FACTORS THAT INFLUENCE THE ADOPTION OF METAL SILO BUSINESS AMONG THE TRAINED ARTISANS: A CASE OF EMBU, HOMA BAY AND MIGORI COUNTIES, KENYA

BY

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DECLARATION

This research project report is my original work and has not been presented for an award of degree in any other university.

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Michael Kariuki Ndegwa Date
L50/65002/2010

This research project report has been submitted for examination with my approval as the university supervisor.

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DEDICATION

This work is dedicated to individuals, organizations and institutions whose mission and dedication are to eradicate extreme hunger in Africa through research and development programmes. May all our concerted efforts bear fruit and lead to the realization of the goal in our time.

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And to the Almighty God for giving me life and providing in every way for me to achieve all that I have achieved in my studies and in life. Praise be to your Name.

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ABBREVIATIONS

CIMMYT	Centro Internacional de Mejoramiento de Maizy Trigo (Spanish for International Maize and Wheat Improvement Centre)
EGSP	Effective Grain Storage Project
FGD	Focus Group Discussions
GIS	Geospatial Information Services
GNP	Gross National Product
IFAD	International Fund for Agricultural Development
IRD	Integrated Rural Development
MOA	Ministry of Agriculture
NESC	National Economic and Social Council
NGO	Non Governmental Organization
SDC	Swiss Agency for Development and Cooperation
SEP	Social Economic Programme
SPSS	Statistical Package for Social Science

ABSTRACT

The Effective Grain Storage for Sustainable Livelihoods of African Farmers" project (EGSP) was piloted by CIMMYT in Malawi and Kenya through funding from SDC. The project aimed at fabricating metal silos by training local artisans who will make the silos locally available to the farmers. Though empirical findings from the implementation of a similar project in Central America reveals high and reliable profit potential on the side of the artisans, the adoption of the business opportunities provided by the silo making venture to the trained artisan in Kenya is significantly low. Informal project evaluations indicate only 30% of the trained artisans are practicing the business at their workshops. This study sought to assess the factors that influence the uptake of the metal silo business among the trained artisans. As its objectives, the study aimed to establish the relationship between the dependent variable, which is the 'Adoption of the silo business' and the independent variables which are artisans' level of education, the artisans' main source of income and the income level as well as the age and level of experience of the artisans. The findings are hoped to be useful to CIMMYT as ex-post evaluation for EGSP pilot phase and for the replication phases and for other stakeholders particularly the public policy sector. The study employed an ex-post evaluation and descriptive survey designs and adopted a multinomial Logit regression model to analyse the factors of metal silo business adoption. It involved all the artisans from Embu, Homa Bay and Migori counties who were trained on how to fabricate metal silos. Data from the individual artisans was collected using a pretested questionnaire. SPSS was used for entering and managing field data and for descriptive and frequency analysis of quantitative data. STATA was used with regression models to identify the factors that determine the adoption of metals silo business among the trained artisans. The results of the survey indicate that a third of the artisans takes orders directly from individual farmers, grain traders, institutions, etc and makes metal silos at their own workshops, a third does not engage in metal silos business at all while a third is normally hired by the first category. The likelihood to make metal silos either at own workshop or as a hired artisan reduces with age while the same increases with years of experience in technical work. The likelihood to make silos at own workshops also increases with ownership of a workshop before training, running a workshop as the primary occupation and metal work as the main professional training for the artisans.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Storage pests cause enormous damage to stored maize, causing huge losses among small scale farmers to whom maize is an important staple food (Tefera, Kanampiu et al. 2010). A project to reduce storage losses was initiated at International Maize and Wheat Improvement Center (CIMMYT) in 2008. The Effective Grain Storage for Sustainable Livelihoods of African Farmers project (EGSP) was initiated in 2008 in Kenya and Malawi and funded by Swiss Agency for Development and Cooperation (Luz George 2011). The implementation of the project appreciated the participation of the community as paramount in meeting its goals and objectives. Community participation is conventionally considered as a key component in technology dissemination and adoption and results into ownership and sustainability of an intervention. It is therefore considered as a global best practice and highly promoted among the donor communities.

In project design there are varied participatory models depending on the project design, its deliverables and the predetermined project outcomes to be met through the participating stake holders. One of these models, which is relatively modern and considered as effective, is the "Social Enterprise Model." The model promotes ownership and sustainability of development interventions through the involvement of the local community (People, Institutions and Businesses) in activities and initiatives that lead to profitable gain in the process of implementation of the main intervention. This model was applied by CIMMYT in the metal silo project whereby the production and dissemination of the silos was devolved to the private sector

by introducing silo artisans to the project, to enhance implementation of the project. The project targeted training of farmers, trainers and tinsmiths in metal silo construction in order to provide the farmers with better alternative storage solutions (Tefera, Kanampiu et al. 2010).The silo prices were to be determined by the dynamics of the free market and the laws of supply and demand.

In the adaptation of the model, CIMMYT identified and trained some community members as metal silos artisans and trainers of other artisans (ToTs) within the community. The ToTs and their trainees were expected to turn the skills acquired into microenterprises through small scale fabrication and dissemination of the silos among the farmers in their locality for on-farm grain storage. They invest in them as a source of income by selling them to the farmers. The idea was to locally make available the metal silos to the farmers for ease of access and make them affordable. In Kenya, the technology was promoted by CIMMYT in partnership with the Catholic Dioceses of Embu and Homa Bay. The two institutions participated in the dissemination of the technology by selecting the artisans to be trained in metal silo fabrication and subsidizing the silos for the rural communities.

1.2 Statement of the Problem

Engaging in metal silo fabrication and marketing can create jobs and serve as a vehicle for rural enterprise development (Tefera, Kanampiu et al. 2010) as evidenced by the POSTCOSECHA Programme which relied on a large number of local tinsmiths for the production of metal silo in Honduras, Guatemala, Nicaragua and El Salvador between 1983 and 2003 (Fishler, Berlin et al. 2011). Findings show that there is profit potential from the metal silo business. The metal silo manufacturing activity is, therefore, an additional source of income for tinsmiths. In Latin

America tinsmiths earn a net annual income of about US $ 470 from the production of metal silo alone (Fishler, Berlin et al. 2011). Most farmer-tinsmiths accrue extra seasonal income that they are able to earn by manufacturing metal silos when they are not in the field. In some cases tinsmiths included jobless rural youth engaged in manufacturing metal silos (Tefera, Kanampiu et al. 2010).

Four years after the inception of the project (Effective Grain Storage for Sustainable Livelihood of African Farmer) in Kenya, there still lacks a proper documentation on dissemination and adoption of the metal silo technology among the trained artisans in Kenya and other African countries. However, the metal silo has been widely used in Central America for on-farm grain storage. In Kenya, the adoption of the metal silos among the small scale farmers and local artisans has not been well documented but reports indicate low adoption rate. A Rapid Result Assessment and general observation by the project implementers revealed a slow uptake of the technology as an enterprise among the trained artisans. Results indicate that only a third of the trained artisans who are practicing silo business at their own workshops. The study therefore, identifies the factors that led to this problem.

1.3 Purpose of the Study

The study sought to assess the factors that influence the adoption of metal silo business among the CIMMYT trained artisans

1.4 Objectives

The objectives of the study were:

1. To determine the influence of education level of the artisan on adoption of the metal silo business,
2. To assess the influence of income level of the artisan on the adoption of the metal silo business.
3. To assess the influence of income source/occupation of the artisan on the adoption of the metal silo business.
4. To determine the influence of age of the artisan on the adoption of the metal silo business.
5. To determine the influence of experience of the artisan on the adoption of the metal silo business.

1.5 Research Questions

1. How does education level of the trained artisan affect the adoption of the metal silo making business?
2. How does the income level and source/occupation of the trained artisan affect the adoption of the metal silo making business?
3. How does the age of the trained artisans affect the adoption of the metal silo making business?

4. How does the experience of the trained artisans affect the adoption of the metal silo making business?

1.6 Significance of the Study

This study was intended to generate key data and information regarding the adoption of metal silos fabrication as a business opportunity among the artisans. The findings are useful to CIMMYT – SEP as an ex post evaluation to establish the impact of the project on the artisans and the role of the artisans in promoting the adoption of the metal silos among the local grain producers. The findings herein may guide research and development agents in future design of technology promotion projects, particularly in the replication of the metal silo intervention in other communities and countries. Besides, the findings may be useful to the public policy and programmes makers, both in the government and humanitarian organizations, in understanding how social enterprise models enhance the adoption of technologies among the small scale entrepreneurs.

1.7 Delimitation of the Study

The study targeted persons who were trained as metal silo artisans from Embu, Homa Bay and Migori counties from Kenya. The counties were selected for the survey since they were the project sites for the implementation of EGSP1 between 2008 – 2010 which was a pilot project for the fabrication of metal silos through the artisans in rural farming communities and disseminating them to the farmers for safe farm level grain storage.

1.8 Limitations of the Study

One of the limitations to the study was the fact that the study is focused on only one component of a pilot project which is the involvement of local artisans in production and dissemination of metal silos. This was a limitation since the project was in 3 counties and engaged 60 artisans for piloting. This poses a challenge on the sampling considerations. The researcher endeavored to interview all the artisans in the study area as much as possible. The second limitation was to do with the tracing of the trained artisans since it is not a random sample and they are widely scattered geographically. The field team was provided with the GIS coordinates and the contacts of the trained artisans for ease in accessing them.

1.9 Definition of Significant Terms Used in the Study

Adoption rate: Refers to number of the artisans who are fabricating metal silos and selling them for profit out of all the artisans who were initially trained.

Effectiveness: Refers to ability of a project to achieve all it was set to achieve at the project formulation level.

Efficiency: Refers to the ability of a project to reach its goal at minimum cost and within schedule. It is concerned with the selection of a model that is simple but able to produce the project deliverables and spread the benefits.

Impact: Refers to the long term high level results of a project on the targeted beneficiaries. It is concerned with the felt and experienced transformation on the community that can be directly associated with a project.

Local Artisans/Micro Entrepreneurs: Refers to all the metal smiths who were trained by CIMMYT or previous project on how to fabricate a metal silo with profit intentions.

Metal Silo: It is a hermetically sealed container made from galvanized metal sheet used to store dry grains for a long period of time.

Post harvest storage: Refers to the household and small scale farm level handling of grains after they have been harvested until consumption or trading.

Relevance: Refers to the ability of a project to meet real and priority needs of its target community.

Sustainability: Refers to the continuation of interventions and developmental activities beyond the project implementation period and into the long future.

1.10 Organization of the Study

This study is organized into five chapters which are preceded by the preliminaries. Chapter one is the introductory section which outlines the research objectives and the research questions. A background to the study, problem statement, purpose of the study and the significance of the study are other subsections within this chapter. In chapter two, the researcher reviews literature that is deemed relevant to the study. Chapter three presents the methodology of the study. These include the study design, target population and sampling procedures, research instruments as well as data collection and analysis techniques. Chapter four is a presentation of the data collected and analyzed as well as discussion on the findings. Chapter five entails the summary of findings, discussions, conclusion of the study and the recommendations made from the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In the chapter, literature that is related to the study topic has been reviewed. This literature ranges from explaining what is a metal silo to reflecting on the best practices in project management. The conceptual frame work of the study is also covered in this chapter.

2.2 Metal Silo

Safe storage of grains at farm level is very crucial since it directly contribute to food security as it mitigates the impact of dismal and non-consistent harvests. Traditional storage practices in developing countries cannot guarantee protection against major storage pests of staple food crops like maize leading to 20 -30% grain losses, particularly due to post harvest insect pests and grain pathogens (Tefera, Kanampiu et al. 2010) This loss is valued at 4 billion dollars annually (Fishler, Berlin et al. 2011). It was from this backdrop that the metal silo technology was introduced to the rural communities who practice subsistence agriculture. The technology promotes safe on-farm grain storage which reduces after harvest crop loss significantly thereby encouraging the farmers to maintain their harvest beyond the low price glut period either for food or to trade later when the prices are fair.

A metal silo is a cylindrical structure, constructed from a galvanized iron sheet and hermetically sealed. It is airtight and therefore eliminates all oxygen from inside killing all the possible organisms that may be inside and locks out all pests such as rodents, insects and birds. (Tefera,

Kanampiu et al. 2010). Traditional cribs and gunny bags, the most common storage facilities cannot guarantee protection against the larger grain borer that causes over 30% of the losses, sometimes wiping out the entire harvests during severe infestations. They are not even effective against the common weevil that accounts for 10-20% post harvest losses in the area. However, a new technology is proving effective in protecting harvested grains from attack not only from these deadly weevils, but also from other insects and pests. Metal silos are not only guaranteeing full protection against the destructive pests, they are promising to be the ultimate weapon for improving food security for small-scale farmers in Eastern Kenya.

Different studies have described the metal silo and outlined their history and potential (Tefera, Kanampiu et al. 2010); have shown that metals silos are highly effective in protecting maize grain from storage pests (De Groote, Kimenju et al. Forthcoming), and that it has a substantial impact on reduction of losses and improving food security. The benefit cost analysis of the metal silos based on average annual production of 720 bags for each household in Kenya, showed that the NPV, IRR and BC ratio all favor investing in the metal silo technology (Kimenju, De Groote et al. 2009). Further, ex post evaluation report on the Postcosecha Programme which fabricated and distributed metal silos to rural farmers in Central America, confirms the positive effects of the metal silo use on rural households in regards to reduction of postharvest grain losses and changes in the use, storage and selling dynamics of grain. Subsistence farmers keep almost the entire production for covering own consumption needs and by using the metal silo they have increased their food security by 30 to 35 days per year (Fishler, Berlin et al. 2011).

2.3 Training of Artisans

Some studies propose training on entrepreneurial skills for artisans, since these have been shown to have a positive impact on the performance of *Jua Kali* artisans in Kenya (Berengu 2012). A major factor in sustaining employment in the informal sector is training in entrepreneurial, managerial, and technical fields (Maundu 1997). In research undertaken in Kenya involving over 800 entrepreneurs in 19 towns, about 43 training needs were identified. The most of the entrepreneurs interviewed expressed a preference for financial management and marketing as top priorities (Yambo 1991; Maundu 1997). Other skills requested included: fashion design, product development and improvement, product finishing, use and maintenance of machines, personnel management, welding, metal work and body building, etc (Yambo 1991; Maundu 1997) In addition, about 78% of the respondents indicated that they would like to be trained as trainers of other artisans or entrepreneurs (Maundu 1997).

Others propose alternative training models for engineering artisans. In Zimbabwe, the apprenticeship model is recommended because in this model recurrent formal training costs were lowest, mainly because of the limited amount trainees spent off the job receiving theoretical and workshop instructions hence it is cost effective (Bennell 1993). In Kenya, It has been established that most entrepreneurs and artisans acquire their *Jua Kali* skills through on-the-job training and apprenticeship. The duration of the training is quite varied depending on the kind of trade or skill one is going in for. Training may range from six months to five years. This training is important as it seeks to develop essential work skills and attitudes required for survival at the informal sector of *Jua Kali*. (Twoli and Maundu 1994; King 1996; Maundu 1997). Whatever the source and duration of training and subsequent experience in the work environment, training in

entrepreneurial, technical, and managerial fields does offer the way forward to the success in and creation of employment opportunities in the *Jua Kali* sector (Maundu 1997)

2.4 Project Effectiveness and Efficiency - Best Practices in Project Management

Evaluations of more than a decade of integrated rural development (IRD) projects have revealed serious shortcomings in reaching the goal of mass poverty alleviation(IBRD 1987). Sizeable numbers of the poor were not reached by project activities, nor were positive effects consolidated on a sustainable basis. The important question during project appraisals is concerned with what could be the determinants of a successful project performance. This could lead to the discovery of the factors why some development projects are significantly successful and of great impact to the communities involved while others are greatly unsuccessful and at times frustrating to the implementers. Project deficiencies are in part management related and very often due to a serious underestimation of the great complexity of multisectoral programmes with ambitious goals. The disregard of the target group principle and of due consideration for framework conditions (economic and institutional) played an even more important role, as did the lack of compatible technical solutions (Nagel 1997).

In evaluating the effectiveness of the projects funded by The World Bank, (Jenkins 1997) presents the striking results of the causal-effect relationship between the quality of the prior economic appraisal and the success of projects. If the economic appraisal of a project had been poorly done prior to its approval, the probability that it would perform unsatisfactorily by the third year after implementation is seven times higher than that of a project with a good economic analysis. By the fourth year the probability of failure of a project that is poorly evaluated is 16

times higher than the corresponding probability for one subject to a good economic evaluation. There may be reasons for this relationship other than causality. Jenkins assigns good project appraisals the first priority of a sound investment appraisal system in identifying and stopping bad projects and approving the viable ones.

The macroeconomic policies of a country are important determinants of project performance. (Isham and Kaufmann 1999). Although their empirical studies were based on nationally and internationally World Bank funded projects, it is evident that the macroeconomic conditions of a country have the potential to enhance or hamper the performance of any project at the community level. An ideal local example would be the impact of the East African Community open markets on the mobility and costing of labor, raw materials and farm inputs/implements within the member states. In addition, gender issues in development need to be keenly considered for development projects to be effective in achieving their goals and impacting sustainably on the community. Development efforts should seek to empower rural women and men equally. This should be intended right from the planning and designing of projects. IFAD supported projects and programmes address inequalities by enhancing women's access to productive resources and increasing their participation in decision-making. For over 30 years of its existence, IFAD has placed increasing importance on gender equality and women's empowerment, both as objectives in themselves and as instruments for poverty reduction. In IFAD's experience, women can become a powerful force in transforming the lives of their families and communities when programmes acknowledge the specific needs and constraints of both women and men, and when women are provided with concrete opportunities (Carr and Hartl 2008).

Further, any development agency needs to develop strategic linkages and partnerships with other like-minded partners to enhance coordination and sustainability of interventions. These may include the local community, respective government departments, other NGOs as well as public-private partnerships. Many developing countries' governments are actively seeking ways to encourage more NGO action. Governments in India, the Philippine, Bolivia, Mexico, Jordan, Egypt, Uganda, and Togo belong to this group. The Governments of Guatemala and Honduras have worked closely with NGOs to design social development funds aimed at cushioning vulnerable segments of society against the shocks of economic recession and structural adjustment. Nevertheless, relationships among NGOs and between them and governments are not free of distrust (Sachs 2006).

While some governments are inclined to let NGOs take the lead on controversial development issues, (e.g. Family Planning) many developing country governments are suspicious about NGOs and their self appointed role as agents of change. According to some observers, the growth of NGOs often poses a dilemma for the state, especially in societies where voluntary associations did not play a formative role and where the state predominated. Some governments insist on their sovereign political right to act as gatekeepers between organizations within their borders and agencies from the outside world (Sachs 2006). On development grounds, there appear to be strong arguments favoring the encouragement of collaboration between NGOs and governments. The World Bank point out that development aid has not always come up to its full potential. Aid can be made more effective by linking it more directly to the antipoverty impact of countries' overall policies. Getting experienced NGOs into national and local policymaking, program

design, and project formulation may contribute to development that is more sensitive and responsive to the needs of the poor (WorldBank 1990).

2.5 Commercializing Rural Enterprises

The vast majorities of people in Third World nations live and work in rural areas. Over 65% are rurally based, compared with less than 27% in economically developed countries. Similarly, 62% of the labor force is engaged in agriculture. Agriculture contributes about 20% of GNP of developing nations (Todaro 1977). The basic reason for the concentration of people and production in agriculture and other primary production activities in developing countries is the simple fact that at low income levels the first priorities of any person are for food, clothing and shelter. Agricultural productivity is low not only because of the large numbers of people in relation to available land but also because low developed countries' agriculture is often characterized by primitive technologies, poor organization, and limited physical and human capital inputs. Thus, technological backwardness arises because Third World agriculture is predominantly noncommercial (Todaro 1977).

Commercializing rural enterprises entails helping the communities endorse a profit mentality to whatever they do. The profit made helps the rural persons meet their subsistence needs, create employment for self and others as well as attach an economic value to their work hence leading to sustainability. Social enterprise plays a significant role in the economy and can be an effective way of commercializing economic activities for the rural communities. Many of them (social enterprises) operate in areas of the country where economic activity and job creation are

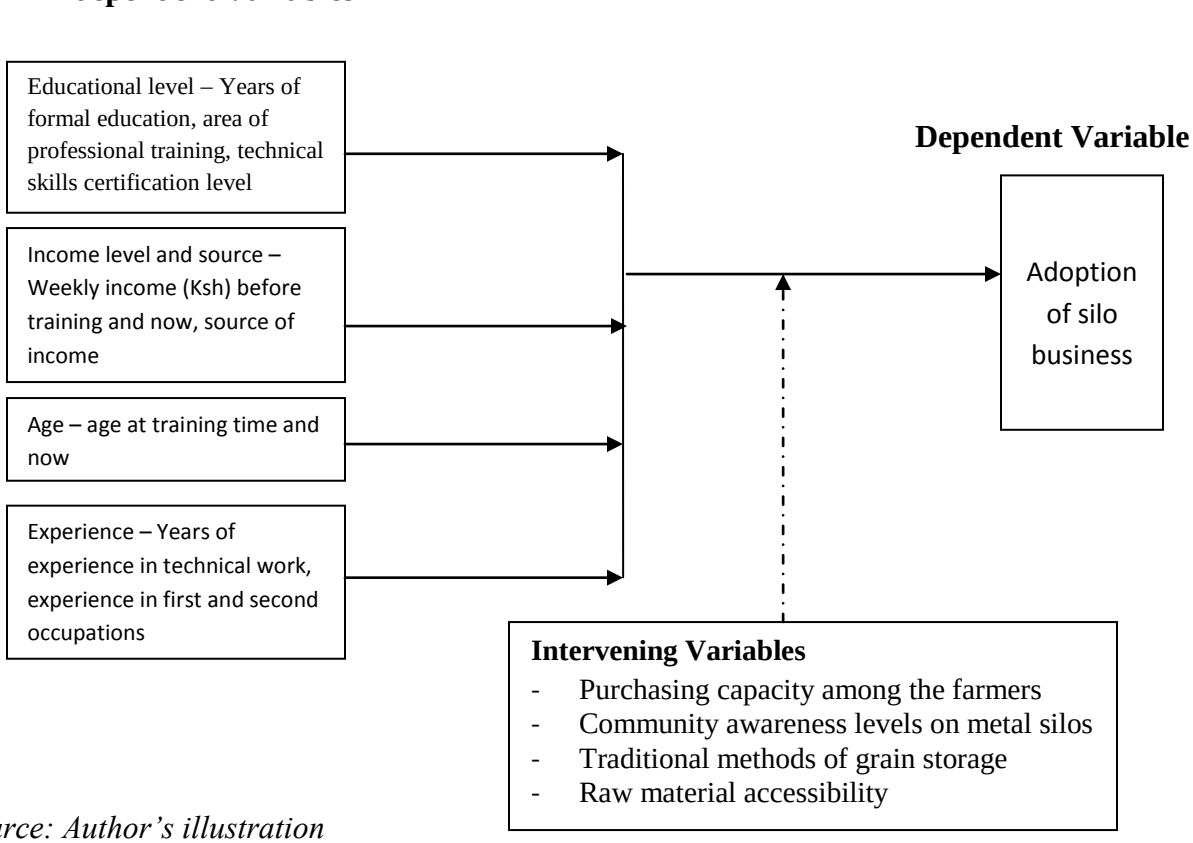
particularly needed, creating real opportunities for the people who work in them and for the communities that they serve (Robin Lowe 2006).

The ultimate goal of a social enterprise is to meet social economic goals of communities through generation of products or services that create social benefits or generation of profits which are invested in meeting community priority needs. This description suggests that social enterprises are to be defined as organizations that combine an income-generating or business-type activity with a social purpose (with surplus reinvested in the 'cause'). However, there are also organizations that generate social change and new approaches to social problems through implementing innovative ideas, which create social benefits. (Robin Lowe 2006)

2.6 Technology Transfer and Adoption in Agriculture

The Kenyan Vision 2030 document highlights the agricultural productivity as being constrained by a number of factors including limited extension services and limited application of agricultural technology and innovation. The document further identifies the markets related challenge to agriculture as supply side inefficiencies resulting from limited storage capacity, lack of post harvest services and poor access to input markets (Government of Kenya 2007) Credit availability and the structure of credit markets has been identified as playing very important role in the adoption of new technologies and therefore, in development itself (Kaushik 1990). This will ensure access to capital which is a key factor of new technology adoption.

2.7 Conceptual Framework



Source: Author's illustration

Figure 1: Conceptual Framework

Conceptual framework helps identify the relationship between independent and dependent variables by breaking down the concepts behind the objectives of the study. Figure 1 shows the direction of causal effect relationship between the independent variables which are; the artisans' level of education, the artisans' income level, the main occupation of the artisan before the training, artisans' access to capital, the age and experience of the artisan and the dependent variable which is the adoption of the metal silo business. The researcher has also identified the purchasing capacity among the farmers, community awareness levels on metal silos and preference to traditional methods of storage as the main moderating variables which are beyond the scope of this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the researcher has given details on how the actual research work was carried out. Subtopics such as study design, target population, sample size, research instruments, methods of data collection and analysis have been tackled.

3.2 Study Design

The study employed two main research designs namely ex-post facto and descriptive research designs. Ex-post facto, also known as causal comparative designs attempt to determine the cause of reasons for existing differences in the status or behavior of different groups of individuals after going through a similar experience. The design is ex-post facto design since the evaluator attempted to identify the major factor which has led to a difference in two/more groups of individuals after both the effect and the alleged cause had already occurred and are studied by the evaluator in retrospect. Descriptive research design is undertaken with the aim of describing characteristics of variables in a situation. The main goal of this type of research is to describe relevant aspect of the phenomena of interest which may be individuals, organizations or practices in order to provide more information about those phenomena. In the context of this study, the phenomena are all the individuals trained by CIMMYT as metal silo artisans. It is concerned with conditions or relationships that exists, opinions that are held, processes that are going on, effects that are evident or trends that are developing.

3.3 Target Population

The study targeted all the artisans trained by CIMMYT as metal silo fabricators from Embu, Migori and Homa Bay counties of Kenya which were the regions where the pilot project was implemented. The study considered the fact that not all who were tinsmiths before training. Some were carpenters, masons, electricians, farmers, teachers, etc. The study seeks to bring out the effect of their occupation before training on the adoption of the entrepreneurial opportunities provided by the metal silo technology. The CIMMYT trained artisans from the pilot sites are 60 in total. Additionally, the study targeted representatives of the local partners and the stakeholders in the project as key informants. In total, the study targeted 10 of them making the total population to be 70.

3.4 **Sample Size and Sampling Procedures**

Though the geographical area covered by the population of the study was expansive, the population in terms of absolute numbers was considered too small for sampling. The artisans targeted by the study were approximated to be 60. The study adopted a census which involved all the members of the target population as respondents. This was arrived at after the application of the 'Normal Approximation to the Hypergeometric' formula (Felier 1968) for calculating sample size from any population size. The formula: 'n = Nz^2pq/(E^2(N-1)+ z^2pq)' assumed 95% confidence level and had the following characteristics: z = 1.96, E (+- error) = 0.03, p = 0.5, q = 0.5 and N = 60. Using this formula with the above characteristics, the sample size (n) was 57. The researcher approximated this to the whole population since the difference was 3 cases only. This was also to act as a contingency plan in case the survey would logistically not be able to meet all the trained artisans. Besides, the study engaged a total of 10 key informants who were

representatives of the project implementers and local stakeholders. Further, the researcher conducted 2 FGDs involving 30 people where 15 of them were trained artisans and so had been accounted for in the 60 respondents to the questionnaire. Therefore, the total working sample size was 83 persons. The key informant interviews and the FGDs were mainly conducted for the purposes of triangulation of the data collected through the questionnaires from the artisans.

3.5 Research Instruments

The study employed three main research instruments namely: questionnaires, focus group discussion guide and interview guides. The questionnaires were administered on individuals who were trained as metal silo artisans. They were the focal interest of the study. Focus group discussions involved some of these artisans other stakeholders in regard to the metal silo technology. These were; project implementers, farmers and other stakeholders in food security interventions in the project areas. Finally, the study applied key informant interview guides mainly on the local partners who were involved in the implementation of the project. They include the Diocese staff and the MoA officers.

3.5.1 Validity of the Instruments

Validity is the ability of an instrument to measure what it is designed to measure. It is defined as the degree to which the researcher has measured what he has set out to measure (Kumar 2005). To ensure the validity of the instruments that were used, the researcher checked them against the objectives of the study. The data tools were also piloted and necessary corrections made before they were used in the field. The researcher also involved experts from the UoN as well as peers to check for any mistake in the data tools and recommend corrections.

3.5.2 Reliability of the Instruments

Reliability is a measure of the degree to which the research instrument yields consistent results after repeated trials (Mugenda and Mugenda 2003). If a research tool is consistent and stable, and, hence, predictable and accurate, it is said to be reliable. Therefore, a scale or test is reliable to the extent that repeat measurements made by it under constant conditions will give the same results (Kumar 2005). The researcher used split-half method to test for reliability. This method was more practical in that it did not require two administrations of the same or an alternative form test. The total number of items were divided into halves, and a correlation taken between the two halves. This correlation only estimates the reliability of each half of the test. It was necessary then to use a statistical correction to estimate the reliability of the whole test. This correction is known as the 'Spearman-Brown prophecy' formula (Carmines and Zeller 1979). Pxx''=2Pxx'/1+Pxx' - Where Pxx'' is the reliability coefficient for the whole test and Pxx' is the split-half correlation. The study split odd numbered items to one half and the even numbered items to the other half of the test. The reliability of each half (Pxx') was 0.25 which gave a Spearman-Brown prophesy (Pxx'') of 0.75 which implies a strong positive correlation and hence acceptable.

3.6 Methods and Procedures of Data Collection

This study relied mainly on primary data collected through questionnaires administered to the trained artisans from Embu, Migori and Homa Bay project regions. The researcher developed the data tools with the technical support of the University Supervisor and the Project Leader at SEP-CIMMYT. Thereafter, the researcher inducted all the enumerators to the tool by going through it together while clarifying issues that arose. In the mean time, the researcher, through the support

of SEP-CIMMYT project team mobilized all the targeted respondents (the artisans) from the two sites. This was possible since their contacts were available from the CIMMYT database. Using the GIS coordinates and the mobile contacts provided, the field team traced the respondents and interviewed them on site for those who were actively engaged as artisans while others were interveiwed from their homes. Focus group discussions consisting of MOA officials, Diocesan officials involved with the project, an active and non-active artisan, as well as an adopting and non-adopting farmer were conducted at each project site. The field team spent five days per project site.

3.7 Data Analysis Techniques

The researcher applied qualitative and quantitative methods to address the objectives of the study. He uses descriptive analysis to characterize the respondents and frequencies to assess the silo business take up level. Further, he applies a multinomial logit model to examine the factors that determine the artisans' take up of the business opportunity provided by the training in metal silo production.

The metal silo business uptake level was measured in this study using a multinomial choice variable of 0=does not practice at all, 1=practice at own workshop and 2=hired by the second category. The most commonly used approaches for estimating such discrete dependent variable regression models are the Logit and Probit regression techniques (Gujarati, 2004). The two models are similar and generate predicted probabilities that are almost identical (Gujarati, 2004; Liao, 1994). The main difference between the two is the nature of their distribution. The Probit has a normal distribution while Logit has a logistic (slightly fatter tail) distribution. The choice between Probit and Logit regression model depends, therefore, on the distribution assumption

one makes (Okello et al., 2011). However, the Logit regression model is more powerful, convenient and flexible and is often chosen if the predictor variables are a mix of continuous and categorical variables and/or if they are not normally distributed (Okello et al., 2011). Some of the predictor variables in this study were categorical in nature and therefore the researcher adopted Logit regression model. Further, the dependent variable for this study took more than two unordered categories and therefore a multinomial Logit regression model was used to identify the drivers of metal silo business uptake among the trained artisans.

The established generic multinomial Logit model can be expressed as;

$$\ln Y = \alpha + \sum_{k=1}^{k} \beta_{mk} X_{ik} + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where Y is a choice variable taking the value of 2 if one makes silos at own workshop, 1 if one is hired and 0 if one does not make silos at all. β is the vector of coefficients, X is a vector of explanatory variables, α is the constant and ε is the stochastic term. The empirical model estimated contains the following variables: Artisans age (in years) at the point of training, Years of formal education, Geographic region (1=Embu, 0=Otherwise), Distance (KM) to the nearest main shopping centre, Main professional training (1=Tinsmith, 0=Otherwise), Experience in technical work (years), Primary occupation at the point of first training (1=Workshop, 0=Otherwise), Workshop ownership before training (1=Yes, 0=Otherwise), and Income level (Ksh) at the point of training.

3.8 Ethical Considerations

All professions are guided by a code of ethics that has evolved over the years to accommodate the changing ethos, values, needs and expectations of those who hold a stake in the professions.

Most of them have an overall code of conduct that also governs the way they carry out research. In addition, many research bodies have evolved a code of ethics separately for research (Kumar 2005). The researcher duly observed the following social research ethics as identified by (Rukwaru 2007): Observes and maintains integrity and humility all through, respects the respondents privacy and preserves confidentiality on their identities and personal information, observes intellectual honesty and avoid distortions at all cost, all forms of collaborations and support are acknowledged and objectivity is upheld all through and the conclusions arrived at are free of any biasness.

3.9 Operationarization of Variables

Table 3.1 Operationarization of variables

Research Objectives	**Type of Variables**	**Indicators**	**Measurement scale**	**Data analysis technique**
To determine the influence of education level of the artisan on adoption of the metal silo business,	Independent: Education Level	Number of years in the formal education Highest level attained – lower primary, upper primary dropout, KCPE, Secondary school dropout, KCSE, Tertiary level or college education	Ordinal	Multinomial logit regression
To assess the influence of income level and source/occupation of the artisan on the adoption of the metal silo business	Independent: Source of income and level of income	The main occupations of the trained artisans before and after the training. Weekly average income of the trained artisans before and after the training	Source – Nominal Level - Scale	Multinomial logit regression
To determine the influence of age and experience of the artisan on the adoption of the metal silo business.	Independent: Age of the artisan, work experience of the artisan	The age in years of the trained artisan The work experience in years of the trained artisans in their respective occupations	Age and experience - Scale	Multinomial logit regression
	Dependent Variable: Adoption level of the silo technology by the trained artisans	The number of the trained artisans who are running the silo making business out of the total number trained	Nominal	Descriptive, Frequencies

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the data that was generated to answer the research questions. Descriptive statistics have been used to characterize the respondents who have been disaggregated into their respective categories namely: Those who do not practice at all, Hired artisans and those who make silos at their own workshops. Cross-tabulation analyses have been used to put the predictor variables into perspective in relation to the dependent variable. Finally, regression analysis adopting multinomial Logit model was run identify the factors influencing the adoption of metal silo business among the trained artisans. The chapter is organized into four sub-headings namely: Response rate, demographic characteristics, metal silo adoption levels and factors that influence the adoption of metal silo business among the trained artisans. Within these subtopics, relevant data is analyzed, presented and interpreted.

4.2 Response Rate

The study targeted all the artisans who had been trained on how to make metal silos under the auspices CIMMYT between 2008 and 2010. In total, they were 60 artisans and were spread over the two project regions which were Embu and Homa Bay. The field team interviewed a total of 58 trained artisans which is 97 percent of the targeted respondent.

4.3 Demographic Characteristics

Table 4.1 presents the socio-economic characteristics of the artisans.

Table 4.1: Artisans' characteristics

	Not Practicing (n=19)		Hired Artisans (n=19)		Practices at own workshop (n=20)	
Variable	Mean	SD	Mean	SD	Mean	SD
Artisan's current age (years)	38.2	11.3	34.5	10.5	43.9	10.4
Age at the time of first training (years)	32.8	10.9	28.7	9.1	36.1	12.1
Years of formal education	8.7	3.4	8.9	2.9	9.2	2.8
Distance (KM) to the main centre	.5	1.0	1.2	1.7	1.0	3.4
Years of experience in technical work	10.8	8.4	12.9	8.4	21.5	8.3
Years of experience in primary occupation before training	10.1	8.4	7.2	7.1	13.2	10.0
Years of experience in the current primary occupation	12.9	8.7	11.8	9.1	20.5	9.1
Combined income before ('000' Ksh)	2.4	2.3	2.4	1.7	5.5	5.1
Combined Income now('000' Ksh)	5.3	6.5	5.0	3.7	11.3	8.7
Number of days trained	27.0	82.2	18.1	40.0	9.9	9.0
Change in income since they were firstly trained ('000' Ksh)	2.9	4.8	2.7	2.6	5.8	4.9
Number of silos made so far					42.1	103.5
Number of silos sold so far					41.9	103.6
Total bags of grains stored annually	14.6	11.7	9.6	5.8	10.9	8.2

Of all the interviewed artisans, 67 percent are from Homa Bay region while 33 percent are from Embu region. All of them were males. There was no any female artisan trained on silo business in the regions covered by the research. At the time of training in metal silo production, most (57 percent) operated workshops as their primary occupation. This has now gone up to 60 percent. Most (86 percent) are farmers though only 36 percent of them have metal silos for their domestic use. More specifically, 65 percent of those making silos at their own workshops had metal silos for domestic us, 39 percent of the hired artisans also owned silos while none of those who were not making silos at all owned silos.

As shown in table 4.1, there is a significant difference in their mean of age whereby artisans making silos at own workshops have the highest mean (44) followed by those who do not make silos at all (38) and the least being hired artisans (35). Their level of education is considerably low with a mean of 9 years which is barely above primary education. Suffice it to say that the informal sector is generally considered to be an avenue for entry by those school leavers who either cannot afford or qualify to enter the formalized vocational training (Maundu, 1997). Years of experience in technical work as a variable is also significantly different with artisans making silos at own workshop being the most experienced with a mean of (22 years) followed by the hired lot (13 years) and those who are not making silos at all being the least experienced in technical work (11 years). The mean of income both now and at the time of training is also significantly different for the artisans making silos at their own workshop (before Ksh 5,520, now Ksh 11,335) from that of the other categories (Approx. Ksh. 2,000 before, Ksh. 5,000 now). The key thing to note in regards to the incomes of all categories is that their incomes since training and now has doubled in absolute terms.

Table 4.2 presents the different modes of training used by the interviewed artisans to attain their technical skills and the percentage of artisans who went through those modes. They include colleges, vocational centers and apprenticeship training.

Table 4.2 Artisans' Formal Professional Training

	Tinsmith	Otherwise	Total
College	50%	50%	17%
Vocational center	87%	13%	26%
Apprenticeship	94%	6%	57%
Total	84%	16%	100%

Out of all the interviewed artisans, 94 percent have technical training as their main formal professional training in life, mostly as tinsmith which was proxied by training in welding and metal work and stands at 84 percent (Table 3). Most (57 percent) attained their training through apprenticeship, 26 percent from vocational centers while 17 percent attended colleges for their professional training. Most artisans (58 percent) have no certification for their technical skills while 39 percent have grade 3 which is the lowest level of grading. Only 6 percent have attained grade 1 which is the highest level.

4.4 Metal Silo Business Adoption Level

This subsection presents adoption of the metal silos business by various variables. It starts by giving the general adoption levels then compares adoption by counties, education level, workshop ownership and type of workshop owned.

4.4.1 County of residence and level of adoption

Table 4.3 represents the different counties where artisans were interviewed and the adoption levels from those counties. The counties are Embu, Homa Bay and Migori counties.

Table 4.3 County of residence and level of adoption

County	Level of adoption by the artisans			
	Does not practice at all	**Hired**	**Makes silo at their workshops**	**Total**
Embu	26.4%	36.8%	36.8%	100.0%
Homa Bay	31.8%	31.8%	36.4%	100.0%
Migori	41.2%	29.4%	29.4%	100.0%
Total	32.8%	32.8%	34.4%	100.0%

As shown in Table 4.3, a third of the trained artisans make silos in their own workshop, another third make them when hired by the first group, while a third does not practice the silo business at all. In Embu 26.4 percent do not practice, 36.8 percent are normally hired while 36.8 percent make silos at their own workshops. In Homa Bay 31.8 percent do not practice, 36.8 percent are hired while 36.4 percent practice at their own workshops while in Migori 41.2 percent do not practice at all, 29.4 percent practices as hired artisans and 29.4 percent makes silos at their own workshops.

4.4.2 Workshop Ownership at the time of traning and adoption level

Table 4.4 presents the relationship between ownership of workshops at the time of training and adoption of silo business.

Table 4.4 Workshop ownership and adoption level

Had a workshop	Level of adoption by the artisans			
	Does not practice at all	Hired	Makes silo at their workshops	Total
No	20.7%	22.4%	5.2%	48.3%
Yes	12.1%	10.3%	29.3%	51.7%
Total	32.8%	32.8%	34.5%	100.0%

As shown in table 4.4, 51.7 percent of the respondents owned workshops at the time of training while 48.3 percent did not. 29.3 percent of the respondents owned workshops and did metal silo business at their own workshops, 10.3 percent had workshops but did not take direct orders for metal silos and made them as hired artisans by the former category. 12.1 percent of the trained artisans had workshops at the point of training and did not adopt the metal silo business at all. Most of them sited low demand, cost of transportation and outsourcing for the special sheet used for metal silos and specialisation in other products which are more known by their customers and therefore fast moving as the key reasons for not adopting the metal silo at all. Low demand was expounded as a product of low awareness of the technology among the farmers and the price of the metal silo on the end user/farmer which is significantly higher as compared to other conventional grain storage methods. Most of the atisans who seemingly were benefiting from the sale of silos were selling them to institutions, cereal traders and sponsoring projects who were either granting or subsidising them for the farmers.

Table 4.5 presents the relationship between the kind of workshops owned by the artisans and the adoption of the metal silo business. Workshop ownership was into two categories which are tinsmith workshops and other types of workshops.

Table 4.5: Workshop kind and adoption level

Workshop kind	Level of adoption by the artisans			
	Does not practice at all	Hired	Makes silo at their workshops	Total
Otherwise	9.4%	3.1%	6.3%	18.8%
Tinsmith	15.6%	15.6%	50.0%	81.3%
Total	25.0%	18.8%	56.3%	100.0%

As shown by tabel 4.5, 81.3 percent of the trained artisans with workshops were tinsmiths while only 18.8 percent of the artisans owned other kind of workshops which included mechanical garages, carpentry workshops, etc. 50 percent of all the respondents were tinsmiths and they made silos at their own workshops. The non practicing and hired tinsmiths were 15.6 percent for both categories.

4.4.3 Level of education and adoption level

Table 4.6 presents the relationship between the education levels of the artisans and the adoption of metal silo business. Education level categories include Lower primary, Upper primary, KCPE, High school, KCSE and tertially level.

Table 4.6. Level of formal education and adoption level

Level of Formal Education	Level of adoption by the artisans				
	Does not practice at all	Hired	Makes silo at their workshops	Total	Cumulative Total
Lower Primary	1.7%	1.7%	1.7%	5.2%	5.2%
Upper Primary	6.9%	3.4%	3.4%	13.8%	19.0%
KCPE	12.1%	15.5%	10.3%	37.9%	56.9%
High School	1.7%	5.2%	10.3%	17.2%	74.1%
KCSE	8.6%	5.2%	6.9%	20.7%	94.8%
Tertiary	1.7%	1.7%	1.7%	5.2%	100.0%
Total	32.8%	32.8%	34.5%	100.0%	

As show in table 4.6, most of the artisans (56.9 percent) have only primary education with only 37.9 percent who have actually completed primary school and thereby attained primary school education certificate. The rest, 13.8 percent and 5.2 percent dropped at upper and lower primary respectively. Only 43.1 percent of the artisans went proceeded with the secondary education. 20.7 percent have attained secondary education cerficate while only 5.2 percent who went beyond that and have attained tertially level education. Those who have completed primary level and high school drop outs account for the 20.6 percent out of 34.5 percent of the artisans making silos at their own workshops.

4.5 Factors That Influence Adoption of Metal Silo Business Among the Trained Artisans

Table 4.7 presents the results of the multinomial Logit regression analyzing the factors that affect the adoption of metal silo business among the artisans.

Table 4.7: Factors that influence adoption of metal silo business

	Makes silos at own workshop			**Hired Artisans**		
Variables	**Coef.**	**S.E.**	**P>z**	**Coef.**	**S.E.**	**P>z**
Age at the time of first training	-0.23	0.10	0.02	-0.13	0.07	0.08
Years of formal education	0.06	0.31	0.86	0.19	0.15	0.21
Distance (KM) to the nearest shopping centre	0.22	0.44	0.62	0.25	0.39	0.53
Experience in technical work	0.31	0.11	0.00	0.15	0.08	0.05
Ownership of workshop before training	4.00	2.10	0.06	0.58	1.27	0.65
Income before training	0.00	0.00	0.40	0.00	0.00	0.45
Primary occupation at the time of training	3.07	1.52	0.04	-0.01	0.83	0.99
Field of professional training	0.33	1.34	0.08	0.49	0.98	0.62
Geographical region	-1.45	2.38	0.54	-1.19	1.31	0.37
Constant	-2.65	4.96	0.59	1.45	2.45	0.55
The base outcome is ‘does not practice at all’						
Number of objects	57					
LR chi2(18)	53.1					
Prob > chi2	0.0					
Pseudo R2	0.4					
Log likelihood	-36.1					

As shown in 4.7, a number of factors influence the likelihood to practice metal silo business either at own workshop or as a hired artisan. Among them, age, experience in technical work, ownership of a workshop at the point of training, primary occupation at the time of training and main professional training stand out. The probability to start a silo business at own workshop or practice on hire basis decreases with age. Holding other factors constant, a unit increase in age decreases the likelihood to do silo business at own workshop by 0.1 percent while it decreases the likelihood of being hired by 0.07 percent. A unit increase in years of experience in technical work increases the likelihood of starting a metal silo business at own workshop by 0.11 percent and that of making silos as a hired artisan by 0.08 percent holding other factors constant. Similarly, holding other factors constant, ownership of a workshop at the point of training increases the likelihood of one starting a silo business and receiving tenders directly by 2.1 percent while this has no statistical significance on the likelihood of one practicing as a hired silo artisan. The study associates this to the strong positive relationship between years of experience in technical work and ownership of a workshop by the time of first training whose Pearson's R is 0.5 (signifying a strong positive correlation) and as shown by Figure 2. Most of the artisans without workshops at the time of training lie below 14 years of experience in technical work while most of those with workshops are above 14 years of experience.

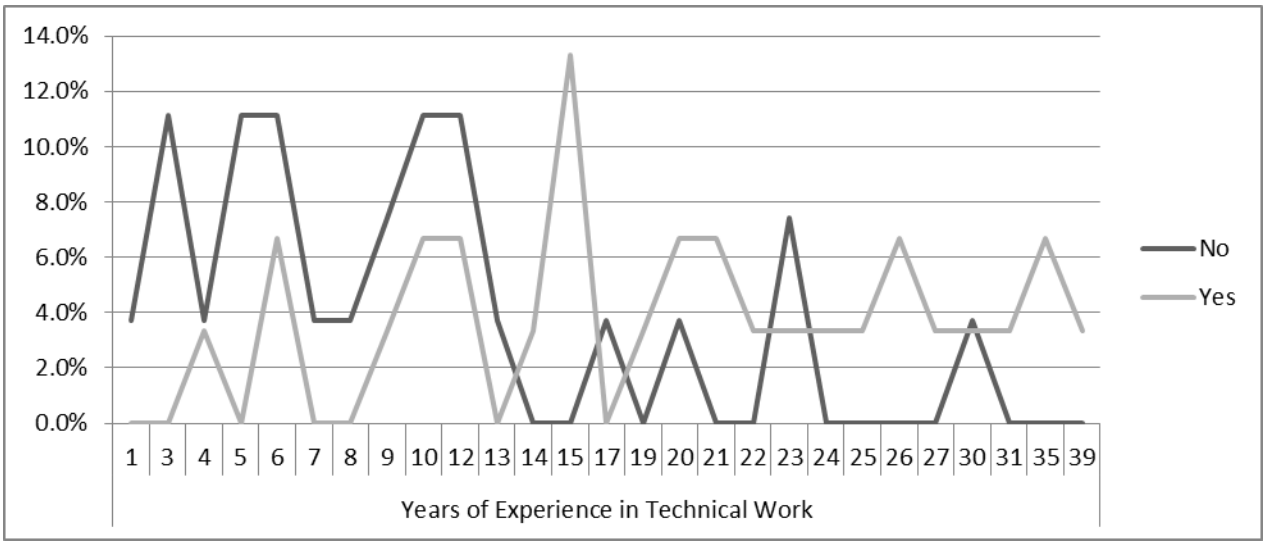


Figure 2. Years of experience in technical work and workshop ownership

Further, the probability of metal silo business take up at own workshop increases with primary occupation at the point of training. This was a dummy variable which took the value of 1 if one operated a workshop as their primary occupation at the point of training and 0 if otherwise. Holding other factors constant, this increases the likelihood to start a silo business by 1.5 percent. Also, the probability of metal silo business take up at own workshop increases with professional training as a tinsmith. Professional training was a dummy variable taking value 1 if one is trained as a tinsmith and 0 if otherwise. Holding other factors constant, training as a tinsmith increases the likelihood of an artisan starting the metal silo business by 1.34 percent. The pseudo R2 (adjusted coefficient of determination) reveals that the included variables explained 40 percent of variations in the adoption of the metal silo business among the trained artisans.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a conclusion of the findings and presents the recommendations generated from the data analyzed.

5.2 Summary of Findings

It was found out that all the artisans who were trained in metal silo fabrication were males. This was occasioned by the fact that there were no female artisans on the ground during the selection of the trainees. Those who have completed primary level and high school drop outs account for the 20.6 percent out of 34.5 percent of the artisans making silos at their own workshops. It was also observed that persons with very low education level and those with higher level education especially above secondary education consituted a very low percentage of the trained artisans (5.2 percent for both categories).

Adoption levels deferred in different counties but generally, a third of the artisans make silos at their own workshops while a third are hired by the first category while a third do not practice silo business at all.

The adoption of the metal silo business as the dependent variable increases with years of experience in technical works, workshop ownership at the time of training, tinsmith as the main professional training and operation of a workshop as the primary occupation. The same decreases with age at the time of training.

5.3 Discussions

As outlined in the previous chapter, experience in technical work, workshop ownership, tinsmith as the main professional training and workshop operation as the primary occupation as independent variables have a positive relationship with the likelihood to start a silo business. Metal silo business largely involves working with metal sheets and soldering rods. The artisans who had received professional training as tinsmiths and have sufficient experience in technical work especially running their own workshops as their primary occupation are expected to have more advanced expertise and experience in metal work which increases their chances of metal silo business up take whether at their own workshops or as hired artisans. They are also likely to have the necessary tools required for silo business and have necessary market linkages and experience for the raw materials. This corroborates previous study which concluded that what is eventually a more significant determinant of entry into self-employment (for *Jua Kali* artisans) is the range of experience obtained over many years in the manufacture, design, sourcing of materials, knowledge of clients, marketing, etc (King, 1996).

Age as a factor of metal silo business adoption has an inverse relationship with the dependent variable. The older one is the lower the chances of adopting the business. This would imply that the elderly artisans would be more risk averse in relation to adopting new products at their workshops. The other possibility would be that the older artisans are more settled at their workshops and have over time built a reputation around particular products which are fast moving and hence brings in required income and hence they may not see the need to diversify. Lastly, the elderly artisans may not have the energy and time to do the extra work of marketing the silos by proactively going to the farmers and institutions to introduce the technology and demonstrate how it works explaining its superiority over the traditional grain storage methods.

This was a key component of the project since it will move the technology to the target consumer as the artisans creates and expands their businesses.

Those who have completed primary level and high school drop outs account for the 20.6 percent out of 34.5 percent of the artisans making silos at their own workshops. This would imply that some level of education, at least primary level certificate is a motivation towards one adopting the business while high levels of education, especially secondary education certificate and above, would open an individual opportunity for other lucrative occupations and therefore are not found within the 'Jua Kali' industry and therefore they are not practicing the metal silo business.

Most (57 percent) attained their training through apprenticeship, 26 percent from vocational centers while 17 percent attended colleges for their professional training. This corroborates previous argument that not all training of informal sector artisans occurs at specific worksites since some formal institutions also offer some training but in Kenya, the informal sector trains substantially more artisans per year than those trained at the formal institutions (Maundu, 1997; Yambo, 1991)

As earlier observed, commercializing rural enterprises entails helping the communities endorse a profit mentality to whatever they do. The profit made helps the rural persons meet their subsistence needs, create employment for self and others as well as attach an economic value to their work hence leading to sustainability. The results are indicative of situations where artisans have not just improved their incomes by adopting the metal silo businesses but have employed other artisans either full time or on contract basis to run the silo business.

5.4 Conclusions

The training of artisans on how to make metal silos is a worthy venture since it helps the adopting artisans diversify their businesses and increases their income. As such, this needs to be promoted by different stakeholders to facilitate the dissemination of metal silos among farmers. To ensure higher adoption rates among the trained artisans, a selection criterion would be important to ensure the right people have been trained. The criteria should consider factors such as age, years of experience in technical work, ownership of a tinsmith workshop and professional training in tinsmith work.

5.5 Recommendations

1. For maximum outcome, programmes and projects of similar nature should consider young artisans with sufficient experience in technical work and are professionally trained as tinsmith. They preferably should have their own workshops though this need not be a strict prerequisite since those without workshops are likely to be hired by those with workshops.
2. Programmes should develop an integrated training curriculum for the artisans. The curriculum should integrate business management skills into the technical skills training. These skills were found to be paramount in supporting the artisans as they run their businesses. To cover the technical skills, the study recommends apprenticeship training in a concerted manner whereby trainees are attached to practicing artisans who are in turn accountable to the organizers of the programme. Both the trainer and the trainee should receive training on business management and entrepreneurship skills.

3. Strong linkages with organizations and government line ministries should be developed particularly to create awareness on the silo among the rural farmers so as to create a demand for the artisans. Such linkages will also enhance sustainability of the results beyond the project period.
4. Professional associations should be formed which brings all the silo artisans from a particular region together. The association should facilitate the process of bringing the raw material closer, help in marketing the members' product, enforce quality control through branding silos produced by the members and receive and train new and interested artisans. This will also enhance the sustainability of such technology promotion projects and that of the members businesses. Besides, the members will create networks within which those who have workshops can hire those who are trained but have no workshops and hence cannot take orders directly.

5.6 Suggestions for further research

The study recommends the following as areas of further research:

1. The impact of metal silo business on the artisans' income and livelihood,
2. A cost benefit analysis of different training models of artisans in Kenya,
3. Factors that affect the adoption of other innovative products by artisans, and
4. Replication of this empirical study in areas where metal silos have been promoted. This should include Malawi and Central America.

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APPENDICES

APPENDIX I: LETTER TO SEEK PERMISSION FOR CONDUCTING RESEARCH

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CIMMYT-EGSP Project Leader
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Dear Sir/Madam

RE: PERMISSION TO CONDUCT RESEARCH AMONG THE METAL SILO ARTISANS TRAINED BY CIMMYT DURING THE EGSP PILOT PHASE

I am a student from the University of Nairobi undertaking a Masters degree in Project Planning and Management. As part of the course requirements, I am required to conduct a research project whereby I have identified my topic of study as 'Factors that Influence the Adoption of Metal Silo Business among the CIMMYT Trained Artisans'

I am writing to seek for permission to conduct a research on the adoption rate by the artisans and the factors affecting their adoption of the business opportunities provided by the project. Therefore, I am requesting to be allowed to collect data regarding my topic of study. Upon completion, I will share my findings with your office.

I look forward to receiving positive feedback

Thanking you in advance

Yours Faithfully,

Michael K. Ndegwa

APPENDIX II: QUESTIONNAIRE FOR THE ARTISANS

My name is Michael K. Ndegwa. I am a post graduate student at the University of Nairobi. I am carrying out a study on the metal silos artisan work from Embu and Homa-Bay regions for my thesis. Being one of the trained silo artisans, you have been selected to participate in this study. The results of this study will be used for academic purposes and can provide useful information for the implementation of future interventions to improve grain storage using metal silos. All information about your business will be kept strictly confidential and will not be shared with people or institutions that are not involved in the research. You or your business will not be personally identified in any study report or publications.

Participation in this study is voluntary and will take at most 45 minutes. You have the right to refuse to participate in this study. If you choose to participate, you have the right to stop at any time and to not answer certain questions in the questionnaire. If you refuse or stop your participation at any time, there will be no consequences. You may ask any questions you have about the study. If you have questions later, they can be directed to Michael Ndegwa at 0720269326.

PART A – BIO DATA

1. Name_____
2. Mobile Number_____

   Owner Relationship: Self (1), Relative (2) Friend (3) ----------☐
3. Gender _____Male (1) Female (0)_____☐
4. Age (Years)_____☐
5. Level of formal education: Lower Primary (1), Upper Primary (2), KCPE (3)

   High School (4), KCSE (5), Tertiary (6), _____☐
6. Years of formal education _____☐
7. Literacy Level: Cannot read or write (1), Read Only (2), Read and write (3)__☐

PART B – SITE INFORMATION

8. Site: Home (1), Workshop (2) _____
9. County_____
10. District_____
11. Division_____
12. Location_____
13. Sub location_____
14. Village_____
15. Shopping Centre_____
16. Home/Site Distance (KM) from the main shopping centre _____
17. GPS Reading: Longitude_____ Latitude_____ Altitude_____

PART C - INCOME LEVEL AND MAIN OCCUPATION

18. What is your main professional training?
    i) Teaching (1)
    ii) Technical skills training (artisan, masonry, carpentry, mechanic etc) (2)
    iii) Agriculture/farming (3)
    iv) None (4)
    v) Other(s) (5) _____
19. How did you attain the training:
    i) College (1),
    ii) Vocational Centre (2),
    iii) Apprenticeship (3)
    iv) Rehabilitation centre (4)
    v) Others_____ (5)

20. If technical skills training, which field are you mainly trained in?
    i) Welding and Metal work (1)
    ii) Wood work and carpentry (2)
    iii) Masonry (3)
    iv) Mechanical engineering (4)
    v) Electrical engineering (5)
    vi) Other(s) (6)_____

21. What is your highest level of technical training grading (Grade attained)_____

22. Years of experience in technical work_____

23. What are your first 2 main occupations currently?

		1st	2nd	Experience (Years)
i)	Formally Employed (1)			
ii)	Casual labor (2)			
iii)	Farming (3)			
iv)	Workshop (4)			
v)	Business (goods and services) (5)			
vi)	Silo Business (6)			
vii)	None (7)			
viii)	Other(s) (8) - _____			

24. Do you have a workshop now? Yes (1) No (0)_____

25. What kind of a workshop is it? (Main activity at the workshop)
    i) Carpentry (1)
    ii) Tinsmith/welding (2)
    iii) Electrical and Electronics services (3)
    iv) Mechanical works (4)
    v) Other(s) _____

26. For how long have you operated this workshop (years) _____

27. What is the main product at your workshop?
    _____

28. Are you a farmer yourself? Yes (1) No (0) _____

29. Do you store grains? Yes (1) No (0) _____

30. How much per season?

	Bags Per Season
1st Season	
2nd Season	
Annual Total (Calculate)	

31. Do you have a metal Silo(s)? Yes (1) No (0)_____

32. If yes what is the total capacity?_____

PART D – ARTISANS TRAINING AND ADOPTION

33. Did you receive training on silo Manufacturing? Yes (1) No (0)_____

34. If yes, when?

	1=Yes 0 = No	Training Institution: CIMMYT (1), Caritas (2), ToT (3), MoA (4)	# Days
1st Round			
2nd Round			
3rd Round			
Individually			

35. Have you been making silos after the training: Yes (1) No (0)_____
(NB: If no go to Section E)

36. If yes, when did you start the business: MM/YY_____

37. Do you make for your own account or hired? Own (1) Hired (0)_____

38. If hired, how many silos have you contributed to? _____
(NB: If Hired go to Section E)

39. If own, how many staff do you employ? _____

40. If own, how many silos have you made and sold so far and what was your profit?

Year	Capacity (90kg-bags)	Number Made	Number Sold

41. Who bought?

Buyer	Year	Capacity (Bags per silo)	Number bought	Average Price	Unit Cost of production – Material Only	Profit – Enumerator to calculate	Number Subsidized

42. What are popular sizes? _____

43. Why:
    i) _____
    ii) _____
    iii) _____

44. How much money was your starting capital? Ksh._____

45. Where did you get capital from for the metal silo business (list possible sources)

Variable	**1= Response 0 = Non-response**
Personal Savings	
Credit Institution/Bank	
Credit from family/friends	
Donations	
Other(s) _____ _____	

46. If a credit facility, how much and what was the interest?

	Amount	Repayment Period	Annual Interest
Bank			
Microfinance			
SHG			
Family/Friend			

47. Has the metal silo business been able to pay for the loan? Yes (1) No (0)_____

48. What was your approximated income per week before you started the business:
    Ksh_____

49. What is your approximated weekly income now

Ksh_____

50. To what do you attribute the change in income?
    i) Metal Silo Business (1)
    ii) Others (2)_____
    _____

51. Where do you get the raw materials from and at what price?

	Source	Dist in KMs	Unit Price (Ksh)	Is cost of transportation a hindrance? 1 = yes 0 = no
Galvanized metal sheet				
Soldering rod				

52. List 3 key challenges faced
    i) _____
    ii) _____
    iii) _____

53. What training would you recommend in order to improve your work
    i) _____
    ii) _____
    iii) _____
    iv) _____

54. List any other recommendations to enhance the artisans work
    i) _____
    ii) _____
    iii) _____
    iv) _____
    v) _____

PART E - FOR NON-ADOPTERS

55. What are the factors that made it difficult for you to adopt the idea?

Variable	**1 = Response 0 = Non-response**
Lack of capital	
Involved in other occupations	
Lack of a workshop and tools	
Insufficient training	
Low interest by the artisan	
Lack of effective demand	
Access to the raw material	
Distance from the market centre	
Other(s) _____ _____	

56. What are the training gaps
    i) _____
    ii) _____
    iii) _____

57. What was your approximated income per week before the training:
    Ksh_____

58. What is your approximated weekly income now
    Ksh_____

59. To what do you attribute the change in income level?

    General remarks and observations enumerator NB

APPENDIX III: FOCUS GROUP DISCUSSION GUIDE

1. What are the main staple food crops grown in this area?
2. Which crops do farmers store?
3. What are the common storage methods and containers used in the area?
4. Do you think the metal silos have a potential in this area?
5. What do you think could be hindering silo artisans from operating at full potential?
6. What do you think is the awareness level of metal silos on the farmer side?
7. What recommendations would you make to increase the adoption of the silo technology among the farmers and the artisans?
8. Do a SWOT analysis

APPENDIX IV: LOCAL PARTNERS KEY INFORMANTS INTERVIEW GUIDE

Organization _____

Officer Position _____

Officer Name _____

Mobile Number _____

Date _____

1.	What is the key business of your organization?	
2.	How many staff are involved in this project?	
3.	What time is allocated to the project?	
4.	How many artisans did you train or organize training for?	

5.	What were the selection criteria for the artisans?	
6.	What are the success stories have you had in the implementation of the project?	
7.	What could have led to this?	
8.	What do you consider as the failures of the project?	
9.	What could have led to this?	
10.	What do you think is the awareness level of the metal silos among the farmers?	

11.	Do you think the farmer and area targeting is appropriate?	
12.	Which other areas do you recommend for this intervention?	
13.	What are the challenges faced?	
14.	What recommendations would you make to improve the performance of the project?	
15.	On a scale of 1 – 5, how would you rate the overall project performance?	
16.	Why?	