in areas where the crop does not perform well. Non Governmental Organisations (NGOs) such as Zimbabwe Resilience Building Fund (ZRBF) have partners and complimented government efforts in Nyanga and provided crisis modifier packs. more appropriate. These strategies are aimed at reducing the prevalence of food, income and nutritional insecurity among households. For example, there is acknowledgement by the NGO that in the current policy environment, sorghum production is now mainly done by a few resource constrained smallholder farmers who lack the support, commercial orientation and cannot produce enough for sale. This, coupled with long distances to markets, high transportation costs and high transaction costs act as barriers to entry for farmers and investors leading to inefficient domestic sorghum markets. Marketing of produce has therefore largely remained rudimentary with very little, if any real gains from such transactions.

Apparently the ZRBF project focuses on considerable efforts to develop effective maize, sorghum and cowpeas production and marketing systems among smallholder farmers. However, adoption of the crisis modifier packs, production practices and marketing is still relatively low and so are the volumes of the grains being produced and traded. The current study puts to test the viewpoint that the low adoption of this potential food and income security stabilizer is affected by a number of socio-economic and socio-cultural factors such as lack of adequate support services, erratic and variable performance of the production and marketing techniques. There is hope that production of these NGO supported crops will come in as a more

lucrative alternative since some of the variable costs of production are catered for through input subsidy programs.

4.2 Methodology

The study population comprised of small scale farmers in Nyanga District of Zimbabwe. The study site was conveniently chosen since it is the area where the ZRBF project on crisis modification mechanism is implemented. A sample of 185 farmers participated in the survey which yielded cross sectional data in February 2019. Specific data on social, economic and institutional drivers of adopting the packs from the project were collected using a self administered structured questionnaire. Variables such as the age of the household head, prices of commodities in markets and extension services practices were captured for further analyses. Refer to Chapter Three for detailed explanation of methods used.

4.3 Estimating the multinomial logit regression model

Generally the term adoption refers to various processes and stages as one uses an innovation for some desired or expected benefit such as increased yields (Neil, *et al*., 2001). However, in the context of this study adoption is defined to mean using a pack supplied by ZRBF during the period under review. This definition created a binary dependent variable for each of the three clusters since any stakeholder would either be an adopter or non-adopter. The specification of the multinomial logit model (derived from the logistic regression function) allowed for the determination of the determinants of the adoption decision (Greene, 2000). The likelihood of observing the dependant variable (P_i) was tested as a function of variables which include age, training, gender of household head, access to credit and during in farming. Therefore:

$$P_i = \Pr\left(Y_i = 1\right) = \frac{\exp\left(Z\right)}{1+\exp\left(Z\right)} \tag{4}$$

The natural log transformation of (1) results in (2):

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \sum_i^n \beta_i \mathrm{X}_i + \mu_i \tag{5}$$

$$Z_i = \beta_0 + \sum_{i}^{n} \beta_i \mathrm{X}_i, + \mu_i \quad (6)$$

Where:

- P_i is the probability that the i^{th} farmer is an adopter of any one of the ZRBF pack being disseminated (Yi = 1);
- β_0 is the intercept;
- β_i 's are the slope parameters to be estimated; and
- X_i 's are the independent variables captured in Table 1.

The marginal effect for the model is given as:

$$\frac{\delta P_i}{\delta X_j} = \frac{\exp(z)}{1+\exp(z)}\left(\frac{1}{1+\exp(z)}\right)\beta_j. \quad (7)$$

In this model, the dependant variable, Z_i in (6) is the natural logarithm of the probability that the choice to adopt a particular pack would be made (Ramanathan, 2002). The multinomial logit model implies diminishing magnitude of the partial effects for the independent variables. The coefficients give the signs of the partial effects of each of the independent variables on the adoption probability (Woodridge, 2003). The dummy variables included in this model were defined to distinguish between two groups. In this study the coefficient estimates are the *ceteris paribus* difference between the two groups.

4.4 Factors determining choice of particular ZRBF packs by farmers

Guided by the frameworks in Chapter two, the study used a multinomial logit regression analysis framework to determine factors that influence the farmer's choice of a particular pack from ZRBF. The results for various variables which were tested are as in Table 2.

Table 2 Multinomial logit regression estimates for ZRBF packs choices in Nyanga District

Variable	ZRBF pack					
	Not in the project		*Bio-fortified maize, horticulture and cow-peas*		*Sorghum, horticulture and cow peas*	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Age	1.964**	0.043	0.909*	0.001	0.842*	0.008
Land	1.850**	0.290	1.143	0.747	1.220**	0.016
PriceM	0.971	0.437	1.337**	0.034	0.081	0.451
PriceS	0.039	0.278	0.069	0.329	1.056**	0.027
Membership	-2.446***	0.067	0.998**	0.043	0.749**	0.028
Market	-1.619**	0.011	-1.147**	0.015	-0.183	0.841
Extension	-0.365	0.396	0.751**	0.021	0.189	0.953
Training	-1.603**	0.030	0.028	0.3280	0.726**	0.016
Income	1.964	0.118	1.402***	0.084	-0.239	0.364
Experience	1.331	0.396	0.035	0.687	0.748*	0.002
Constant	0.327	0.143	1.407	0.002	0.166	0.453

The base cluster is all the adoption of all ZRBF packs. *; ** and *** shows p-values significant at 1 %, 5 % and 10 % levels respectively.

Of the 10 variables capture in the analyses, 4 significantly ($p<0.05$) influenced the decision not to be involved in the project and 6 influenced ($p<0.05$) the other two clusters of packs from the ZRBF project. Household specific variables, market conditions and institutional factors affect the decisions to take up some pack from the project. These variables' effects were not universally the same across all the clusters analysed. This can be an indicator of the variability in pack specific attributes and the associated market and marketing status. For example what affected the choice which included a maize variety was different from what affected the adoption of the pack with sorghum.

4.4.1 Age of household head

From the above analysis the results showed that age of the household head had a positive and significant ($p<0.05$) influence on the adoption of the packs from the project. The reason maybe that the younger farmers are not interested in the traditional crops such as maize and sorghum which are included in the packs. They feel that due to their lower market prices, they will diminish their aggregate incomes from adopting the packs. Discussions showed that the younger farmers would have adopted a horticulture and cow peas pack if it was offered by the project since these are considered high value crops. Thomlow (2007) also reported that older farmers are in a position to accept the cereal crop packages since they are more concerned with household food security.

4.4.2 Land holdings

A prior to the study, the hypothesis was that land holding was expected to have a positive and significant effect on the adoption decisions. From the results, land holding is a significant ($p<0.05$) variable to the adoption of packs with no maize. This maybe because the average landholding size in the study area, which is a communal area was not large enough to generate the multiplier effect from increased agricultural activities. Farmers would be more willing to try sorghum given that maize has been viewed as a non performing crop for long times. Langyintuo and Mungoma (2008) noted that land size affects the willingness to adopt innovations by small holder farmers.

4.4.3 Prices of commodities and household income

Prices are a critical consideration when farmers decide on crop choices (Devereux, 2006). The result of this study confirms the hypothesis that prices positively incentives farmers to supply more of a commodity in any given market *ceteris paribus*. This can be directly attributed to the fact that the small scale farmers will increase their chances of getting meaningful returns from the enterprises if market prices are favourable. Household incomes are also an important determinant of adoption decisions. In this case farmers with higher levels of household income are most likely to adopt the pack with the improved maize variety since they anticipate to generate more income and invest further into agricultural activities through the multiplier effects of adoption benefits. Ndiritu *et al*. (2014) supports this view point arguing that since agricultural activities are seasonal and risky, farmers are more likely to take up innovations which increase their economic sustainability.

4.4.4 Distance to markets

Distance was measured by the duration it takes to reach the nearest and reliable market. From the results shown above distance to market has a negative and significant ($p<0.05$) influence on the adoption decision. The longer the distance to the market the less the likelihood of demanding the innovations since farmers feel they will not have chances of reaching the markets and sell their produce (Patel, 2009). Because of longer average distances to most lucrative markets in the study area, farmers are forced to remain locked in their traditional crops and not join the project. In this regard, distance to the market increases the transaction costs of accessing buyers thereby discouraging production (Musara *et al*., 2019).

4.4.5 Assistance from extension officers

Extension services are an important ingredient in catalysing generation and dissemination of information within farming communities. Increased contact with extension agents should increase the chances of accessing high amounts of information about emerging innovations. This finding is consistent with a study by Amare *et al*. (2012) in maize-cowpeas farming in Tanzania. However, according to Rukuni *et al*. (2006), in most African small-scale setups, farmers are likely to have less access to extension services, which may be able to educate them about innovative practices. Moreover, extension services are often directed towards farmers who are wealthier and more likely to adopt modern innovations. This inequality in the distribution of resources is linked with production inefficiency and limited control of important agricultural resources (FAO, 2011).

4.5 Conclusions

The study shows that farmers adopt the pack which they feel is relevant to their needs. For example based on the orientation of production, farmers adopted sorghum inclusive packs due to the nutritional expectations. A relatively few farmers had access to all the packs. About 38% of surveyed farming households used the sorghum, horticulture pack and cow peas innovation, while 13% were not part of the project. The pack with bio-fortified maize was the most popular among farmers contributing 49 % of the respondents. Social, economic and institutional factors are important in determining the choice of package from the available project alternatives. These variables include age of decision maker, the household income, distance to the market and the prevailing market prices.

4.6 Recommendations

The study recommends that the there is therefore need to reduce distances to the market which discourage uptake of particular crop enterprises by decentralising the markets. Extension networks also need to be realigned with the demands of the products from the packs. This is likely going to enhance the uptake of the packs especially the one with sorghum which has had lower uptake. Promotion strategies for the available packs can also unlock the desire by farmers to take up these crisis modifier kits.

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CHAPTER 5

STAKEHOLDER RELATIONS AND ECONOMIC EFFICICNY OF ZRBF CRISIS MODIFIERS IN NYANGA DISTRICT, ZIMBABWE

Abstract

Strategic partnerships among stakeholders in the uptake and use of innovations is a gateway to their productive use. This is especially so in the small holder areas where stakeholders shun farmers as being risks partners with lower return potential. To explore these relationships, the study used an inclusive and interactive approach with stakeholders involved in the ZRBF project in Nyanga District of Zimbabwe either directly or indirectly. A sample comprising 185 smallholder farmers was randomly selected from participating and non participating clusters. Six extension officers, 3 local agrodealers, 5 briefcase buyers and 4 retailers participated in the study. Focus group discussions and key informant interviews were conducted in the area. Participatory stakeholder thematic analysis was used to determine the relationships, constraints and opportunities among stakeholders. The major constraints across the packs were unresponsive extension services and unreliable markets for the produce. There is strong link between farmers and the Non Governmental Organisation's extension agents but weak networking between farmers and markets as well as research institutions. The main challenges are encountered with marketing of sorghum and the producers suggested establishing farmer associations to market produce. Stakeholders also pointed towards the need to adopt functional capacity strengthening programmes which include multiple stakeholder on a common platform. Smallholder producers are mainly concerned with the prices of output but the study shows that this concern might be offset by high productivity levels through adopting appropriate production innovations outside the ZRBF project.

Key words: linkages, stakeholders, coordination, multiple linear regression, thematic analysis

5.1 Introduction

Rukuni *et al*. (2006) reported stakeholder interaction on a commonly ground platform is a useful tool in food and income security. They argued that it is a catalyst in determining the competitiveness and effectiveness of the holistic market system along various activities through

which farming households access finances, inputs and sell their surplus produce. Efficient market systems are desirable especially for the drive by Less Developed Countries (LDCs) to in-cooperate marginalized crops in strategic food security programmes. These market characteristics strengthen the functioning of the stakeholder interactive platform through minimising failures and leakages. The main challenge in these arrangements has been to identify the role, benefits and limits of stakeholders Ortmann and King, 2007). This can be said especially for the LDC governments which have historically always had a tight but usually quasi-silent grip in these markets. Conventional analysis has therefore in most cases excluded the government or the government appears as a silent player in the agricultural marketing picture. In line with embracing the innovation system approach to agricultural development, practitioners have called for the government to play an instrumental and more direct role in creating conducive environments to business and investment if agriculture is to contribute towards economic growth.

The government of Zimbabwe has appreciated this and has included other strategic stakeholders such as banks and NGOs in supporting agribusiness relations (GOZ, 2013). In light of these trends, there have been joint efforts to strengthen and enhance multiple crop and livestock production and marketing in Zimbabwe. The main aim of the interventions is to improve productivity levels, provide support services and enhance market access for actors such as small holder farmers. Of note is that the private sector and NGOs have made strides in developing agro-processing through supporting entrepreneurs in innovation based clusters by providing support from production through to marketing (Mutami, 2015). Through these initiatives, the small-scale farmers are being encouraged to join these clusters in their localities. The government has also in recent years responded by strengthening research and development components through initiatives on for example high yielding seed varieties and market linkages for strategic crops including sorghum and maize as well as traditional cash crops such as soya bean and cow peas.

Musara *et al*., (2019) concurred and attributed the low supply of crops in multiple markets to a number of drivers including an unreliable seed market, inappropriate production practices and weak institutional support structures such as financing and extension services. Thomlow (2007) also identified government policy as another factor compromising crop production expansion prospects in Southern Africa. For example, the government has over time tended to support the maize sub sector more than the small grains counterparts. Ultimately stakeholders including

the farmers have responded to this support asymmetry by limiting production and confining the marketing of these marginalized crops to the rural markets with little or no expansion into the more lucrative urban and processing markets. This has affected the functioning of potentially viable stakeholder platforms and compromised farmers' incomes in the process. The study therefore seeks to explore these stakeholder networks and isolate the gaps which currently exist.

5.2 Methodology

The study was conducted in the Nyanga District of Eastern Zimbabwe. The area has diversified agricultural practices which ranges from animal husbandry and crop production. The major livelihood activity is crop production, animal husbandry, non forestry timber activities and illegal mining activities. To explore these relationships, the study used an inclusive and interactive approach with stakeholders involved in the ZRBF project in Nyanga District of Zimbabwe either directly or indirectly. A sample comprising 185 smallholder farmers was randomly selected from participating and non participating clusters. Six extension officers, 3 local agrodealers, 5 briefcase buyers and 4 retailers participated in the study. Focus group discussions and key informant interviews were conducted in the area. Participatory stakeholder thematic analysis was used to determine the relationships, constraints and opportunities among stakeholders. Refer to Chapter 3 for elaborations on methods adopted for the study.

5.3 Gross margin and ratio analyses

Gross margin is the difference between output revenue and the total variable costs. It is used to evaluate the performance of different enterprises or the same enterprise across different clusters of players. Gross margin analysis was done for the maize, sorghum and cowpeas enterprises to determine the profit margins associated with the practices of farming. This was used to test the hypothesis that maize production is profitable. A linear multiple regression analysis was then used to determine the factors that affect the aggregate profit margins among the three enterprise clusters. The formula used to calculate the gross margins was:

$$GM = TR - TVC \tag{8}$$

Where:

- GM is the gross margin;

- TR is the total revenue; and
- TVC is the total variable costs.

However though gross margin is an important analytical tool to access the profit margins of different farming enterprises it has some disadvantages. There is no inclusion of fixed costs in the analysis. This incomplete analysis may lead to wrong conclusions which either understand or overstate the margins. It also does not take into account possible environmental and social effects that may arise due different types of technologies. Results of a gross margin analysis are valid for the season under consideration therefore they may be not useful for other recommendations outside the current state. Some capital budgeting approaches were then adopted to augment the gross margin analysis.

5.4 Multiple regression analysis

The multiple linear regression, based on the Ordinary Least Squares (OLS) philosophy was used alongside the gross margin analysis approach. Hoddinott *et al*. (2010) defined multiple regression analysis as a statistical tool allowing a researcher to examine how multiple independent variables are related to a dependent variable. In the context of this study, economic efficiency was extracted for analyses and is defined to mean the net margin generated by the farmer during the farming season. This definition created a continuous dependent variable since farmers would get different amounts of income from the three clusters of the packs. The aim was to determine whether, in a complex model, the choice of pack would determine the economic efficiency levels. The specification of the linear multiple regression model allowed for the determination of the determinants of the amount of net income (Greene, 2000; Maddala, 1993).

$$Y_i = \beta_0 + \sum_{i}^{n} \beta_i \mathrm{X}_{i,} + \mu_i \qquad (9)$$

Where:

- Y_i is the amount of income that the i^{th} farmer generated;
- β_0 is the intercept;
- β_i 's are the slope parameters; and
- X_i 's are the independent variables.

The coefficients give the signs of the partial effects of each of the independent variables on the amount of income generated (Woodridge, 2003).

Data obtained in this study were analysed using the interpretative approach and specifically through thematic content analysis for the qualitative data. This allowed the study to separate specific themes which were associated with the stakeholder relationships in the study area.

5.5 Effect of pack choice on farm physical and economic productivity

A gross margin analysis as in Table 3 was done to measure the effectiveness of agricultural innovations in the form of pack distributed by ZRBF on farm physical and economic productivity.

Table 3 Gross margin analyses of different packs

Item	PACK ONE			PACK TWO		
	Maize	***Horticult Amount***	***Peas***	***Sorghum***	***Horticult Amount***	***Peas***
Weighted market price ($)	268.9	563.8	632.8	255.3	583.2	621.5
Yield (units)	1.56	0.45	0.48	1.62	0.56	0.49
Total revenue ($)	**419.5**	**253.7**	**303.7**	**413.6**	**326.6**	**304.5**
Variable costs ($)						
Seed ($)	42.8	11.3	21.2	33.3	23.5	20.3
Fertiliser ($)	123.6	16.2	18.6	108.5	13.4	17.8
Labour ($)	19.4	15.8	16.3	17.9	19.8	15.5
Transport ($)	17.92	20.5	19.9	22.4	19.6	22.7
Total Variable costs ($)	**203.7**	**63.8**	**76.0**	**182.1**	**76.3**	**76.3**
Gross margin	**215.8**	**189.9**	**227.7**	**231.5**	**250.3**	**228.2**
% gross margin	*8*	*3.4*	*3.6*	*9*	*4.3*	*3.7*
% net margin	*138.3*	*422*	*474.3*	*142.9*	*446.9*	*465.7*
Gross margin as % of costs	*10.6*	*29.8*	*30*	*12.7*	*32.8*	*29.9*
TOTAL GROSS MARGIN		**633.4**			**710.0**	

Farmers who adopted the sorghum, horticulture pack have significantly higher ($710) aggregate gross margin as compared to their counterparts who took up the pack with maize ($633.4). However both packs generated positive gross margins and given the multiple risks in the study area, indications are that growing within the project is a viable livelihood option. The ratio of gross margin to total variable costs ranged between 10 and 30 % which shows a reasonably high return on every dollar spent by the farmer. This is in the same range as findings from a similar study by Amare *et al*. (2012) in a maize-cowpeas integrated innovation study. The gross margin per price ratio ranges between 3 and 8 % showing that the prices offered in the current markets for the enterprises are favourable. A similar pattern was reported by Mango *et al.* (2014) in a food security study in Mudzi district of Zimbabwe who however reported higher ratios in the magnitude 26 %. Fertilizer was the major variable cost accounting for on average 61 % of the total variable costs. This is consistent with reports by Musara, Chimvuramahwe and Borerwe (2012). There is therefore need to identify other low cost options such as manure so as to increase the gross margin accruing to the farmers.

It was then important to validate whether the choice of a specific pack has a bearing on the aggregate gross margins gained by the farmers. To achieve this, a multiple linear regression model was run with the pack type as one of the dependant variables. Results are in Table 4.

Table 4 Estimates of the determinants of gross margin

Variable	Coefficients	t-value	Significance
(Constant)	-0.002	-0.012	0.990
Adoption status	0.795	1.228*	0.003
Age of respondent	-0.132	-1.073**	0.076
Household size	0.450	3.151*	0.003
Land allocation for maize	-0.585	2.295**	0.027
Land allocation for sorghum	1.516	1.092**	0.048
Land allocation for cowpeas	0.935	0.993**	0.033
Additional finance allocated	0.090	0.499	0.620
Networking	0.072	0.859	0.396
Average price for crops	1.338	2.859*	0.001

Assistance from extension officers	-0.166	-2.245	0.392

*; ** and *** indicate p-values significant at 1 %, 5 % and 10 % levels respectively.

Results show that age of farmer, adoption status, household size, amount of land allocated to the crops and the average prices significantly ($p<0.05$) affected the aggregate gross margin from the project packs.

5.5.1 Adoption status

The farmers who adopted the package with sorghum had a significantly higher ($p<0.01$) gross margin). This could be attributed to the low cost nature of producing sorghum and its acceptability in the markets. Given that the relative prices of maize and sorghum are not significantly different, farmers who produced sorghum were better off than those who produced maize. Additionally, the labour and fertiliser costs for the sorghum were lower than those for maize. This demands that the ZRBF project coordinators review that maize package to accommodate the disparities in production costs with sorghum. This also calls for functional capacity building programmes for farmers involved in the projects so that they migrate towards producing for the markets rather that remain locked in subsistence oriented production.

5.5.2 Age of household head

From the result above age had a significant ($p<0.05$) influence on the gross margin for the whole pack. There is evidence that age has direct implications on farming experience and this is most likely going to positively impact on outputs and prices fetched in markets. Older farmers have bargaining experience and may fetch higher prices for their produce. The findings of this study concur with the findings of Musara *et al*. (2012) who concluded that higher level of experience is associated with the ability to access information about production and markets which will help farmers to increase output and positively affect the gross margin.

5.5.3 Land allocated to the crops

The land allocate to the respective crops had a significant and positive influence on the gross margin. This might be a sign that the productivity levels for the crops might be low thereby the need for farmers to crop on larger areas in order for them to gain economic benefits.

Additionally, since fertilizer had the highest contribution to the total variable cost this might be the reason that the fertilisers are thinly spread over the large tracks of land in an effort to increase aggregate output and higher margins. Hassan *et al*. (2008) also highlighted the same outcome and highlighted that increasing area of crop produced will not necessarily increase production and even marketing margins. Instead the innovation in Nyanga must focus on increase productivity of the limited resources supplied by the project.

5.5.4 Age of household head

The weighted price for the three crops has a direct bearing on the total gross margin attained. Prices motivate farmers to improve on efficiency so that they produce more of diversified crops with small packages of resources. Thomlow (2007) reported that source of marketing information is also another variable that cannot be excluded on the farm performance measurements. However, because of poor networking in the area the farmers reported that they sometime find it difficult to penetrate the most rewarding market. This calls for improved coordination of stakeholders on the project platform so that farmers are linked to rewarding markets thereby increase their marketing margins.

5.6 Stakeholder thematic analysis and interactions on the ZRBF project platform

A number of distinct themes were isolated to explain the behavioural patterns of farmers and other stakeholders with respect to project options at their disposal and knowledge. These thematic issues revolved around cost effectiveness, information access and potential to enhance farm performance with the selected enterprises. The major stakeholders identified to be directly linked to the project were the NGO, farmers, transporters, traders and extension officers. The missing stakeholders who may improve the functioning of the project are the researchers and financiers. As summary of the thematic responses generated from the study are in Figure 2.

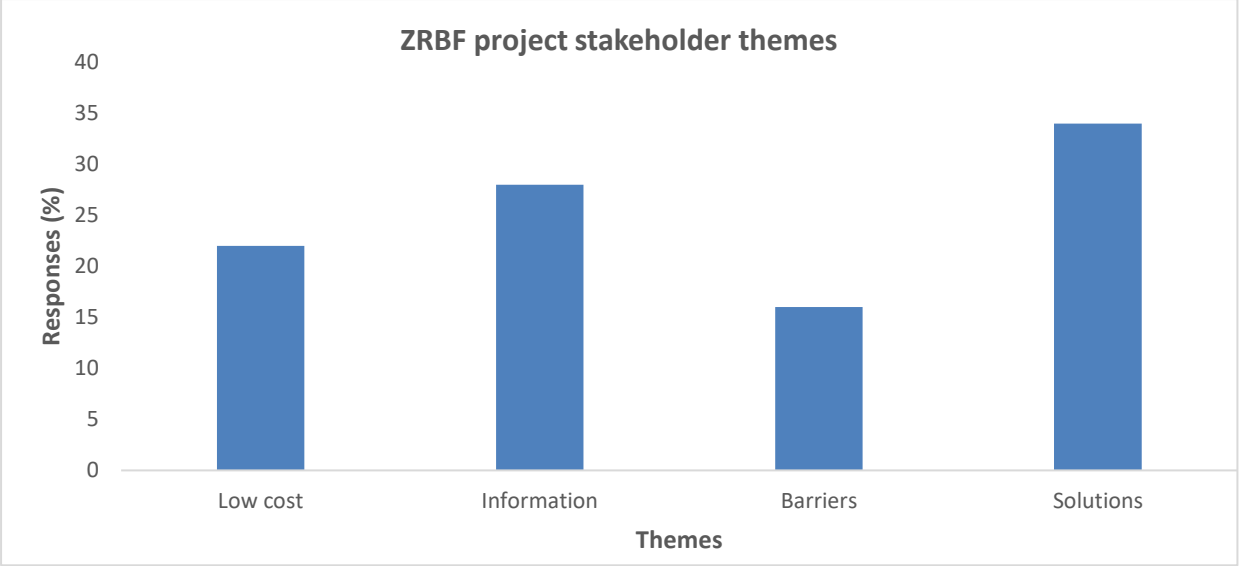

Figure 2 Thematic responses from stakeholders

5.6.1 Lowered farm operating costs

About one fifth of the participating stakeholders expressed experiencing lowered operating costs as a result of the project when asked of the contribution of the project in facilitating market linkages for improved productivity and food security. They argued that lowered operating and transaction costs will generate higher net income margins and help improve the overall welfare. Operating costs identified are incurred on activities such as transportation of goods from the field and to the market, payment of labour used in land preparation and purchase of spare parts for farm equipment.

One farmer said:

> "*It [the project] reduces some costs of production and travelling to and from the input markets"*

A transporter said:

> "*Information and communication sharing on the project platform has reduced the losses. Sometime back, I went to Nyanga from Harare in search of maize and sorghum, unfortunately, the yield levels were not adequate for farmers to sell, so I had to go back empty handed".*

The above sentiments show that the participants are facing a challenge on high costs incurred during production and marketing. Farmers have improved efficiency and are benefiting from economies of scale. There was consensus that traditionally, small scale farmers had challenges

in increasing food production through farming but due to the project they have access to a greater number of stakeholders to interact with and considerable information about the goods and services they provide. The findings are also confirmed in empirical work by World Bank (2008).

5.6.2 The project as a platform for exchange of information

The use of the project as a platform for exchange of information among the value chains actors was said to be of importance by the stakeholders. They reported that the project acted as a platform for exchange of information through voluntary interaction, sharing of ideas and peer learning. It is a place where farmers and traders get information on the latest market trends of agricultural commodities.

One trader said:

> *"The project is useful to me because it helps me to get information on products and when I can buy them. They also assist me to ask other traders about their own experiences in the business".*

Another extension agent said:

> *"It [the project] makes farming easier and getting information about marketing and pricing of products from suppliers."*

One retailer indicated that:

> *"With the use of links on the project platform, one can be able to make quick and good decisions on what, when, how and of how much the commodity to buy, pricing and promotion. The use of the project as a platform for exchanging information is of economic importance this is because it saves time and other resources'.*

From the above, the study observes that the project played a vital role in all dimensions of the agribusiness sector which is based on the value chain concept. Moreover, the use of the links shortens the traditionally long marketing and selling channels for farmers' produce. This is confirmed by a study in Morocco by Ilahiane (2007) which found that farmers with supported in crisis modifier based projects increasingly dealt directly with wholesalers or larger-scale intermediaries than smaller intermediaries. Although better market access can be a powerful means of alleviating poverty, Minten and Dukpa (2010) found that market participation still depended on the quality of what producers had to sell. This dimension still needs to be

strengthening in the project so that farmers can even export their produce. Financing institutions can help farmers to invest in more appropriate production and storage structures.

5.6.3 Project integration in overall farm performance

There is evidence from the discussions that effectiveness of the project in facilitating market linkages can be only recognised by the informed stakeholders. There are some barriers to effective integration of the project activities in the overall farm performance matrix through market linkages. These are the restrictions that hinder flow of market linkages benefits along the value chains hence resulting in poor farm performance.

One extension officer pointed out that:

> *"Illiteracy is the most challenge that we are facing with small-scale farmers, among them there are some who do not know what market oriented production is all abou?."*

From what was highlighted by the stakeholders, it clearly shows that there are asymmetries due to proximity challenges. The efforts of the project options usually miss potential targets and as such this discourages farmers and other small actors in the value chains from utilising opportunities on the project platform. A study by Ortmann and King (2007) also made similar observations. However, farmers should be encouraged and motivated about the project, since there is a shift in technological changes and farmers should learn to adjust and suit the environment of technology.

5.6.4 Challenges for small scale farmers and the project role in providing solutions

The project roles are to provide long term solutions to the challenges faced by small scale farmers and other stakeholders such as access to reliable raw materials.

One farmer said:

> *"Low marketing prices on agricultural products still remains one of the critical challenge that we are facing when we are selling our products."*

A community leader who was not part of the project indicated that:

> *"The most challenge is lack of capital to purchase maize seeds, fertilizers and chemicals, hence resulting in low productivity."*

The reality of smallholder farming communities is that they are the low income zones of most countries. As such they always lag behind the technological advancement revolution. This, according to Rukuni *et al*. (2006) brings about the major problem of poverty and food insecurity. To mitigate such a challenge they should be establishment for rural and micro operational finance to assist farmers to access production factors including ICT platforms so that their income levels can increase.

5.7 Conclusions

The gross margins generated by farmers who adopted the sorghum and bio-fortified maize seed variety were positive returns. This is an indicator that farmers can attain some acceptable income from participating in the project. Stakeholders identified production marketing related challenges during discussions. These included high operating costs and limited access to reliable information on sources of complimentary inputs and rewarding markets. This is mainly so given that the project terminates at production and does not offer marketing opportunities for the beneficiaries.

5.8 Recommendations

There is need to functionally capacitate farmers and other stakeholders such as extension agents and buyers on mutually beneficial relations which they may harness from for business growth. It might also be beneficial to establish an interactive platform where ideas and new information is disseminated and discussion on critical issues done frequently.

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CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This section presents a summary of the study findings and the conclusions derived from the results. Suggestions for further study are recommended as well as the way forward in addressing the problem and related issues.

6.2 Summary and conclusions

With the first objective, the regression analyses results showed that social, economic and institutional factors are important in determining the choice of package from the project options. These variables include age of decision maker, the household income, distance to the market and the prevailing market prices. It was found that age had a significant positive influence on the adoption decisions. Distance to the market negatively determined the adoption decision with longer distances to the market discouraging uptake of particular crop enterprises. The market prices are catalysts for adoption and encourage increased productivity among farmers. Extension officers were of importance as it was shown that the more frequently one interacted with the agents, the more likely they were to be informed about the costs and benefits thereby likely to adopt the packages. There is hope that the adoption of the ZRBF packs in Chapter 4 might lead to increases in productivity and gross margins among farmers. As such the second objective pays particular attention to this dimension.

From the second objective, the gross margins indicated that farmers were generating positive returns from the packages adopted. This gives encouragement for more farmers to be included in the project. However, there still remains potential to increase yield levels and connect farmers with highly rewarding markets for further increases in gross margins. Farmers need to manage their variable costs structures to enhance farm performance. However, at the terminal end of the project, it remains unavoidable to examine the inter relationships among stakeholders in Chapter five with the aim of strengthening these to improve chances of adoption and gross margins for farmers.

With the third objective, the fundamental thematic issues reported by stakeholders are reduction in operational costs, access to information and knowledge. Additionally, barriers to effectiveness of project activities and the mitigatory capacity of the project in relation to the problems faced by stakeholders. The project has provided space for stakeholders to relate in terms of what to produce, how to produce and where to get the raw materials. There is therefore a case for enhancing activities and interactions by facilitating broader and cross cutting market linkages along the selected value chains in the study area. Inefficient marketing channels were reported as a challenge by most stakeholders. Farmers also reported lack of adequate information on how to produce efficiently using the mechanisms they would have adopted.

6.3 Policy implications and recommendations

The study recommends that the following be considered for implementation to improve the ZRBF project and help farmers in Nyanga District:

- Extension officers can enhance linkages with farmers and other stakeholders since they remain central in the generation and dissemination of critical information about production and marketing. Adoption of ICT modes can also help reduce the need for face to face meetings and hence improve the flow of information.

- Functional capacity building across stakeholders can be done to enhance knowledge bases in the operations of the project and other terminals which connect to the project such as finances and markets. For example trainings and educational workshops may be facilitated such that everyone is acquired with financial knowledge. Functional capacity in negotiation skills might also be considered.

- The probability of accessing investment finance can be significantly improved when financiers are brought on board the project. It might work to establish functional innovation platforms which accommodate stakeholders across the various pillars of the value chain. This will also improve the networking by various stakeholders. Financiers may also improve on access by establishing low cost portfolios which farmers and traders may tap into.

- There was advocacy for intervention in supporting research and development centres so that more appropriate high yielding varieties are released into markets at affordable prices.

Training centers need to be formed in the localities of farmers and augmented by marketing information centers so that farmers make informed decisions based on existing linkages and market prices. This is most likely going to increase productivity levels among small scale farming zones and enhance chances of participating in rewarding markets.

6.4 Areas for further research

Since the study was done over one season, it will be important if the study can also be repeated over a number of seasons and results compared for effective decision making. Additionally, since the study focused on one project area, it will be effective to also follow the project to more drier parts of the country and test how the project performs on those environments. This will increase the chances of generalising the research outcomes to multiple areas in Zimbabwe.

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APPENDICES

Appendix I: Household survey questionnaire for smallholder farmers

My name is Kennias Sarireni, a MSc Food Security and Sustainable Agriculture student at Bindura University of Science Education. I am conducting a research entitled **"The production efficiency of a resilience building and food security project: A case of Crisis Modifier Mechanisms implemented through ZRBF in Nyanga district, Zimbabwe"** as part of the requirements for the degree programme. Information gathered from this interview will be confidential and will not be used for any other purposes except for this study. Your cooperation will be greatly appreciated. Thank you.

Identification details

Questionnaire number:_____
Name of enumerator: _____
Date of interview: _____
Name of farmer: _____
Location (village): _____

SECTION A: Demographic distribution

1. Sex: (put corresponding number in box) □ 0. Male. 1. Female.
2. Marital status: (put corresponding number in box) □ 0.Married 1. Otherwise
3. Number of years in education of farmer (state years): _____
4. Household size (state number):_____
5. House hold members who contribute towards agricultural activities (state number)_____
6. Are you formally employed? (put corresponding number in box): □ 0. No 1.Yes
   If Yes, state average monthly income ($)_____
7. State other sources of income and total monthly income from each source:_____
_____

SECTION B: Agronomic and financial performance

8. Household landholdings (hectares):_____
9. What are the main crops grown on plots? (list crops):_____
_____
10. For crops listed in 11 above, what are the land allocations? (state in ha list in order):_____

11. For crops listed in 11 above, what are the yield levels? (list in order of the crops):_____
_____
12. For crops listed in 11 above, what are the marketing channels? (list in order of the crops):_____
_____
13. For crops listed in 11 above, what are the market prices (list in order of the crops):_____
_____
14. For crops listed in 11 above, what are the distances to the market? (state walking minutes in order):_____
_____
15. What is the distance to the nearest point of collecting the packs? _____minutes
16. In your opinion what can be done to improve the relationships with the buyers of your produce?
(Explain)_____
17. In your opinion are there are opportunities to sell more produce in the current markets?
(Explain)_____
18. Are you aware of alternative markets for your produce? (put corresponding number in box)
 0. No 1.Yes
19. In your opinion are there opportunities to sell produce in these new markets? (Explain)_____
20. What is limiting you from using these markets?
(Explain)_____
21. How do you rate the Critical Success Factors (CSFs) in your markets on the scale provided?
1.Not Important. 2.Slightly Important. 3.Moderately Important. 4. Fairly Important. 5.Important. 6. Very Important, 7.Critically Important.

Industry Specific CSFs	**Market Segment**			**Follow on questions**
	1	**2**	**3**	
Price				What determines the price? To what extent does it fluctuate in response to supply?
Quality				What are the key determinants of quality?
Sales volume				At what price point? What are the industry profits?
Delivery Reliability				What distribution channels are most in line with your business model? How can these be improved?
Packaging				How important is the wrapper to the consumer? How does the wrapper affect the production costs?
Flexibility				How flexible is the market to consumer demands?
Innovation				What institutions are needed to improve R&D capacity?
Other (specify)				

22. How do you finance the purchase of additional inputs? (Specify in the table below).
Rate the reliability of the source of finance on the scale: 1. Not reliable. 2. Slightly reliable. 3. Moderately reliable. 4. Very reliable. 5. Extremely reliable

Source of finance	Duration	Average finance per year ($)	Challenges	Reliability
1.				
2.				
3.				
4.				

SECTION C: Management practices.

23. Are you in the project? □ 0. No 1.Yes
If Yes state duration in the project (state seasons):_____

24. Who informed you about the project? (please state one source): □ 0. No one 1.Family members 2. Group members 3. The implementing NGO 4. Other social networks

25. Why did you/did not join the project? (please explain)_____
_____
_____

26. Seed pack preferred by farmer (please state one): □ 0. No 1.Yes
a. bio-fortified maize, horticulture pack and cow peas. b. sorghum, horticulture pack and cow peas. c. not in the project.

27. Have you received any training on the packs? (put corresponding number in box) □
0. No 1.Yes

28. Who provided this training? (state training agent(s))
_____
_____

29. What training aspects were covered? □ 0. No 1.Yes
a. Management and maintenance. b. Benefits. c. Challenges. d. Alternatives

30. How frequent do you receive this training? (State average per season)._____

31. In your opinion, did you benefit from the training? (put corresponding number in box)
□ 0. No 1.Yes

32. In your opinion what aspects need to be captured in the training? (Explain)._____

33. How frequent do you receive extension services? (State average visits per week)._____

34. Who provides the extension services? (State all sources):_____
_____

35. What constraints do you experience with the packs? (rate the problems on the basis of the given scale):1. Not a serious problem 2. Slightly severe. 3. Moderately severe. 4. Very severe. 5. Extremely severe.

Constraint	**Rating**	**Suggested solution(s)**
Late delivery of packs		
Unavailability of training on using packs		
Inefficient extension services		
Low productivity levels		
Labour shortages		
Market unreliability		
High transport costs		
Low market prices		

36. What inputs do you use in crop production and what are the sources? (If not in the project and if the project state the additional inputs besides the packs). Rate the reliability of source on the scale: 1. Not reliable. 2. Slightly reliable. 3. Moderately reliable. 4. Very reliable. 5. Extremely reliable

Input	**Units**	**Unit cost ($)**	**Total cost ($)**	**Source**	**Reliability**
Seed					
Fertilisers:					
Inorganic					
Organic					
Herbicides					
Pesticides					
Labour:					
Land preparation					
Sowing					
Weeding					
Fertilising					
Spraying chemicals					
Harvesting					
Thrashing					
Transporting:					
Inputs from market					
From field to home					
Produce to market					
Other (specify)					

37. Please state stakeholders you are aware of in the project?

_____

_____

_____

38. Please state the roles and responsibilities of the stakeholders you are aware of in the project?

_____

_____

_____

39. Do you have any arrangements with stakeholders in the project? (put corresponding number in box) □ 0. No 1.Yes

40. If yes please state specific arrangements (e.g. contracts).

_____

_____

_____

41. In your opinion do you think these arrangements are balanced?
(Explain)_____

_____

_____

42. In your opinion what can be done to improve these arrangements?
(Explain)_____

_____

SECTION D: Policy structures

43. Are you aware of any policies that are currently impacting on the dynamics of the project? (please elaborate)_____

44. Who do you think has to be involved in supporting the project either directly or indirectly? (please
explain)_____

45. What specific policies issues need to be put in place to support the uptake of the project and its scaling up and/or out?
(Explain)_____

Appendix II: Results on demographics of sampled households

Demographic data summaries

Data were collected on the age, education, training of household head and other factors that contribute to the adoption decision training, contacts with extension agents and distance to the market. Data are presented using frequencies, mean comparisons, and regression analysis. Descriptive data summaries are in Table A1.

Table A1 Summary of demographic characteristics

Items	Frequency	Percentage (%)
Age of household head		
18-25	2	4
26-33	8	16
34-41	13	26
42-49	11	22
50 and above	16	32
Extension contacts		
1-5	34	68
6 and above	16	32
Training		
1-3	6	12
4-6	37	74
7 and above	7	14
Highest level of education of household head		
Primary school	7	14
Secondary school	34	68
Tertiary	9	18
Distance to market		
1-10	13	26
11-20	24	48
21-30	8	16
31 and above	5	10

The sampled comprised of more (68 %) of lower contacts with extension officers. A significant proportion of the respondents received some training accounting for about 80 % of the sample. From the study area, large number (68 %) of interviewed farmers have formal education

terminating at the secondary level. Just under 80 % of the sampled respondents walked considerable distances to the markets.