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Gender Analysis of Maize Post-Harvest Management in Kenya: A Case Study of Nakuru, Naivasha and Embu Districts

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Executive Summary

This gender analysis study for maize post-harvest management was carried out in Kenya under the International Maize and Wheat Improvement Center (CIMMYT) through its Effective Grain Storage Project Phase-II (EGSP-II). Maize is Kenya's main staple food taken to be synonymous with household and national food security. It is therefore the country's most frequently produced and marketed crop. About 75 percent of the maize in the country is produced by small-scale farmers. Women and men play vital roles and are engaged in different activities across the maize value chain, from production to consumption including post-harvest management (PHM). This study provides a critical analysis of gender relations in crop post-harvest management and gender roles in grain storage management, technology handling and dissemination. The results will assist EGSP-II team's address the different preferences and priorities of women, men and youth in the design and adoption of metal silos.

This study aims to assist partners in improving their strategies for developing gender responsive approaches through better project planning, monitoring and evaluation, thus ensuring equitable processes and positive outcomes for women and men. In addition, this study provides new empirical evidence and knowledge on gender and post-harvest, and how the gaps can be addressed. Apart from Kenya, this study was carried out in three other countries (Malawi, Zambia, and Zimbabwe) where the EGSP- II was implemented. Ultimately, the study will inform the development of a tailored gender strategy that can be applied by EGSP as well as similar focus programs in fostering gender equality outcomes for post-harvest technology development, promotion and adoption.

This gender analysis study was carried out in 3 areas in Kenya: Nakuru, Naivasha and Embu. Data was collected from, key informants, focus group discussions, in-depth interviews with metal silo artisans, case profiling of adopters and non adopters of post-harvest technologies and a partial gender audit of EGSP partners. Several key findings are derived from this study: first, sexual division of labor in post-harvest management of maize was very clear-cut and women and men perform different tasks that include, de-husking, stalking of the maize and transporting from the farm to the homestead. Shelling using machines and marketing is a task carried out by men and male youth. On the other hand, women put more of their labor in: winnowing especially if

this is done manually; drying grain; storage and; preparation of grain for consumption. Division of labor is culturally-specific and is also affected by: individual farm household characteristic; levels of income; access to technology and; appropriateness of the specific technology. On the other hand, in the absence of male-heads of households, women perform all the other tasks traditionally done by men, such as cutting and piling of maize stalks and transporting grain from the farm. There are differences noted among the pastoralist and the agricultural communities that were studied. Among the Maasai and Kalenjin (ethnic groups) women perform all the tasks related to post-harvest activities, while among the Agikuyu, Luyhia, Luo, Kisii and Kamba (ethnic groups), the division of labor in post-harvest activities is performed by men and women.

Second, study participants perceived very high post-harvest losses which they estimated at 30 to 60 percent because of rodents, weevils, dampness or humidity-making maize rot (aflotoxin), climatic changes such as excess rains causing aflotoxin, spillages during transportation, drying, and theft. Over the years the farmers noticed two types of weevils; the usual small black ones which they control by dusting the maize with actellic super and the Larger Grain Borer (the red big ones). Rats, on the other hand, have largely increased in numbers especially in Nakuru area. Dampness and humidity is also a great challenge given climate change. Sporadic rains occur mainly during the harvest season and destroy maize both at the farm and in storage. Theft of maize is a major threat to farmers, and many of them are forced to store maize in their bedrooms. Women reported that the practice of storing grain within their bedrooms is hazardous to their health because the maize is dusted with super- actellic. In addition, women fear that thieves can break into their bedrooms and harm them. Methods used to control post-harvest losses (PHL) include: dusting both the maize and beans with actellic super to control the weevils, selling the maize at the farm when it is still green, using pesticides and herbicides to spray the pests. Post-harvest losses negatively affect family incomes, the levels of food available for household consumption, resources available for purchasing inputs for the next planting season. As a result, households may face food insecurity in ways that force them to purchase maize for domestic consumption.

Third, findings reveal that farmers store their grain in various structures including: bags, baskets, in the house, stores made of wood with iron sheet-roofs and raised from the ground or traditional granaries (cylindrical and wicker wall and traditional crib) only found in Embu, especially

among the Mbeere. Other types of granaries used include, improved granary wood-wall (made of timber and roofed by iron-sheets) and a timber store with iron roof which is an improvement from the traditional granary. The choice of storage facility and method of storage vary with intended purpose of the storage. For example, smallholder farmers store their maize seeds by hanging the unopened cobs under the kitchen roof over the fire place. The soot accumulates over the cobs to prevent attacks by weevils and other pests and therefore, preserved for the next planting. On the other hand, grain meant for consumption is rarely treated with chemicals, but this depends on the amount stored and the length of time it will last.

Fourth, those who have adopted the metal silo technology see their benefits over traditional storage methods. Adopters of metal silos agree that the stored grain are fully protected from rats, weevils and termite attack and cannot allow water to sip through the grain. The metal silos serves as a long term measure for food security, reduces post-harvest grain loss and helps avert hunger in the households and also in the community. Women reported that, owning a metal silo reduces their labor burden therefore they do not have dry or dust maize frequently with pesticides and this allows them to engage in other activities. Male farmers reported that they no longer have to buy pesticides or bags to store the maize and therefore in the long run using metal silos saves money. Men do not have to sell maize from the farm; they can now wait and sell when prices are good. Women also pointed out that their health status improved because they no longer use chemicals to dust the maize and neither do they consume food that is contaminated by the use of pesticides.

Fifth, artisans were selected and trained on metal silos fabrication however at the time this study was carried out, no woman had been selected or trained as an artisan. Given the challenges artisan’s face the training package should include: business management; market strategies; gender-specific targeting strategies; and record keeping. Training artisans on gender-specific targeting strategies will enhance their businesses by targeting different categories of farmers, men, women and the youth. Training more artisans in the village polytechnics could improve general awareness of metal silos in the communities. Demonstrations at the market centres or displays of models at their workshops will create more awareness among farmers. Women and the youth should be deliberately targeted and particularly, women encouraged to train as artisans.

Trained women artisans can enhance the distribution and adoption of metal silos to other women farmers because they act as role models.

Sixth, promotion and dissemination of post-harvest technologies is mainly done through women's groups, organised farmers trainings, meetings with farmers in their farms, field days and exhibitions. Although, a larger number of women are reached, this is often by default and not by design since the implementers lack gender strategies for ensuring gender equality in the promotion, dissemination and adoption of the metal silos. The study divulges that the promotion of the metal silos and hermetic bags in Nakuru and Naivasha, first targeted male farmers. Limited adoption reflects the lack of consultation among potential beneficiaries and social barriers women face in accessing and adopting new technology.

In this study, we argue that greater attention be paid, to how the new post-harvest technologies are going to affect household relations, division of labor and how the project should deliver and equally benefit women and men. Strategies will include:

- Training artisans on gender issues, to become sensitive to the different needs of women, men and youth when fabricating the metal silos is crucial. Artisans should be aware of the gender dynamics in the households and this will help them promote and market the silos. Training women artisans and involving women in the maintenance of metal silos can be one strategy for challenging rigid gender roles, hence, women like men may own and benefit from the new technology;
- Business development strategies of the promotion, dissemination and adoption of metal silos include: mapping the number of women groups Faith Based Organizations (FBOs) and Non-Governmental Organizations (NGOs) in the region; linking up with agricultural extension officers; visiting individual farmers and displaying metal silos at market centres and; encouraging women, men and youth to buy. Different needs of men, women and youth should be considered in the design, size and price of the metal silos and incentives created such as reduced prices in certain seasons or guaranteed repairs. Organization of women only groups is considered to potentially empower women and also an opportunity for women to gain better access and use the technology to improve their livelihoods;

- Other forms of dissemination are through the media, vernacular radio stations, newspapers, documentaries and television, pamphlets and brochures. Community radios stations provide opportunities for dissemination information about technologies and educating rural population. Mobile phones also offer great opportunities for women and men, especially in the rural areas, to get connected with information relevant for their livelihoods and social welfare. The youth can mainly be reached through the internet and social media and message-alerts sent to farmers' mobile phones can be very effective in reaching the different categories of the targets.
- Further research is needed to assess the impact of metal silos on gender dynamics in the household and post-harvest management. This will build on the farmers' experiences and suggestions on ways to improve the design of the silos and expand its market and adoption.

List of Acronyms and Abbreviations

ARDP	-	Agricultural Rural Development Programme
ATDC	-	Agricultural Technologies Development Centres
AEOs	-	Agricultural Extension Officers
AfDB	-	African Development Bank
CDN	-	Catholic Diocese of Nakuru
CIMMYT	-	International Maize and Wheat Improvement Center
DOs	-	District Officers
EGSP-I	-	Effective Grain Storage Project Phase 1
EGSP-II	-	Effective Grain Storage Project Phase 2
FBOs	-	Faith Based Organizations
FHHs	-	Female-Headed Households
FRS	-	Famine Relief Stock
GAD	-	Gender and Development
ICT	-	Information Communication Technology
KARI	-	Kenya Agricultural Research Institute
KARLO	-	Kenya Agricultural and Livestock Organization
KSH	-	Kenya Shilling
NAAIP	-	National Accelerated Agricultural Input Access Program
NCPB	-	National Cereals and Produce Board
NGOs	-	Non-governmental organisations
MDGs	-	Millennium Development Goals
MHHs	-	Male-Headed Households
MS	-	Metal Silos
PHL	-	Post-Harvest Loss
PHM	-	Post-Harvest Management
PHT	-	Post-Harvest Technology

SDC	-	Swiss Agency for Development and Cooperation
SGR	-	Government Strategic Grain Reserves
USAID	-	United States Agency for International Development
USD		United States Dollars
WID	-	Women in Development
WB	-	World Bank

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List of local names and terms

Chief's Baraza	-	Chief's meeting
Chama	-	Women groups
Gala	-	Traditional safe stores
Githeri	-	A dish mixture of maize and beans
Njahe	-	Black beans
Miraa	-	Khat
Meko	-	Gas cooker
Panga	-	Machete
Ugali	-	A dish of maize flour

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1.0 Background

With funding from the Swiss Agency for Development and Cooperation (SDC), the International Maize and Wheat Improvement Centre (CIMMYT) implemented the Effective Grain Storage Project (EGSP). The EGSP project focuses on three areas: first, it primarily promotes post-harvest technologies such as metal silos and hermetic (super) bags and supports testing and promotion of technologies through activities such as targeting, training, demonstrations, and documentation. Second, the project fosters the evolution of a vibrant private sector-led post-harvest technology market through capacity building and support. Finally, part of the project team address policy issues including activities such as policy research and policy dialogues. EGSP has two phases: the first phase (2008-2010) targeted Kenya and Malawi and; the second phase (2012-2015) consolidates efforts in Kenya, Malawi while initiating activities in Zambia and Zimbabwe.[1] This is the context in which this gender analysis study for maize post-harvest management was carried out in Kenya as well as in Malawi, Zambia and Zimbabwe simultaneously.

This study provides a critical analysis of gender relations in the crop post-harvest management and gender roles in grain storage management, technology handling and dissemination. This EGSP–II study will contribute and assist CIMMYT in improving their strategies for gender responsiveness thereby providing a basis for better project planning, monitoring and evaluation and therefore ensuring equitable processes and positive outcomes for women and men.

2. 0 Literature Review and Knowledge Gap

This study is a gender analysis of maize in PHM and effective grain storage. It looks at how the division of labour between women and men affects and shapes the gender relations in the households. The distinction between sex and gender is a subject of much discussion and therefore from the onset, it is important to explain the meaning of the two concepts.[2] Earlier

[1] Kandiwa V and C, Mugure, 2013. Gender Analysis in Post Harvest Management, Background Document: The Effective Grain Storage Project (EGSP). International Maize and Wheat Improvement Centre, Socio- Economic Program, Nairobi, Kenya.
[2] C. March, I. Smith and M. Mukhopadhyay, 1999. A Guide to Gender Analysis. GB Oxfam Publications.

writers such as Oakley and Rubin influenced the focus on 'gender' rather than on 'women'.[3] Oakley and Rubin were concerned about the manner in which the problems of women were perceived in terms of their sex, namely, their biological differences from men, rather than in terms of their gender, that is, the social relationship between women and men, in which women are systematically subordinated. Sex is the biological difference between women and men while gender refers to the social roles and identities associated with what is expected, allowed and valued in a woman or man as, established in different socio-cultural contexts.[4] Moser in her book Gender Planning and Development clarifies that gender roles are learned through socialization processes. Gender roles are not fixed but are changeable and are shaped by ideological, religious, ethnic, education, culture and tradition.

Gender roles are also key determinants of the distribution of responsibilities and resources between women and men.[5] According to March *et al.* (1999) beyond the gender roles are the gender relations in the households, where members may act simultaneously; sometimes cooperating, connecting, or mutually supporting each other, conflicting, separating or even competing given their differences and inequalities.[6] By applying the gender relations concept, this study aimed at capturing how decision-making power is distributed between women and men in the households and; how responsibilities and claims are allocated and valued in the context of post-harvest management of grain.

Kabeer (1994) describes gender analysis as a systematic gathering and examination of information on gender differences and social relations in order to identify understand and redress inequities based on gender. Thus, gender analysis provides a basis for robust inquiry of the different roles of women and men play in a farming system; highlights the relationship of women and men in a given community and; the inequalities in those relationships. Understanding these gender relations and the power dynamics behind them is a prerequisite for understanding individuals' access to and distribution of resources, the ability to make decisions and the way women and men are affected by political processes and social development. Kabeer further suggests that institutions such as households, communities, markets and the state are related and

[3] Oakley 1972 and Rubin 1975
[4] Ibid.
[5] Moser, 1989.
[6] C. March op.cit.

not delinked from one another as the picture suggests.[7] That, a gender analysis breaks down the divide between private spheres (involving personal relationship) and public sphere (relationships in a wider society) and therefore it is important to examine, how power relations within the household interrelate with those at the state, market and community.[8] In this study context questions were asked: who does what? Who has what? Who decides? How? Who gains? Who loses? We also mapped out the environment influencing the gender relations ranging from the household to the community and the market thus linking the micro to macro level analysis.

In all the societies, women and men are assigned different tasks, activities and responsibilities. Hence the use of the concept, sexual division of labor, which was found to vary given the different communities in Kenya and distinctions are noted among the pastoralists and agricultural-based communities. Across all communities under this study, the gender power relations are biased in favour of men given the different activities each perform and the value attached to the tasks. We also take into consideration the gendered allocation of resources between women and men by asking questions such as who has access (opportunity to make use of the resource) and who has the control (the power to decide how the resource is used). These questions reveal that, often, women have access but not control over new post-harvest technologies.

Boserup's influential work in the early 1970s challenged the notion of women as passive beneficiaries of development. She called for a focus on Women in Development (WID), to acknowledge the contributions of women's often-invisible labour.[9] In the 1980's, the Gender and Development (GAD) approach followed the WID approach, focusing on larger inequities and unequal relations. GAD advocates called for a deeper understanding of the socially constructed basis of gender differences and how these impact on relationships between men and women. For instance, the GAD approach appealed for an improved understanding of power relations and the gendered nature of systems and institutions which impact on the lives of women and men. Rather than incorporating women into the current patriarchal system, the GAD gender advocates argued for the transformation of a system into one characterised by gender equality.[10]

[7] Kabeer, N. 1994. Reserved Realities: Gender Hierarchies in Development Thought. London: Verso Publications
[8] March *et al.*, 1999
[9] Boserup E. 1970
[10] http://www.gsdrc.org/go/topic-guides/gender/understanding-gender (accessed 26/10/14)

In the recent period, countries have continued to call for progress towards gender equality through a number of international agreements, regional platforms and conferences. In 2000, countries confirmed their commitment to reducing gender inequalities through the United Nations Millennium Declaration, articulated in Millennium Development Goal (MDG) 3, which calls for the promotion of gender equality and women's empowerment.[11]

While women's issues continue to progress, attention given to gender is often inconsistent in development programmes. Scholars like Cornwall (2007) point out that the aim of the transformation of unequal, unjust power relations- is largely ignored and often funds allocated to mainstream gender equality as an important part of these programmes and policies are inadequate.[12] The imperatives for rectifying these inadequacies are based on both economic and equity concerns. Women are key actors in the economic system, yet their neglect in development plans has left untapped a potentially large economic contribution. Both economic growth and social justice call for increased attention to the integration of women into the development process. This paper proceeds from the basis that gender 'agenda' must be pursued simultaneously with equity concerns and economic growth.

Therefore, gender analysis is considered a critical element in development that must be carried out at all stages of policy formulation or program/project design from identification, planning, implementation, to monitoring and evaluation. We are fortunate to now know that if gender analysis is carried out at a later stage and added on, then the programme/project may not be as effective as when the analysis conducted at all stages of the project cycle.[13] This is because, the gender analysis also ensures that both women and men are built into development strategies up front and that programs target their resources most effectively, instead of making costly fixes after the fact.[14] Sound gender analysis should plausibly lead to integration or inclusion of measures or provisions into development interventions that would enhance development effectiveness and increase the likelihood that both men and women benefit. This involves, collecting relevant data and information on the different roles, needs, priorities, and assets of men and women in respect to the intervention proposed in order to identify the differential

[11] Millennium Development Goals
[12] Cornwall, A. 2007. Revisiting the "Gender Agenda'. IDS Bulletin, Vol. 38 No. 2 Pp 69-78
[13] http://info.worldbank.org/etools/docs/library/192862/Module2/Module2c.html (accessed 25/10/14)
[14] http://www.gdrc.org/gender/framework/what-is.html (accessed on 21/10/14)

implications of the proposed intervention. It also involves examining the social, economic, institutional and political constraints that cause differentialal impacts on men and women. Based on the findings from a gender analysis, provisions of alternative compensatory measures are taken to mitigate the effects or impacts of an intervention.[15]

Many of agricultural programmes for example, financed by development partners such as African Development Bank (AfDB), World Bank (WB), United States Agency for International Development (USAID), the Bill and Melinda Gates Foundation, and indeed the SDC, among others, re-affirm that considerations related to gender issues and women's participation influence the success and sustainability of projects.[16] This is in recognition of the fact that women are major contributors to the economy, both through their remunerative work on farms and through the unpaid work they traditionally render at home and in the community. Additionally, in many societies women are systematically excluded from access to resources, essential services, and decision making. The development partners mentioned above see opportunities in closing this gender gap through development projects that must take into account the different roles, needs, and perceptions of women and men.

The AfDB for example, states that failure to consider such differences can result in project delays, implementation bottlenecks, and generally unsuccessful project performance. Programmes aiming to reduce hunger and malnutrition and to help smallholder farming families improve their lives cannot succeed without addressing the role of women in agriculture. Research has shown that when women farmers are meaningfully included in agricultural development opportunities, not only do farms become more productive but adoption of new technologies increases and overall family health improves.[17] Without the most recent data, gender issues remain invisible. Anecdotal stories are not adequate. In this study, we bring out women and men's lives their experiences, needs, issues and priorities given their different cultural context and strategies that may be necessary to achieve equitable outcomes for women and men in the EGSP.

[15] http://info.worldbank.org/etools/docs/library/192862/Module2/Module2c.html (accessed 25/10/14)
[16] AfDB 2010 Gender Checklist: Agriculture; USAID, A guide to Integrated Gender into Agricultural Value Chains. Based on Promoting Gender Equitable Opportunities in Agricultural Chains: A Handbook.
[17] Ibid.

2.1 Gender and Technology Adoption

Staudt in her paper, 'Inequalities in the Delivery of Services to a Female Clientele', observes that, in societies where agricultural production is the mainstay of economic production, men and women do different things, have access to different resources and benefits, and play different roles in the production cycle. Furthermore, inter and intra- household decision-making processes on the allocation and use of these technological resources is also made along gender lines.[18] Consequently, access to new agricultural technologies is crucial, but gender gaps lead to gender inequalities in access, adoption and use across the region.[19]

In Africa, technological development is modeled and implemented everywhere, irrespective of their appropriateness to the environmental, cultural and economic context. Several studies reveal that, women's perspectives are rarely taken into consideration when technology is developed.[20] Evidence from Ghana suggests that gender-linked differences in the adoption of modern maize varieties and chemical fertilizer are not attributable to inherent characteristics of the technologies themselves but instead result from gender-linked differences in access to key inputs.[21] The Ghana study demonstrated that, wealth is particularly associated with adoption of new technology, because wealthier farmers are better able to bear the risk and thus, are more likely to try new technology. At the same time, women have greater difficulty than men in obtaining labor needed for land preparation activities. In rural Ghana, land ownership provides a good measure of wealth, and women tend to own smaller plots of land than men while greater proportion of women is landless. The study therefore concludes that, technology adoption decisions depend primarily on access to resources and if adoption depend on resources (land and labor) and if men tend to have better access than women, then in this context, the technology will not benefit women and men equally.

[18] Staudt, K.A.I. 1977. Inequalities in the Delivery of Services to a Female Clientele: Some Implications for Policy. Discussion Paper No 247, IDS, University of Nairobi.
[19] Ibid.
[20] The Gender Variable in Agricultural Technology http://www.atpsnet.org/Files/working_paper_series_38.pdf (accessed on 31/10/14)
[21] Ndiritu S.W., Kassie, M. and Shiferaw. B. 2014. Are there gender differences in the adoption of sustainable agricultural intensification practices? Evidence from Kenya; Morris, M.L. and Doss, C.R. 2001. How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. CIMMYT.

In their study, Morris and Doss (2001) noted that, despite women's active and continuous interaction with the environment as food producers, concern regarding women's technological knowledge on seed selection practices, pest and weed control measures, harvesting and food preservation technologies, women are hardly included in policy making and implementation. These omissions of the knowledge systems of a significant proportion of agricultural producers make it difficult to develop relevant techniques for rural farmers in the continent.[22] A daunting realization about agricultural technology in the developing world is that it is largely skewed to benefit men and that tasks performed by men such as land preparation, harvesting and processing are easiest to mechanize. For example tractors, combine harvester and processing factories attest to this fact. Women's tasks on the other hand remain labor intensive and time consuming. Furthermore, those female tasks, which are mechanized, often shift to male tasks.[23] Another point of consideration comes from the fact that the introduction of new technology either improves the quality of work for men or reduces their workloads, while increasing those of women.[24]

Based on simple comparisons and observations, evidence consistently suggests that male-headed households adopt new agricultural production technologies faster than female-headed households across the regions. These studies emphasize that while the gender of the farmer *per se* is not statistically significant, it is the differentiated access to education, fertilizers, extension services, credit and size of plot between women and men that mainly explain the observed slower adoption rate of technologies by women than men.[25] Doss strongly recommends the need to take into consideration the heterogeneity of women in assessing differences in access to complementary inputs that, often women in male-headed households are better off and command more resources and better quality land holdings than women in female-headed households. A study conducted by Potash also confirms that actively during farming older women may have

[22]. The Gender Variable in Agricultural Technology: A case of rural farmers in Machakos district – Eastern Kenya. http://www.atpsnet.org/Files/working_paper_series_38.pdf
[23] Ibid.
[24] Palmer, I. 1978. Women and Green Revolution. A Paper Presented to the Conference on the Continuing Subordination of Women in Development Process. Sussex Institute of Development Studies.
[25] Doss, 2001; Phiri *et al.*, 2004; Kakooza *et al.*, 2005; Jagger and Pender , 2006

more resources to draw upon to better respond to extension messages than their younger counterparts.[26]

The three reasons most commonly highlighted given the gender difference in technology adoption are: culturally-appropriateness; physically accessibility and; affordability. For example, value of farm tools owned between male-headed households and female-headed households are likely to be attributed to the relative affordability of these technologies, coupled with women's less income and asset holdings and less access to credit than men.[27] Women often lack cash to pay for fares or purchase transporting technologies. Rural transport services are often infrequent and expensive, and at times, harassment and safety are also a major concern for women travelling long distances alone.[28]

These factors, often limits mobility of women to interact with other producers, input suppliers, and buyers and also infringes on their opportunities to participate in meetings, trainings, extension services, that require travel. All these factors affect their decision and ability to adopt improved technologies and foster entrepreneurship. From another perspective, other studies have indicated that adoption of improved technologies has sometimes increased women's time burdens as additional and highly time-consuming tasks or processes are often required on the onset of these new technologies.[29] Other issues that may occur and affect the adoptions of technologies include the risk of shifting control over profit and assets from the female to the male domain generally will contribute to reluctance among women to adopt and use labour-saving technologies that increase profits or incomes if they themselves do not control these economic gains.

According to Ragasa, many of the studies on agricultural technology flag out the following as affecting adoption: the gender of the farmer or household head; accessibility to information or extension services about these technologies; liquidity; profitability and suitability and; socio-cultural factors.[30] Profitability from or suitability of technology (or lack thereof) is a major factor in non-adoption of many new improved technologies and reflects both supply and demand side issues. Limited adoption can reflect a number of factors including the lack of consultation

[26] Potash 1981
[27] Pender and Gebremedhin, 2006 on Ethiopia; Oladele and Monkhei, 2008 on Botswana
[28] World Bank, FAO and IFAD 2008
[29] Berio, 1984; Suda, 1996; Quisumbing and Pandolfelli, 2008
[30] Ragasa, 2012

among potential users/beneficiaries to identify their needs and preferences or socio-cultural constraints encompassing the various gender norms and social barriers women face in accessing and adopting new technology. Other studies highlight lack of access to information about the technology or the lack of required complementary knowledge and skills to use the technologies.[31] There are several reasons for example, why women are more likely to get less information or extension services or less likely to use or process the information received. Women often lack mobility, access to transport and funds for participation in meetings, training or demonstration plots. Women compared to men have less access to education opportunities and mass media and this are also factors that contribute to gender gaps in adoption of new technologies between women and men.

In Eastern Africa, few studies focus on the gender gap in technology adoption. According to a study conducted by Rugumamu, on post-harvest technologies and gender relations in maize loss reduction in Pangawe village, eastern Tanzania, findings from the study demonstrate that involvement of both men and women in the sensitive operations indicates that some gender relations concerns were appropriately addressed. In addition the only missing link in post-harvest maize loss reduction in all the phases is the availability of appropriate technologies.[32] A study carried out in Machakos District in Eastern Kenya on 'Gender variable in agricultural technology', illuminates women's perception and knowledge of agricultural technology, which has previously been unrecognized and unacknowledged. This was done by highlighting points of departure in gender differentiated technology, which may exist because of differences in environmental contexts, cultural and socio-economic value systems and ideologies. This suggests the need for their inclusion in the development of appropriate technologies for men and women in Kenya.[33]

Numerous studies, examine the gender differences in agricultural technology adoption in general. Given this wide variability and the limited available empirical research for many types of technologies, it is hard to generalize and develop typologies and patterns about why gender

[31] Doss *et al.,* 2003
[32]. Rugumamu, C.P. Department of Zoology and Wildlife Conservation, College of Natural and Applied Sciences, University of Dar es Salaam.
[33] The Gender Variable in Agricultural Technology: A Case of Rural Farmers in Machakos District-Eastern Kenya (available at: http://www.atpsnet.org/Files/working_paper_seies_38.pdf accessed on 21/3/2014)
[33] Ibid.

differences are evident or not in post-harvest technologies. However, there are some key insights and general lessons from these empirical studies reviewed. Hardly any literature that systematically provides a deeper understanding of gender roles and relations in grain post-harvest related activities is documented. All studies point to a mix of many gender-based factors that hinder agricultural technology adoption but none has analyzed comprehensively the gender gaps and root causes, bottlenecks, and binding constraints of grain post-harvest management and outcomes. This study aims to fill this knowledge gap, and to provide a comprehensive gender analysis that draws out, the gender relations in post-harvest activities in the context of EGSP, focusing on the metal silo.

3.0 Rationale for Gender Analysis Study

Addressing gender is crucial for reasons discussed in this section. Women and men play vital roles and are engaged in different activities across the maize value chain, from production to consumption including post-harvest management. National statistics provide evidence that women supply a large proportion of agricultural labor and in some regions in Kenya, they provide up to 80 percent of unpaid family labor to farm household. Rural women are the main producers of maize. Maize provides up to 90 percent of the food consumed by most rural and urban Kenyan population. Failure to recognize women's contribution to the maize sector is costly and results in misguided policies and programmes.[34] Women's contribution to the maize sector is both qualitatively and quantitatively invisible. Statistics on women's yield, post-harvest losses, and technology adoption rates are rarely reported. In the context of EGSP, this gender analysis study provides a better understanding of the different roles women play, household gender dynamics and socio-cultural factors that influence the adoption of post-harvest technologies (PHT) especially the metal silo.

Women and men manage complex post-harvest management systems, but in different ways, given their cultural context, social status and other influential factor resulting in different impact. These potentially differential effects of development interventions on women or men can often be masked or obscured. When gender is explicitly considered in such a study, the effects are

[34] World Bank, 2007

revealed and previously hidden implications become known. Gender analysis challenges the assumption that everyone is affected by the project in the same way regardless of their situation. A gender analysis study therefore presents a more accurate picture of the situation, for example, the actual intra-household relationship, the distribution and control over resources, roles and responsibilities between women, men and youth. Typically, these relationships lead to inequitable outcomes for men, women and youth. This gender analysis study will enhance the understanding of communities in which EGSP is being implemented and also improve staff capacity to develop effective strategies for post-harvest technology design, dissemination and adoption that fosters gender equality.

Similarly, the gender analysis highlights the fact that although men and women live in the same place, each will experience differently the economic, social, cultural, political and geographical environments around them. Different experiences impact differently on their respective capacities and priorities in relation to the use and the innovation of technology whether within enterprises or other activities. Relationships also exist between hierarchies of access, ownership and control; affect the ways in which technology is used and adopted and; how women and men perceive themselves in relation to their use and adoption.

Agricultural programmes including technology developments have several directions to take in the context of gender can either be: gender blind; gender specific and; gender neutral or gender re-distributive.[35] According to Kabeer, gender blind are policies or programmes that are often implicitly male biased while, gender neutral programmes do not address gender equality issues such as access to resource or division of labor and benefits going to women/men but leave everything intact. Kabeer urges re-thinking of agricultural practices by implementing gender sensitive policies or programmes with interventions intended to meet targeted needs of women or men (gender-specific needs); or implementing transformative interventions aimed at distributing resources and programme benefits in a more equalitarian direction (gender re-distribution).

She further explains that gender specific or gender re-distributive approaches create more balanced relationship between women and men and yield positive welfare outcomes especially for women. Additionally, the approaches helps the EGSP team understand the gender relations,

[35] Kabeer, 1994

experiences and preferences therefore there is a better chance of anticipating potential positive and negative impacts of the interventions for mitigation and; increase the possibilities of equalizing opportunities and filling the gender gaps among women, men and the youth. Consequently, the gender analysis aims at helping the EGSP team improve their level of gender awareness and reasons behind choosing and re-thinking specific approaches as either gender responsive or gender transformative in the context of grain PHM.

Kandiwa and Mugure (2013) outline how the gender analysis study will help the EGSP team.[36] First, the gender analysis will help the project team take women's perspectives in the design of the grain post-harvest technologies. For example, if the artisans understand preferences faced by women, men, youth, and the power relations affecting their activities in PHM of maize, the designs will address the different preferences, enhance the metal silo adoption and demand by the different groups and thereby expand their markets and profits. Second, the partial gender audit carried out creates gender awareness among the implementing EGSP partners on institutional gender capacity gaps identified and how to address them in terms gender responsive activities, budgeting and targeting different groups according to their priorities for gender equality outcomes. Third, this analysis is equally applicable, and probably more important, precisely for EGSP-II where women's roles and responsibilities are to be explicitly noted and addressed. Fourth, the gender analysis provides new empirical evidence and contribution to knowledge on gender and post-harvest, identifying knowledge gaps and how they can be addressed. Finally, based on the outcome of the gender analysis studies (Kenya, Malawi, Zambia and Zimbabwe) a common tailored strategy will be developed for use by EGSP as well as similar focused projects in attaining gender equality outcomes for post-harvest technology development, promotion and adoption.

4.0 Study Objectives

The objective of this study is to gain a deeper understanding than hitherto available of gender relations and roles in post-harvest management of grains, with particular reference to metal silos. Specifically, the study seeks to:

[36] Kandiwa, V. and Mugure, C. 2013. Gender Analysis Study for Maize Post-Harvest Management, Background Document.

(a) Provide a deeper understanding of how gender norms shape men and women's post-harvest practices and experiences across diverse maize farming contexts,

(b) Investigate how effective current technology development, promotion and dissemination approaches are in ensuring gender equality in adoption and impact,

(c) Identify knowledge gaps in the area of gender and post-harvest management,

(d) Inform the development of a gender equality strategy that guides the implementation of the post harvest management strategies that ensure equitable processes and outcomes for men and women farmers.

5.0 Research Questions

The above objectives lead to a set of research questions about gender relations and roles in post harvest grain management, which this study seeks to tackle in pursuit of its overall objective. These research questions are as follows:

(1) 1. (i) What roles do men, women, and youth play in grain post harvest management?

(2) (ii) In what ways do men, women, and youth as household members have both separate and joint activities, interests, rights, responsibilities and decision making power?

(3) (iii) In what ways do social and cultural norms determine individual's roles, rights, responsibilities and claims over other members of the household?

(4) (iv) What strategies do men, women, and youth use within households for grain and store management?

(5) (v) What bargaining goes on between men and women in the area of stored grain management, marketing and control over resources?

(6) (vi) What socio-cultural constraints do women and men in different household circumstances encounter in post harvest management?

(7) (vii) How does an improved storage technology such as metal silos alienate or empower men, women and youth who have either individual or pooled storage facilities within a household?

(8) (viii) In what ways do improved storage technologies such as metal silos meet men's, women's and youth's design needs and preferences?

(9) 2. What are the current approaches used by partners in technology design, development, and dissemination? How effective are these approaches in promoting gender equality? In what ways might these approaches be improved to promote gender equality at household level?

(10) 3. What gender knowledge gaps exist in the context/country of study?

4. What lessons can be drawn from this study to inform the development of a gender equality strategy for the implementation of post harvest management strategies for equitable processes and outcomes for men and women farmers.

6.0 Methodology

6.1 Conceptual Issues in Gender Analysis

Gender Analysis is a tool for examining the differences between the roles that women and men play, the different levels of power they hold their differing needs, constraints and opportunities, and the impact of these differences on their lives. In the context of development, it is intended as a tool to illuminate the links between the existing gender relations in a particular society and development problems it needs addressed. It identifies the types of gender differences and inequalities that might otherwise be taken for granted, such as how women and men have different access to resources, carry out different social roles, and face different constraints and receive different benefits. Once highlighted, they can be addressed and alleviated by carefully designing programmes.

The knowledge base explored in recent gender and development debates provides the conceptual rationale for several key principles, which in turn translate into tools and techniques for a gender

analysis. From the 70's after Boserup's[37] description of African farming systems and her analysis of women's role in agriculture inspired other scholars to begin to look at gender issues critically. The United Nations Decade for Women (1976–1985) played a crucial part in highlighting the important but often previously invisible role of women in the social and economic development. Researchers began to move away from a preoccupation with the role of women within the family and women's reproductive responsibilities, towards an understanding of the complexities of women's employment and their productive activities. Whitehead reaffirms that a focus on gender rather than women makes it critical to look not only at the category 'women' since that is only half the story but at women in relation to men, and the way in which relations between these categories are socially constructed. Men and women play different roles in society, with their gender differences shaped by ideological, historical, religious, ethnic, economic and cultural determinants.[38]

Over the period, several gender analysis tools and frameworks have been developed, and in this study we review and adopt some of these namely: the Harvard Analytical Framework; Moser Gender Planning Framework; Women's Empowerment Framework and Social Relations Approach.

a) The Harvard Analytical Framework

The Harvard Analytical Framework[39] makes an economic case for allocating resources to women as well as men. The framework aims to assist planners to design more efficient projects especially those that are agricultural or rural based. It is designed for collecting data at individual and household (micro) levels. Data is collected on men's and women's activities which are identified either as 'reproductive' or 'productive' types, and is then considered according to how those activities reflect access and control over income and resources, thereby highlighting the incentives and constraints under which women and men work. This helps in anticipating how projects will affect their productive and reproductive activities as well as the responsibilities of other household members. The four components of the framework: the activity profiler, access and control profile, influencing factors and project cycle analysis are useful in analysing the

[37] Boserup 1970, The Role of Women in Economic Development
[38] Whitehead, 1979.
[39] Overholt, C. MAnderson, K. Cloud, and Austine, J. 1985 Gender Roles in Development Projects: Cases of Planners. West Hartford, CT: Kumarian Press

post-harvest issues at the household and community levels. In the context of PHM, the activity profile is used to ask the question, who does what? Who has access and control over resources and who benefits (i.e. land, equipment, and capital)? Which are the factors (political, economic, cultural) past and present that determine the gender differences? Where are the opportunities and constraints for women, men, and male/female youth? The limitations of the Harvard Framework are: it emphasizes on gender awareness and offers little guidance on how to identify the causes of gender inequalities; it assumes that having sex disaggregated data on its own will allow practitioners to address gender concerns and; finally it does not involve informants in describing their own views and experiences.

b) The Gender Analysis Framework

The Gender Analysis Framework[40] was developed by Caroline Moser introduces the idea of women's three roles and the implication that these roles have on women's participation in the development process. These are productive roles (e.g. farming, employment, self-employment etc) often carried out alongside reproductive work; reproductive work (e.g. bearing and caring for children, food preparation, water and fuel collection family health care etc). Reproductive roles are often less visible for women and less valued by men. The third role is the, community management (e.g. ceremonies, celebrations, community improvement activities, participation in groups, organizations, and political activities etc) usually done involuntarily and therefore unpaid.

Moser's framework also distinguishes between practical gender needs and Strategic gender needs. The practical gender needs are immediately perceived needs arising from concrete conditions for example, clean water, health care, food production. The strategic gender needs are long term conditions that challenge the nature of the gendered relationship between women and men and leads to transformation of gender relations such as division of labor or access to resources. Both the practical and strategic gender needs of women differ from men's because of their different tasks and responsibilities and because of their different positions in society. The three levels of analyses the (productive, reproductive and community) and the strategic and practical needs of women and men are applied in this analysis. Nevertheless, Moser's framework

[40] Moser, C. 1993. Gender Planning and Development, Theory, Practice and Training. London: Routledge

does not mention other forms of inequalities such as age, class and ethnicity. In this study the gender relationships are analyzed within the context of the different: ethnic communities; age groups of adult women/men and male/female youth and; different social status given the adoption of the metal silo.

c) Women's Empowerment Framework

Women's Empowerment Framework[41] developed by Sara Hlupekile Longwe aims to achieve equal control over factors of production and to participate equally in the development process. The framework puts forward five hierarchical levels of equality that can be achieved: i) Control (equal control over decision-making over factors of production); ii) participation (equal participation in decision-making processes related to policy-making, planning and administration); iii) conscientisation (attaining equal understanding of gender roles and gender division of labor that is fair and agreeable); iv) access (equal access to factors of production by removing discriminatory provisions of the laws) and; v) welfare (having equal access to material welfare (food, income, medical care). The tool also examines project design and how it affects the above five different levels of equality; either negatively, neutrally or positively.

The notion of practical and strategic gender needs into a progressive hierarchy is found to be innovative by showing empowerment as an essential element of development and a strong political perspective, aimed at changing attitudes is vital, and is applied in our analysis. Levels of control, gender awareness, access and welfare are examined. All the same, given the limitations of this framework, we do not assume that the pathway to empowerment is static as presented in Longwe's framework but dynamic.[42]

d) **Social Relations Approach**

Social Relations Approach[43] developed by Naila Kabeer (1994) aims to analyze gender inequalities in the distribution of resources, responsibilities and power locating the family and household within the network of social relations by linking them to the community, market and state. Her approach has five essential concepts. First, development should not only be seen in

[41] Sara Longwe Empowerment Framework
[42] Okali, C. 2012 Gender Analysis: Engaging with Rural Development and Agricultural Policy Processes. Working Paper 026 Future Agricultures. www. future.riculture.org
[43] Kabeer, Naila. 1994 Reversed Realities: Gender Hierarchies in Development Though, London, UK Verso

the context of economic growth alone but also as an increase in human well-being with core elements as survival, security and autonomy. Second, that social relation determines people's roles, responsibilities, claims, rights and control differentiated according to class, ethnicity and race and also change over time. Third, that institutions (state, market, community and family) produce and maintain social inequalities, including gender inequalities and that these institutions have rules (how things are done); resources (what is used and produced); people (who is in/out, who does what); activities (what is done) and; power (who decides and whose interest are served) all of which are gender- based. Fourth, that gender policies differ according to how they reflect gender issues and can be classified as gender-blind, gender aware, gender-neutral, and gender-specific or gender distributive. Fifth, researchers should investigate underlying factors or structural factors responsible for the problems and their effects on those involved.

Kabeer's social relations approach provides a basis for linking the metal silo technology to adoption and use at the household level and; how gender awareness informs market segmentation, design, promotion and post-sales support. In the partial-audit conducted with EGSP partner organization, it was possible to assess whether gender was addressed as a central agenda in the programmes or simply added-on. Social relations approach has facilitated both the data collection and the analysis of how gender relations operate given the different dimensions of social life across various forms of inequalities, across gender, ethnicity and social status. It has further helped in identifying, which women, which men, and which youth and in what socio-cultural context. Finally, identified are the gender–specific structural and institutional constraints and the relative status and opportunities open to women, men and the youth in EGSP phase II. The framework is dynamic, allowing for the assessment of human agency whether; families are making incomes from the technology and; whether household well-being is enhanced.[44]

The social relations framework by Christine Okali urges researchers to step outside conventional understanding of the problem and to engage with the complex realities of social relations starting with sex disaggregated data but clearly identifying which women and men one is talking about and in what circumstances. According to Okali (2012) it is important to understand the following key principles already put forward: that gender relations are dynamic; women and men are heterogeneous social grouping with multiple identities (as spouses, siblings, parents and so on)

[44] Okali Christine

and that; social relations of different kinds: gender, class, marital status, age- often act together given the gender relations in production and reproduction.[45] She reinforces the need to shift attention away from households and marital relations to other institutional sites where limited research was undertaken to date but where change is already being debated about such as agricultural technology innovations, communications, extension and advisory services. Okali (2012) also argues that this provides an important window of opportunity for next strategies in agricultural projects.

Keeping in mind all the other Gender Analysis Frameworks from which we have selectively adopted; Kabeer and Okali's 'Social Relations Frameworks' provides a basis of our analysis. This is because there is need to understand the dynamic nature of gender relations and how these relates to social marginalisation linking micro and macro level factors; the interaction between forms of inequality and; processes of empowerment in the context of post-harvest management of grain. These frameworks further allow for analysis of different categories of men, women and youth given the roles they play, the strategies they use, constraints they experience, and how they derive benefits from the maize post-harvest management and storage technologies given the different communities in which they live.

We also take-on Agarwal[46] bargaining approach and conceptualisation of the household family as a complex matrix of relationships in which there is ongoing negotiation (often hidden), subject to the constraints set by gender, age and type of relationship. Agarwal submits that household members cooperate in as far as cooperation arrangements make each of them better off than the non-cooperation - that one's persons gain is another person's loss. As such the underlying conflict between those cooperating and that the relative bargaining power of the household member in particular the strength of the of the person's fallback position and how well of she/he will be if the cooperation ceased. This allows for examining application of a bargaining perspective involving cooperation and conflict and the notion of a fall-back position characterises intra-household dynamics in contrast to simplistic representation of unitary households. Possibilities exist for critically examine the adoption of metal silos and its effects on

[45] Okali Christine, 2012
[46] Agrarwal, Bina. 1994. A field of one's Own – Gender and Land Rights in South Asia. Cambridge University Press.

households and whether members cooperate or bargain to achieve welfare outcomes for themselves and their families.

6.2 Study Context and Selection of Study Sites

In Kenya, the EGSP project was implemented in Embu and Homa-Bay in Phase I (2008-2010) and Phase II in Nakuru and Naivasha. This research was therefore carried out in three areas: Nakuru, Naivasha and Embu for the following reasons:

- In the second phase of EGSP, CIMMYT collaborates with the agricultural department of Caritas Nakuru for project implementation at community level including promotion and awareness creation (which began in 2013). CIMMYT also is in partnership with the Kenya Agricultural and Livestock Research Organization (KARLO) formerly known as Kenya Agricultural Research Institute (KARI) to tests the effectiveness of alternative storage technologies.[47] The aim of this second phase of EGSP seeks to provide equal opportunity to both women and men to participate and benefit from the intervention. Nakuru and Naivasha were therefore selected first, because CIMMYT is already implementing the project in the two areas. Second, because it was an appropriate time to carry out a gender analysis at this early stage of the project implementation in order to understand the gender norms that shapes women's and men's post-harvest practices and experiences and also to identify the gender knowledge gaps,

- Since EGSP-I was implemented in Embu and Homa-Bay for the last 14 years, Embu was selected to assess how gender equality was addressed in the technology development, promotion, dissemination and adoption. In addition it was selected to identify lessons that can be learned to inform the EGSP phase II in creating equal opportunity for women and men. It was considered that findings from Embu, EGSP phase I and Nakuru and Naivasha EGSP phase II will enrich the development a gender equality strategy that will guide the implementation of the second phase to ensure equitable processes and outcomes for women and men. Again Embu's proximity to Nakuru and Naivasha enabled the research team to maximise on the available resources and time. Homa-Bay however is not in close proximity to Nakuru and Naivasha.

[47] Effective Grain Storage Project (EGSP) Phase II – Background Document

6.2.1 Selected study sites

The three selected studies sites in Kenya were:

a) ***Nakuru County*** (formerly Nakuru district) is located in the South Eastern part of Rift Valley, and borders seven counties with Baringo to the north, Laikipia to the north east, Nyandarua to the east, Kajiado to the south, Narok to the south west with Bomet and Kericho to the west. Nakuru constitutes 4 sub-counties: Nakuru town, Nakuru North, Naivasha and Molo. Nakuru is home to a population of around 1.6 million, living on some 7,495 square kilometers in the central part of the country. The population is very diverse, with residents that have migratory background from different parts of the country. According to 2002 government statistics, with a population total of 1.3 million, 56 percent of the total comprises of the youth who are up to age 25.

Temperatures range from minimum of between 120 Celsius to a maximum of 260 Celsius. Rainfall ranges from 1,800 millimeters to 2,000 millimeters per annum with the wettest season during April and May. The entire Nakuru County is engaged in agricultural activities. Agriculture contributes 48 percent of income. The main storage facilities of include the National Cereals Produce Boards' stores and silos with a combined capacity of over 220,000 tonnes. Nakuru County has become one of the breadbaskets of the country.

b) ***Naivasha*** is one of the sub-Counties of Nakuru and is mostly dominated by a semi-arid environment in the lower catchment and has only a narrow semi-humid zone in the upper catchment. The rainfall is bimodal and is distributed between two rainy seasons in April to June (long rains) and October to November (short rains). There are 28 urban settlements in the Basin with population ranging between 5 000 and 50 000. The five largest divisions in population size in the basin are: Hells Gate (64 000), Gilgil (45 000), Engineer (45 000), Naivasha Town (45 000), Kinangop North (40 000) and Ndundori (35 000) (WWF, 2011). This study was carried out around the Lake Naivasha basin around Hells Gate division.

c) Embu County is located in Eastern part of Kenya and borders the following Counties: Tharaka Nithi to the North, Kitui to the East, Machakos to the South, Muranga to the South

West, Kirinyaga to the West, and Meru to the North West. It is composed 2 sub-Counties (Embu, and Mbeere). The County has a population of 516,212 people (men are 49 percent and women are 51 percent of the total population) and covers an area of 2,818 Square kilometers. The major ethnic communities in the County are the Embu, Mbeere and the Kamba. There are also found other cosmopolitan ethnic communities especially in the urban centres of the County. The main agricultural products are, maize, beans, yams, cassava, millet, sorghum, bananas and livestock products

6.3 Data Collection Tools and Respondents Selection

Four sets of data collection tools were developed by the research team (Kenya, Malawi, Zambia and Zimbabwe) together with CIMMYT and used to conduct key informant interviews, focus group discussions, artisans interviews, case profiling and to carry out partial gender audit of EGSP partners. The respondents were purposively sampled taking into consideration the following factors: adoption or exposure to new technologies; ethnicity; gender; leadership position in the community and; age categories. Specifically, other considerations included:

- Communities exposed/adopted storage technologies in Embu,
- Communities still using traditional storage technologies but recently adopted the new storage technologies (in Nakuru, Naivasha andEmbu),
- Trained metal silos from which 16 (from the 58 earlier trained countrywide) [48] artisans were selected from Embu,
- Ethnic composition of project sites and their socio-cultural settings (annex 14.1 and 14.2).

6.3.1 Focus Group Discussions (FGD)

The FGD groups were composed of: a family unit (wife and husband); women from polygamous unions; widows; single-headed household; elderly women; female-headed households; male-headed households and; female youth and male youth. Communities provided information expressing their views, experiences and knowledge about cultural practices, agriculture and focused on post-harvest losses, gender roles in PHM and gender preferences for new post-harvest storage technologies. An interview guide for sex disaggregated focus group discussions was used to guide discussions with sex disaggregated groups consisting of: women only; men only and;

[48] Economic Survey Data, 2010

female youth only and male youth only. The interview guide solicited community feedback around several themes which included: cropping systems; post-harvest storage practices; roles of men, women, and youth in post-harvest management; improved storage technology; knowledge on and preferences of improved storage technologies; access to and ownership and; strategies for storage of other grain as well as overall food security strategies in the study areas.

Focus group discussions were convened in Nakuru and Naivasha and comprised of; not less than 6-8 men and women from male-headed households, female-headed households and also male and female youth (age 15-25). The sex disaggregated groups comprised of; individuals from nuclear, polygamous, single headed or other category of households and further balanced in terms of socio-economic background. Ethnicity was also taken into consideration (table 1). Therefore in the three study sites:

- In Nakuru, 6 FGDs (2 women only; 2 men/women combined; 1 female youth and; 1 combined female/male youth) were convened in Nakuru Central, Kamuchwa, Kaimayi and Rongai areas (table 1),
- In Naivasha, 7 FGDs (2 combined women and men; 1 combined female/male youth; 1 women only; 1 men only; 1 combined women and female youth; and 1 combined men and male youth) were held at Sero, and Tangi Tatu (table 1),
- In total, 13 FGDs were held in (6 in Nakuru area and 7 Naivasha areas) (table 1).

Table 1: FGD by ethnicity and place (Nakuru and Naivasha)

Focus Group Discussion	**Ethnicity**	**Type of Group FDG**	**Place**
Nakuru			
1.Female Youth	Agikuyu	Female Segregated	Nakuru Central
2.Women	Agikuyu	Female Segregated	Nakuru Central
3.Women/Men	Agikuyu	Combined F/M	Kamuchwa
4. Women	Luo/Luhyia	Female Segregated	Kaimunyi
5. Male/Female Youth	Kisii	Combined F/M	Kapkures - Umoja

6. Women/Men	Kalenjin	Combined F/M	Rongai
Naivasha			
1.Women/Men	Agikuyu	Combined F/M	Sero
2.Female/Male Youth	Agikuyu	Combined F/M Youth	Sero
3.Women	Agikuyu	Female Segregated	Sero
4. Men	Agikuyu	Male Segregated	Sero
5. Women/Men	Maasai	Combined F/M	Tangi Tatu
6. Men/ Male Youth	Maasai	Combined M/M-Youth	Tangi Tatu
7.Women/Female Youth	Maasai	Combined M/M-Youth	Tangi Tatu

During FGD meetings, the research team went to a specific area occupied by a certain community where meetings were arranged for a combined group, thereafter the groups were split or segregated into women only, men only, female youth only and male youth only for further discussions. The research team was composed of three individuals a woman, a man, and a female youth and each held discussions with the segregated groups. For instance, the woman researcher facilitated the FGD with women; the man with the men's FGD and; the young woman with the youth FGD. This was primarily done to ensure that all participants freely participated in the discussion and to get better understanding of the nuances not covered in the combined FGD. Moreover, sex disaggregated focus groups provide the in-depth information on the following: better insight into specific cultural dimensions and their diversities; changes associated with new technologies and; whether these technologies are affecting social relations or individual members of the household in terms of gains or lose. A minimum of 2 FGDs were held per day and this was meant to ensure ample time was dedicated to interrogate the gender issues extensively.

6.3.2 Key Informant Interviews

In consultation with EGSP partners, key informants were selected, given that they are conversant with gender, agricultural systems, and have an overview of post-harvest management issues in

the area. A participatory appraisal was used to gain in-depth perspectives on gender and post-harvest management. The sampling approach was informed by the following considerations:

i) Metal silo household adopters from 2011; new adopters from 2013 and; drop-outs from the use of silos in Embu (after determining their locations in consultation with the artisans);

ii) Local extension persons (minimum 2 women and 2 men per area) and local leaders (minimum 4 women and 4 men per area) equally interviewed;

iii) 16 artisans including those who are doing well and those not doing well and;

iv) Implementing partners (staff directly involved in EGSP) involved in on-farm technology testing as well as promotion and dissemination of information.

In total, 60 key informants were interviewed (table 2). The interviews were carried out in:

- **Embu**- Embu town at KARI; Kanyambuora– Soko Mjinga; Kanyambuora Market; Kithimu Market; Kithimu Kamathatha; Gachiche; Riakamu- Ngingini; and Riakanau–Kilia,
- **Nakuru**- Nakuru Central, Kamuchwa, Kaimayi and Rongai,
- **Naivasha**- Naivasha town**,** Sero, and Tangi Tatu.

Table 2: Key informants interviewed in Nakuru and Naivasha by gender

Town	Gender	No Interviewed
Nakuru	Male	8
	Female	6
Naivasha	Male	8
	Female	7
Embu	Male-Adopters	7
	Female-Adopters	8
	Male Artisans	16
	Female Artisans	0
Total		**60**

The main goal of interviewing these key informants was to have a general overview and in-depth understanding and cultural perspectives in agriculture, PHM and gender roles; gender and technology adoption, ownership and management of technologies; technology preferences;

access to information; effectiveness of the improved post-harvest technologies; their opinions and what they recommend as most desirable attributes of technologies in the community.

6.3.3 Artisan Interview

A tool was developed to guide in-depth conversations with metal silo artisans to understand the following: artisan's knowledge on gender relations in storage at household level; how gender awareness informs market segmentation; design; promotion; post-sales support and vision for business growth and; their gender capacities. The artisans interview guide covered: the historical profile of metal fabrication business; overview of metal silo fabrication business; marketing strategies and promotion for metal silos; identification and profile of past buyers; post-sales support; perceptions of constraints faced by men, women, and youth in adoption of metal silos; perceptions, attitudes, and views on gender and post-harvest management and; knowledge, education and relevant training needed and gaps.

In Kenya, there are 58 trained metal silo artisans recorded and the recorded information also provides artisans geographical location.[49] In order to determine the total number of artisans to interview, a sampling with probability proportional to size approach was employed in order to select the number of artisans in Embu for in-depth interviews. A sample technique adopted by CIMMYT yielded the following sample size for artisans Kenya to be twenty (20) in number. In this sample consideration was further given to those who are doing well; those who are not doing well and; female artisans. [50] It is important to note that, there were no women artisans trained in Embu, so in total 16 male artisans were sampled and interviewed in-depth and profiled as case studies (table 2).

The interviews were participatory and aimed gaining in-depth understanding of factors that: drive the success for artisans; whether they are better able to target their market, including women and youth; insights into commitments of the artisans towards gender aware business development; strategies for technology promotion and awareness among women, men and the youth and; gender knowledge gap in post-harvest management. This approach was guided by

[49] Kenyan Economic Survey Data 2011 updated by CIMMYT 2013
[50] Kandiwa and Mugure, 2013.

the hypothesis that gender sensitive artisans can expand their market share and profit while ensuring equitable impact at household and community levels.[51]

6.3.4 Case Study Profiling

Case study profiling tool was administered to households who had adopted metal silos in Embu, for a relatively longer time within their locale. It enabled documentation on the following; traditional storage practices, gender roles associated with those, and desirable characteristics, and how things may have changed or remained the same over time in terms of access to and control over stored grain. Case profiling also included who owns what assets: household; livestock and; land assets. Questions on the following were asked: cropping systems and post-harvest loss assessment; history and profile of traditional post harvest management system and gender roles; metal silos and super grain bags and gender roles and; intra-household storage practices, design preferences, marketing, and access to information. Additional insight was gained on: changes brought about by the new technology; how this has affected social gender relations in the households; the acceptability of the improved technologies and how these meet the needs of individual and households and; who has most benefited.

Case profiling was only carried out in Embu since the EGSP was implemented in that area for a longer time (14 years). The artisans provided lists of households that adopted improved storage technologies. These lists become the sampling frames from which the gender expert purposively selected household case studies to document 'successes versus 'failures' cases. In total, 16 cases of adopters (8 women and 7 men) were profiled.

6.3.5 Gender Audit

In Kenya the EGSP partners are: Catholic Diocese of Nakuru and Kenya Agricultural and Livestock Research Organization (KARLO). A partial gender audit of agriculture program of Caritas of Nakuru was conducted to assess their involvement in the implementation of EGSP activities within communities. The audit covered: organizational profile; gender integration in EGSP activities; institutional policies, programs, and tools being used to create gender equality; and individual staff knowledge, experience, and attitude on gender responsive programming.

[51] Ibid.

Through the use of semi-structured questionnaire staff directly involved with project was interviewed to investigate the following:

i) How gender is taken into consideration in EGSP programme planning, design, budgeting and implementation guidelines available to help integrate gender;
ii) Financial resources available for implementing gender related activities;
iii) Institutional capacity for mainstreaming gender;
iv) Gender specialists and capacity of staff to integrate gender in their work;
v) Organisational culture and attitudes to gender, attention and seriousness given to gender in the organisation and;
vi) What lessons can be learnt from the institutions with respect to gender integration?

6.3 Organization and Implementation of the Field Work

The team of researchers were composed of: the Lead Consultant and 2 researchers (one young male and one young female). The Lead consultant provided the theoretical and methodology guidance of the whole study and at the same time trained the researchers on gender analysis approaches. Field work was started in Nakuru (10^{th} to 15^{th} March 2014), proceeded to Naivasha (13^{th} to20^{th} March) and thereafter to Embu (1^{st} to 5^{th} April 2014). In Nakuru, two male extension field officers from Agriculture Program of Caritas of Nakuru joined the research team, altogether forming a 5 member team. In Naivasha the research team was joined by 2 field officers (a woman and a man). In Embu the team was joined by 1 woman extension officer from Caritas Embu. The field officers mainly helped the researchers in selecting the respondents (purposely sampled) and in the organisation with the communities to participate in focus group discussions.

In Nakuru and Naivasha, the research team organized, FGDs with men only were facilitated by the male researcher and FGDs with women only was facilitated either by the woman lead consultant or the young female researches and this also applied to FGDs for young women and young men. In Embu, the extension officer helped to identify the trained artisans and household adopters of metal silo who were spread all over in the different areas. The artisans together with the extension officer further helped in identification of the metal silos household adopters.

6.5 Research Limitation

Generally, few challenges were experienced during fieldwork. Most of the logistics were organised in consultation with CIMMYT who had earlier carried a survey (2012) in the study areas. Nevertheless, in Naivasha, the communities are often given substantial financial handouts especially in workshops organised by NGOs. When the communities heard that there were focused group discussions, they thought that they were being mobilised to attend a workshop and therefore they turned out in great number hoping to receive some money. This expectation was not met, as the team was only able to buy them refreshments.

Embu is one of the largest counties in Kenya and therefore it was a challenge identifying geographical locations of the artisans and the metal silo adopters. The participation of the Caritas field staff and the key informed artisans helped in addressing some of these challenges.

7.0 Cultural Context, Agricultural Farming Systems and Gender Roles

7.1 Introduction

A gender analysis is made of the cultural context in which farming systems takes place in the context of the different farming communities living in Nakuru and Naivasha. The section describes patriarchal marriage systems practiced by most Kenyan communities and women's roles and status under these arrangements. Further analysis is made of types of households within the study area in regards to whether they are female-headed households (FHHs) or male-headed households (MHHs) and the different gender relations within them. Insights from FGDs and perspectives from key informants bring out the salient gender elements in post-harvest management of grain. In addition, details of what are aspects are involved in post-harvest management of maize and what has changed or not changed is presented.

7.2 Cultural and Gender Practices in the Community

Nakuru County is home to 1, 603, 325 people (male 50.2 percent and female 49.8 percent represent of the total population), according to the 2009 National Census.[52] It is a cosmopolitan County, with its population originating from all the major communities of Kenya. The Kikuyu

[52] KNBS Census Report 2009

and the Kalenjin (ethnic groups) are the dominant communities in Nakuru. Other communities such as the Luo, Luhyia, Kamba, Meru and Kisii (ethnic groups) are also present in the county. The Agikuyu have mostly settled on the eastern side of Nakuru, the Luo's, Luhyia's and Kisii's in the central parts (Kiamunyi and Kapkures) and the Kalenjins on the western side (Rongai). The population of these communities at the study areas was estimated by respondents as follows: the Agikuyu 60 percent; Kalenjin 20 percent; Kisii's 10 percent; and the Luo's and Luhyia's 5 percent each. Thus, most farmers in Nakuru are the Agikuyu while the Luo and Luhyia are the fewest in numbers. The ethnic diversity of Nakuru County provided a perfect opportunity to carry out a gender analysis taking into consideration the different cultural context of the respondents.

It is estimated by the respondents in Nakuru, that households headed by older people, most of them are male headed (ranging between 85 to 90 percent) widows make up less than 10 percent. Children-headed households are rare since most orphans remain under the care of their grandparents and/or relatives. The study sites in Naivasha are composed of a settler population of the Agikuyu, Maasai and Kalenjins given land by the government at the former Agricultural Development Centres (ADC), after the 1992 and 2008 post-election violence in Kenya. The Agikuyu are the largest ethnic community in Naivasha estimated at 55 percent, mainly settled in Moi Dambi phase I (Sero), followed by the Maasai and Kalenjin both population estimated at 20 percent each, and settled at phase II and III (Tangi-Tatu and Kipkonyo) respectively. Other minority groups in the area include the Borana, Turkana, Samburu, Luo and Luhyia with a total population estimated at 5 percent and are settled in phases IV of the settlement scheme. Households in the settlement area are generally, male-headed households (60 percent), female-headed households (35 percent) with most of them widowed and a few male spouses employed elsewhere. Children-headed households are estimated at only 5 percent in the area.

Family systems in all the communities in Kenya are mainly patriarchal; therefore men hold primary power, predominate in roles of political leadership, moral authority, social privilege and control of property and in the domain of the family, fathers or father figures hold authority over women and children. This also implies that, traditional institutions are male dominated and entails female subordination while, property and titles are inherited by the male lineage. For example among the Maasai, the father is the key figure in the patriarchal family, and,

theoretically, his control is absolute and subject only to interference by close senior elders in situations of crisis. Traditionally, as long as the father is alive, no son had final control over his cattle nor over his choice in marriage; this is still the norm in pastoral areas. In practice, as they age, older men rely on their sons to take over the management of the family, and it is the subservience of women that is the most permanent feature of the Maasai family. After her husband's death, even a forceful widow is subordinate to her sons in the management of her herd, and she finds herself wholly unprotected if she has no sons.[53]

Since marriages are patriarchal, a married woman is expected to move and join the man's clan/family, and most of the time dowry is paid to the family of the woman as a token of appreciation for loss of membership to her natal clan. The marriage institution is perceived as the widening kinship network of the individual through procreation in which relatives by marriage (affinal) are acquired in addition to blood relatives (consaguineal kin). Families are made of a wide network of members, including, brothers, sisters, parents, grandparents, uncles, aunts, cousins, in-laws, unborn children, and deceased relatives. The wide network of family members functions as a social unit within prescribed norms and beliefs and as an economic unit for the survival of its members.

The socio-cultural backgrounds reflect some of the conclusion reached in this study. For instance, socially constructed gender roles remain patriarchal and therefore, generally similar among the different ethnic communities. Men have control over the ownership of resources while women and youth have secondary access rights. On the farm, men generally make decisions about the sale of produce, storage and money that accrue from the sale. In most of the male-headed households, men generally provide the money for buying farm inputs. Women on the other hand, provide the labour that goes into planting, weeding, harvesting and storing and at the same time are responsible for home care work. The male youth on the other hand tend only to get involved in farming when paid directly as paid labourers- carrying out tasks such as cutting maize stalks, transporting the maize from the fields or using shelling machine.

Women's roles vary considerably between and within regions in Kenya and are changing rapidly in many parts of the country, where economic and social forces are transforming the agricultural

[53] http://www.everyculture.com/Africa-Middle-East/Maasai-Marriage-and-Family.html (accessed 5/11/14)

sector. Rural women often manage complex households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals, processing and preparing food, working for wages in agricultural or other rural enterprises, collecting fuel and water, engaging in trade and marketing, caring for family members and maintaining their homes. Many of these activities are not defined as "economically active employment" in national accounts but they are essential to the well-being of rural households. By examining the intra-household relationships, such as possibilities to bargain, agree or disagree and in-depth understanding of behaviors and possible incentives in the post-harvest activities.

Farming roles have changed over the years. In the past, post-harvest activities such as cutting down the maize stalks, transporting the maize to the homestead, shelling the maize and storing were carried out by men and male youth. Women performed tasks such as drying the maize, winnowing and packing it for storage. However, these roles have greatly changed due to various factors including: men migrating from homes to towns to seek employment; households not depending on farming as the only source of livelihood; breakdown of social support structures and; lack of interest in farming especially among the youth. Consequently, women are doing most of the farm work or sometimes use hired labor to help them perform difficult tasks if they can afford it.

The Agikuyu women in Nakuru reported that they mostly do farm work on their own. However in cases when women are denied control over the farm produce by their spouses, they hire other plots away from their family farms to till and make independent choices with regard what to store or sell. Kisii and Kalenjin women reported that even though they do most of the farm work, total control of the produce and the resources that accrue from it is in the hands of their male spouses. Alcoholism is reported as a big challenge among men and male youth in Nakuru area. Money from the sale of farm produce is sometimes used to buy alcohol leading to one of the key causes of food insecurity in households. Few Luo's and Luhyia's settlers in the area and are engaged in very small-scale farming with the women offering most of the labour while their men are employed outside the farms in Nakuru town.

In Naivasha, women do the farming while men are responsible for marketing the produce. All members of the household enjoy the money from the maize sales; men, women and children in

terms of buying new clothes, food and paying school fees, but the men have an upper hand in determining how money is spent. The Kalenjin and Akamba women stated that they do not take care of the livestock or milk them as this is the reserve of men but they do the housework and farming with the help of their children and hired labor. The Kalenjin and Agikuyu men reported that, often they assist their wives with menial tasks around the house and in the farms like fetching water using a bicycle or donkey and ferrying goods every once in a while. The Agikuyu and Maasai women on the other hand do all the housework, do all the farming activities and also take care of the livestock and milk them. The Maasai women also construct their own houses. It is only until their children grow up that the Maasai women get some assistance from the children in their daily tasks. The Maasai men reported that they do not farm tend or milk the livestock but 'supervise' the women and children as they perform these tasks. Some Maasai women reported that they are only respected in their marital homes once they have borne male children who are heirs to the homes, the land and livestock once their fathers are not around.

It is important to note that these roles and responsibilities are passed down from generation to generation-through socialization and people do not dispute them but rather conform to them. Most women especially the Agikuyu and Maasai expressed dissatisfaction with the negative cultural setting because a lot of burden is placed on them with little or no rewards. To mitigate this, some of the women have gotten employment outside their homes, started alternative businesses or joined women groups (*chama*) where they benefit by being empowered and getting useful information. In the FGD women acknowledged that, the most effective mechanism in changing some of these roles is the use of new farming technologies. With the introduction of new technologies, men have easily adopted them enabling them to get more and more involved and interested in farming. Men are taking up responsibilities that they may not have done in the past such as winnowing and shelling using the shelling machines, transporting farm produce to homes using wheelbarrows or tractors, owning and storing maize in the metal silos, simply because they are being done using technologies.

7.3 Agriculture and Farming Systems and Post Harvest Losses

7.3.1 Agricultural Sector

The Kenyan agricultural sector comprises six major sub-sectors, namely, i) industrial crops, ii) food crops, iii) horticulture, iv) livestock, v) fisheries and vi) forestry. Although less than eight per cent of Kenya's land is under cultivation, agriculture in Kenya is the most important economic activity. About 80 percent of Kenya's work force engages in agriculture or food processing. Farming in Kenya is typically carried out by smallholder producers who usually cultivate not more than five acres of land using limited technology. These small farms are operated by about three million families and account for 75 percent of total production.

Kenyan food crop commodities play a major role in income generation, employment creation and earning foreign exchange expenditure through international trade. Food crops are classified as follows: cereals (maize, wheat, sorghum, rice, millet); pulses/legumes (beans, pigeon peas, cowpeas, chick- peas, green grams, dolichos); and tubers (sweet potatoes, iris potatoes, cassava, arrow- roots and yams). The main food crops out of this classification are maize, rice, wheat, sorghum, potatoes, cassava, vegetables and beans.[54] On the other hand, major agricultural cash crops are tea, coffee, horticulture, maize, wheat, sugarcane, daily products, cotton, sisal, pyrethrum and cashew nuts. Fruits and vegetables are other key exports.[55]

Maize is Kenya's main staple food and 75 percent of the maize in the country is produced by small-scale farmers and the balance 25 percent by the large-scale farmers. Thus, maize has always been taken to be synonymous with household and national food security. It provides daily food calorie uptake to over 30 percent of Kenyans and is the country's most frequently produced and marketed crop. Kenya's low-income earners spend about 28 percent of their revenue on maize. It is produced by over 90 percent of national households in areas where it is grown. About 30 percent of all producers sell part of their produce.[56] Maize may be consumed fresh, ground, boiled or mixed with other foods such as beans. It is eaten in form of grain, processed to offer various product ranges which includes maize flour, maize meal that used for making the Kenya's common meal *ugali* and porridge, and is sometimes fermented to produce alcohol to make local beer.

[54] GOK Agricultural Sector Development Strategy 2009-2020
[55] http://www.kari.org/node/39 (accessed on 5/11/14)
[56] Ibid.

Since maize is adoptable to a whole range of climate conditions, it is the single most extensively grown crop. However, the chief growing areas are Trans Nzoia, Nakuru, Bungoma, and Uasin Gishu Counties. In Nyanza, other parts of the Rift Valley and Western Province, maize is grown alongside other subsistence crops like beans, potatoes and bananas. While the majority of households grow maize primarily for household consumption, a significant proportion, especially in the main producing depends on the crop for cash income. Given the supply situation, small-scale producer households on average retain about 30-50 percent of total annual harvest for home consumption while the balance is marketed with the proportion depending on the perceived supply-demand situation and prevailing household cash needs.

7.3.2 Crop Farming in Nakuru, Naivasha and Embu

The most common crops grown in Nakuru are maize, beans, sweet potatoes, Irish potatoes, tomatoes, carrots, cabbages, kales and banana's. In the eastern location of Nakuru farmers grow coriander (mainly for its seeds), carrots, pumpkins, peas, spinach, arrow roots, fruits (tree tomatoes and passions), cassavas, beetroots, onions and Napier grass. In western part of Nakuru, farmers grow finger millet, millet, sorghum, wheat, and fruits (avocadoes and guava). In Naivasha, the most common crops are maize, beans, Irish potatoes, sweet potatoes, kales, cabbages, onions, tomatoes and carrots. The Kalenjin farmers also grow capsicum; while the Agikuyu grow garden peas, pigeon peas, black beans (*njahe*) and; the Maasai grow finger millet (Table 3).

In Embu, major grains and legumes grown are; maize, beans, cow peas, green grams and pigeon peas. Farmers are also growing additional horticultural crops including tomatoes, kales, spinach, coriander, carrots; and fruits including bananas, mangoes and *miraa*. Most of the farmers grow these crops for both household consumption and commercial purposes. The major commercial crops are; maize, beans, green grams, horticultural crops and miraa. A large percentage of farmers also keep dairy cattle, goats and cows, bee-hives and rabbits.

Table 3: Crops grown in Nakuru and Naivasha

Area	Nakuru	Naivasha
Types of crops	Maize Beans Sweet potatoes Irish potatoes Pumpkin Arrow roots Finger millet Millet Sorghum Wheat **Horticultural crops**; tomatoes, carrots, coriander, carrots, peas, **Vegetables;** cabbages, kales, spinach, beetroots, onions **Fruits;** banana's, tree tomatoes, passions, avocadoes and guava Napia grass	Maize Beans Irish potatoes Sweet potatoes Finger millet **Vegetables;** kales, cabbages, onions, capsicum, garden peas, pigeon peas, dolidas (njahe) **Horticultural crops;** tomatoes and carrots

In Nakuru and Naivasha, the most important crops for both women and men are maize and beans. This is because the main Kenyan staple foods that is used for making *ugali and githeri* (githeri is mixed maize and beans). Women grow maize and beans to ensure food security while men especially grow maize as a cash crop. Maize also sells fast both locally and nationally. If stored well and therefore, not destroyed by weevils, rodents and aflotoxin, the two crops (maize and beans) can stay for a long time (6-8 months) and thus guarantee household food security. In Naivasha farmers reported their preference for maize and beans is because they do not use pesticides or herbicides and only weed twice in every season, making production cost easy and cheap.

The additional crops grown such vegetables, Irish and sweet potatoes establishes nutritional food balance and subsidises maize, ensuring that households do not run out of food before the next harvest. The youth from these areas are generally not involved in agriculture and the few who are, prefer to plant horticultural crops because of their short maturing period, quick and good

income. Most of the youth living with their parents strictly farm for income and depend entirely on their parents for food while those who have married and settled on their own, farm both cash crops (horticultural), maize and beans for subsistence and incomes. The female youth are mainly involved in farming maize and beans while the male youth farm the horticultural crops.

Farmers in Nakuru and Naivasha grow maize once and beans twice a year. The maize can be stored up to 6 months but because of PHL most farmers run out of maize on average between 3 and 5 months after harvesting. Other factors such as the yield that the farmers produce, the sizes of their families, and their monetary needs determine the amount of maize that is sold or stored. Alternative income sources from members of the family also influences the amount of maize stored or sold. Among the Agikuyu maize stored for consumption is estimated at one bag per person per year regardless of age or gender, whereas, the other communities simply estimate what is to be stored depending on their rate of consumption over the years.

Beans on the other hand are stored for about 3 months this is dependent on the amount harvested and the size of the family. The quantities of beans planted are usually much less than that of maize in spite of them being cheaper to plant given that the seeds are more often than not replanted, takes a shorter time to harvest, easier to maintain and stored. Weevils generally do not attack beans as much as maize while rats do not feed on them either. The beans fetch more money than maize although it does not sell faster. Notwithstanding the benefits of beans over maize, the farmers from both Nakuru and Naivasha reported that beans are planted more by women than men, and mainly used for household consumption and not for commercial purposes.

In Naivasha many of the farmers have resorted to selling their maize straight from the farm during harvest because of the severe PHL experienced in the area. The maize is therefore sold cheaply (115 Kg bag fetching the same amount of money that 90 Kg bag when sold later). Farmers therefore, face serious losses when the maize is sold from the farm. After selling the maize, they are forced to buy the maize meal at exorbitant cost.

7.3.3 Post Harvest Losses (PHL)

Major causes of post-harvest losses in Kenya include unexpected natural circumstances such as heavy rains, poor harvest management and insects, especially common weevil and the larger rain

borer. These factors affect on-farm foods and therefore affect household food security.[57] Kenya loses 30 to 40 percent of the total grain output due to inefficiencies in post-harvest handling especially during harvesting and storage.[58] In spite of the availability of a wide range of storage techniques, significant grain loss occur on-farm in Kenya each year.[59] Post-harvest losses occur between harvest and consumption, although it is greatly influenced by production conditions such as end-of-season drought and mechanical damage to pods during pre-harvest, causing aflotoxin contamination and mould growth during post-harvest stages. The main causes of grain post-harvest losses in Kenya are because of transporting on poor roads, lack of storage, pest infestation, and poor quality of storage facilities, weather and spillage.[60]

7.3.4 PHL in Nakuru

Most of the farmers in the study areas incur post-harvest losses. The farmers approximated the losses at between 30 to 60 percent. These loss estimates are way above those reported in the literature.[61] Both men and women farmers reported that in Nakuru, post-harvest losses occur mainly because of rats, weevils, and heavy rainfall. Other causes of post harvest losses include humidity, theft, lack of storage facilities, lack of fertilizers, congestion, bad roads, lack of information, birds and, spillages. It was unclear why fertilizers would matter. Nonetheless, the in-depth discussion revealed that a large number of factors that can be included in survey tools that seek to investigate the causes of post-harvest grain losses.

Over the years the farmers have noticed two types of weevils; the usual small black ones which they control by dusting the maize with actellic super and Larger Grain Borer (the red big ones) which cannot be controlled by the same method. However, farmers complained that the market is flooded with fake actellic super which are ineffective. Most of the farmers stated that they fall prey to these chemicals due to lack of adequate information and desperation to control the weevils. Other methods used by farmers to control weevils include:

- Making sure that grain is completely dry –women were more likely to report this aspect,

[57] GOK Agricultural Sector Development Strategy 2009-2020
[58] Rembold *et al.,* 2011.
[59] Derera *et al.,* 2001.
[60] WB, 2011: 8
[61] See for instance, Rembold (2011) and more even lower PH losses reports by Kaminski and Christensen (2014);

- Treating with scanner,
- Storing maize in the bedroom to avoid the likelihood of theft,
- Using chemicals that kill rats,
- Owning cats,
- Education and awareness creation,
- Placing sacks on wooden stilts/pallets,
- Metal silos, stores or super grain bags,
- Use of certified seeds,
- Sell maize fast when it is still green,
- Harvest early before the rains,
- Storing the maize in big plastic containers that are sealed either with plastic covers or cow dung,
- Storing in sacks without winnowing,
- Dusting the maize with ash,
- Smoking the maize over the traditional fire,
- Some farmers grind charcoal and mix it with ash in order to ensure efficacy of the treatment and,
- One farmer reported using herbs to clean the store before storing maize in it.

Further, farmers indicated that unlike in the past weevils nowadays attack maize in the farm. Rats, on the other hand, have largely increased in numbers in the area and have developed some resistance to the chemicals and rat-traps. Other farmers have developed innovative methods to deal with the menace and also discovered that rats can be killed using human medicine known as indocine.

Dampness and humidity is also a great challenge given climate change. Sporadic rains occur mainly during the harvest season and destroy maize both at the farm and in storage. Most of these small-scale farmers cannot afford to take their maize to agricultural plants for drying and therefore the maize is dried by spreading it on canvas in their compounds when the sun is up and packing in sacks for storage when it rains. This process is tedious, takes a lot of time, and is not very effective given that sometimes as soon as one spreads out the maize it starts to rain and by the time they put the maize back into storage some of it has been rained on. Another method

used by the farmers to avoid rotting of the maize is placing the sacks of maize on wooden stilts in the store so to avoid dampness. One farmer mentioned that she uses the rotational method in her store to avoid humidity and dampness. She says that even though the maize is stored in sacks and placed over wooden stilts, she exchanges the sacks every few weeks by placing those that have been on top at the bottom and vice versa. She also always ensures that one corner of her store is empty at all times for the air to circulate hence avoiding humidity and dampness.

Theft of maize is a major cause of PHL in Nakuru more than any of the other study areas. Most of the respondents in Nakuru, testified that theft was such a major issue in the area, that many of them are forced to store their maize in their bedrooms. Women reported that storing maize in the bedrooms is hazardous to their health and well-being given that the maize is dusted with super-actellic, at the same time, the thieves can even break into their bedrooms and harm them. Sadly, a lot of those stealing the maize are youth mainly male from the neighbourhood and sometimes even their own adult children, who are involved in drug and alcohol abuse or are unemployed. Women, mainly from the Agikuyu community, reported that at times they are forced to sell maize from the shared storage without informing their spouses. This they attributed to the fact that they sometimes need money to meet their own personal/household needs, which their spouses are not willing to provide as one woman, justified her action:

> "*I am the one who does most of the farm work, so if I sell without informing anybody, that is my sweat(labour), since I have no alternative source of income"*(female respondent)

It is noted that men are more geared towards using modern methods (pesticides) to control PHL than women who prefer traditional methods such as smoking seed maize and so on.

The seasonal harvest in Nakuru and Naivasha is not able to sustain the farm households until the next season, mainly because of PHL. Maize is sold immediately at throwaway prices because of rodents and weevils, and this reduces incomes, leading to food insecurity. When stores become empty, women are forced to find alternative incomes to feed their families, such as providing casual labour in the neighbouring farms. For those who keep cows and goats, milk is sold to earn some money to buy more maize for home consumption. Other women reported having joined groups where they engage in merry-go-rounds (receiving money in-turn from members of the

group) in order to get money to buy maize. Men across all the communities interviewed also reported supplementing family food needs by selling livestock or generating alternative incomes.

In cases where PHL was controlled or managed well, there were bountiful harvests and precautions are taken to ensure that there is enough stock to last until the next season. In Nakuru, most farmers do this by controlling access to and use of the grains, avoiding selling or giving away larger portions to neighbours and relatives and supplementing the grain with other foods such as Irish and sweet potatoes.

7.3.5. PHL in Naivasha

Farmers in Naivasha estimate their PHL at about 30 percent for maize and between 10-20 percent for other crops such as potatoes and beans. In 2013, the farmers experienced very high PHL estimated at 60 percent on average for all crops due to a disease outbreak on the farms. PHL losses are experienced by men, women and youth farmers, however, the respondents agree that women tend to be more affected by it than men and youth because they are the ones who are expected to put food on the table. The men and youth in this area tend to sell their crops especially maize at the farm when it is still green but, they also have other sources of income such as providing casual labour to flower farms around Lake Naivasha. Thus PHL does not necessarily affect the men as much as the women given that the men have alternative sources of income, while the women mainly rely on the farm to feed their families. Although it was reported that most men support their families whenever there is food shortages.

Post-harvest losses negatively affects family incomes, the levels of food available for household consumption, resources available for purchasing inputs for the next planting season hence causing food insecurity and farmers have to buy maize several months after harvest at a higher price in spite of having harvested their own maize. In several occasions, post-harvest losses were grave, forcing families to seek relief food from the government and other well-wishers. The greatest causes of PHL in Naivasha are weevils that attack the grains right from the farm; rats that eat the grains in the store tearing through the gunny bags used for storage and; sporadic rains and cold weather (frosts) making it difficult for maize to dry, resulting in aflotoxin. Once the maize is infected by aflotoxin it cannot be used for food for humans or animals resulting in total

waste, with huge losses for farmers. More men than women attribute PHL to theft while more women attribute PHL to lots of rain at harvest therefore maize not drying well.

The farmers in Naivasha use both traditional and modern methods to control. Some of the traditional methods used to store beans include, dusting with ash made from bean-chaff and storing the beans without winnowing. For maize the seed cobs are hanged at the kitchen roof where smoke from the cooking dries them. Smoking is done on a very small scale as most farmers in Naivasha buy maize-seeds. Other methods used consist of storing the maize with layers of Mexican Marigold or Eucalyptus to keep weevils away from grain. Farmers from this area have used this method for the longest time but in the past the maize was stocked in layers in-husks, whereas nowadays it is stored after having been shelled. This may be attributed to the fact that in the past the farmers had large and safe stores (called *gala* by the Maasai) where the maize was piled outside the home. Today they are forced to store maize inside their houses due to the rising levels of theft.

Methods used to control PHL by farmers in this area include dusting both the maize and beans with actellic super to control the weevils, selling the maize at the farm when it is still green, using pesticides and herbicides to spray to kill the pests and diseases. One respondent reported using powder from the battery as poison for the rats. However, it was noted that some of these chemical are dangerous for livestock (cattle, goats, and chicken) because if they feed on it they die. The chemicals also create apprehension, particularly with the possibility of children being poisoned.

Drying maize is a challenge because Naivasha is cold with a lot of rainfall during the harvesting season. As a result, farmers sell a large proportion of their harvested maize straight away at the farm so that, they do not have to worry about drying the maize and other PHL. The little that remains after the sale is easily manageable in terms of drying and storage. Maize is dried on a canvas in their homesteads when it is sunny. The farmers were taught how to test the humidity levels of the stored maize by using a glass with salt in it - if the grain- sticks to the salt then they are not dry and the farmers continue to dry the maize in the sun. After some time the test is done again and if the grain do not stick to the salt then the maize is considered dried and at that point it is dusted with actellic super and stored in the house.

The control measures for PHL in Naivasha are very different for men, women and youth unlike in Nakuru. More men and youth sell their maize at the farm, having grown it mainly for commercial purposes, while women dust either their maize with actellic super or use Mexican Marigold or Eucalyptus leaves for storage having grown the maize mainly, for food.

In Naivasha, actellic super is found to be so far the most effective and affordable method in controlling weevils in this area according to both men and women despite the fact that the chemical hazardous to human health and certain precautions need to be taken when using it including; wearing protective gear (mask and gloves) when applying it. However more women stated that actellic super to be a more effective strategy of controlling weevils compared to men. In this area, application of actellic super is done mainly by the women although most of them complain about health complications as a result of inhaling chemical fumes. According to both men and women the second most effective way of controlling rats is by using cats. One of the traditional methods of storage is using bags to store grain. Rats are considered a problem by farmers in this area because they usually destroy the bags and feed on stored grain therefore farmers are using cats to control rats. Both men and women also stated that, the use of 'rat and rat' poison is can also be used to control rats, although only a small number of men and women stated this. After shelling, the maize is sorted once again and laid on a large canvas to dry by the women and this method was used by very few men and women to control PHL.

Treatment of maize with ash and Mexican marigold or eucalyptus leaves was also found to be an effective method of controlling pests by more women than men. Women use other traditional methods of managing pests such as dusting with ash made from bean-chaff. Storing maize with layers of Mexican Marigold or Eucalyptus to keep weevils away from grain is also an effective method to control PHL according to women. Storing the maize without winnowing after treatment of the grain with ash and Mexican marigold was considered to be a method of controlling PHL but only mentioned by very few women. Selling maize at the farm when it is still green according to men only is also an effective method they use to reduce and control PHL hence men reduce their risk to PHL. Using pesticides and herbicides to spray the pests was also considered a method of controlling PHL by very few men. Owing to losses of grain through

theft, it was only men who found that storing grain under lock and key was a method of controlling PHL.

7. 4 Gender Roles in Post-Harvest Management of Maize

Post-harvest management involves the activities carried out by farmers from the point at which the maize is mature, through harvest and finally storage. Different communities in the same region and same communities in different regions carry out these processes differently, for example, the Agikuyu in Nakuru harvest their maize differently from the Kisii's in Nakuru and from the Agikuyu in Naivasha. The steps may be different for the farmers depending on the area and community that they come from but they all take place within the following broad framework:

- De-husking the maize at maturity,
- Transporting the maize to the homestead,
- Shelling the maize,
- Winnowing the maize,
- Storing the maize,
- Processing the grains for consumption and,
- Marketing

7.4.1 Post-Harvest Management of Maize in Nakuru

When the maize is mature, the youth and men generally (reported by all the communities: Kisii, Luo, Luhyia and Agikuyu) cut the stalks and heap them to dry as the area is prone to sporadic rains occurring during harvesting period. Every resident member of the household participates in the transportation of maize from the farm to homesteads -women, men, youth and children. Depending on the income of the family and the distance from the farm to the homestead the maize is transported using; donkey carts, push carts, pick-ups, motorbikes, bicycles or it carried on their backs. Sometimes, the farmers who are able to pay use hired male labor. Most farmers store the maize in the outside granaries for further drying. With the help of children women are responsible for de-husking the maize. Once in the homestead the women and children sort the husks to separating the good maize from the bad.

In Nakuru, farmers shell their maize, using hired, mobile shelling machines (generally owned by men) and operated by the youth. The shelling machine is a new technology adapted by many farmers since it saves time and energy and is affordable (i.e.1 bag of maize cost approximately costs between Ksh 70 (USD 1) and Ksh 110 (USD 1.20)). The machine has the capacity to shell and winnows. The machine takes, approximately 10 minutes to shell a 90 Kg bag. In many circumstances, the owners of the machine move with it from place to place and men and women farmers can invite it to their homestead for shelling under agreed payment rates. In the past the shelling would either be done by hand or beating using metal or wooden sticks. This was a very laborious task usually, done by men and male youth. Nowadays the youth do not carry out any farming activity without being paid. Women attribute this to the increasing alcohol abuse in the area, laziness and lack of interest in farming.

After shelling, the maize is sorted once again and laid on a large canvas to dry by the women. In case it starts raining or when it is getting dark the women pack the maize in sacks and store it in the house. In the morning the task is repeated until the maize is completely dry. After this, it is winnowed still by women and finally put in the sacks for storage. Among all the communities interviewed, winnowing was and is still is strictly done by women especially when using the traditional method of two baskets. However, the shelling machine, which comes with a sieve, allows men to also participate in winnowing. Nevertheless, winnowing remains largely the responsibility of women as the men reported that they only do it when it is necessary, that is when the harvest is a lot or when their spouse is ailing or away from home.

After winnowing the maize is divided into two, grain that will be sold is under the responsibility of the male-head of household, and that to be stored for food under the responsibility of the wife. In the past, amongst the Kalenjin's there used to be 2 stores; one for storing food reserves, controlled by the man and another for storing food for consumption which was under the management of the woman. This has changed over time with the farmers storing food for reserves and that for consumption in different sacks in the same storage facility. In order to cut cost the maize for sale is not treated with chemicals (actellic-super) as this is found to be very expensive. Only the maize to be stored for food is treated with the chemicals, mostly by farmers who can afford to buy it. The men buy the actellic super and the women treat the maize. After maize is stored for a period, (usually 1 to 2 months) it is again put outside on canvas to dry and

then treated again using actellic super. This process is repeated severally times until the stored maize are depleted.

Communities are informed that actellic super is hazardous to human health and certain precautions need to be taken when using it including; wearing protective gear (mask and gloves) when applying it. Maize that is treated should be stored away from people so that they do not inhale its fumes and; washing the maize before consumption. Despite this awareness, farmers rarely take the precautions because as said they do not have the time or resources to do so.

In the past, the men solely treated the maize with chemicals since they were targeted by agricultural extension workers. Communities also believe that women's bodies are more sensitive and that chemicals may harm their unborn children. Over the years this perception is changing as men seek employment outside their homes while women take over responsibilities which were once carried out by men. It is important to note that traditionally men's roles in farming were clearing the bush/land in preparation using animal draft-power. Women's roles included planting, weeding and harvesting; and the youth helped in harvesting especially in cutting down the stalks of maize and shelling it by beating it with metal or wooden sticks. One thing that is common across all the communities is that women carry out most the post-harvest activities, whether or not their husbands have a stake in the production of maize for commercial purposes. Women plough, plant, weed and carry out most of the post-harvest activities, sometimes with assistance from their husbands and children or hired labor.

7.4.2 Challenges of Post Harvest Management in Nakuru

The greatest challenge in PHM in Nakuru is lack of adequate human and monetary resources in the households to carry out efficient farming. In the past, the whole family including the extended family participated in farming. They had separate parcels of land but they helped each other to farm but now, women are mainly the ones who do the farming. This breakdown of family support structure has resulted in women farming small pieces of land and obtaining little produce that is then destroyed in large proportions by the rodents and weevils.

Farming requires many inputs including buying seeds, fertilizers, pesticides and herbicides. Unfortunately, most of these women who are small-scale farmers cannot afford these inputs

resulting in poor harvest and post-harvest losses. Concerns were raised about, weevils and rodents becoming resistant to the chemicals probably because of fake treatments sold in the market. Women across the ethnic communities felt that despite the fact that they provide most of the labor in the farming; the benefits are not commensurate to their work. In most male-headed households, men control the access, use, sales and incomes especially from the maize. Women reported that this is very discouraging resulting in most women not working as hard or producing as much as they possibly can. In addition to farming, women have other primary responsibilities in the home such as caring for the children, doing the housework, cleaning and cooking hence, they are time constrained and rarely attend forums especially those organised by agricultural extension workers where information and technologies are disseminated including post-harvest technologies. Several women expressed the feeling of being discouraged from farming because of the increased expenses involved in the process or lack of adequate returns. For this reason, some farmers especially the men are selling or renting out land to other settlers. In Nakuru such cases have been reported in Lanet and Rongai amongst the Agikuyu and Kalenjin while in Naivasha it was also reported among the Maasai and Kalenjin which also partly attributed to their lack of interest in farming due to pastoralism that encourages livestock keeping rather than crop farming.

Women also reported experiencing health problems and illnesses such as coughing, asthma, congestion in the chests, allergies, constant sneezing and running noses mainly because of using post-harvest pesticides without proper gear. Women further explained that, because, the chemically treated maize is stored next to their beds and without proper ventilation, there is high possibility of inhaling the fumes, resulting in these illnesses.

7.4.3 PHM of Maize in Naivasha

In Naivasha, it was reported that, cutting the stalks of ready maize using machetes, heaping them in stalks, de-husking, packing the maize in gunny bags and transporting them to the homesteads is done by men, women and youth in all communities apart from the Maasai where the women do it with assistance from hired labour. Maize is harvested in the dry season to avoid incidents of grain rotting in the field. On small farms the maize is left to dry while on the stalks. The cobs are then removed from their husks by hand and taken to the stores. Men in Naivasha, transport the

maize using donkey carts, bicycles, motorbikes or pick-ups and lorries depending on the quantities while the women transport the maize on foot carrying the loads on their backs. Once in the homestead the maize is laid on the canvas or large plastic bags by women to dry after which it is shelled. When the children are on school holiday they assist with de-husking, transporting and sorting the maize.

Most farmers in Naivasha also shell maize using a machine mainly operated by the youth and carried from home to home using a motorbike. It takes 5 people to operate the machine (i.e. 2 people pour the maize in-husks into the machine; 1 person to ensure that it is shelling well and; 2 people to direct the shelled maize and cobs into separate sacks). It is common to have grain remaining on cobs and these are packed into sacks and women shell and sort them later by hand. Even with these few shortcomings, the machine is effective and fast and most women prefer to use it instead shelling the maize by hand. The Maasai and Kalenjin women, use wooden or metal sticks to hit and shell the maize. Shelling of maize using the machine cost Ksh 100 Ksh per 90 Kg. However, some farmers still prefer to shell the maize by hand to reduce wastage. Once the maize has been shelled the women sort and winnow it. Winnowing is done only for the maize that will be stored for home consumption, using traditional method of two buckets. Women also dry the maize, put into sacks for storage. Again only the maize that is to be used for home consumption is treated with actellic super while for sale is not treated. Application of actellic super is done mainly by the women although most of them complain about health complications as a result of inhaling chemical fumes.

In the past, maize was stored with cobs but nowadays farmers prefer to store maize having shelled it because it takes a shorter period of time to dry, it occupies less space given that most of them store the maize in their houses. Some of the maize comes with weevils from the farm and there are higher chances for the weevils spreading when the maize is stored in cobs. Furthermore, chemicals used to treat the maize are more effective when the maize is shelled rather than when it is on cobs. Most of the farmers store their maize in their houses, these are raised from the ground using wooden rafters so that they do not touch the floor and form humidity leading to aflotoxin.

In Naivasha, the men own the stores and are in charge of marketing the maize or selling while the women are responsible for processing the maize for home consumption. Women according to

family needs transport bagged maize to the millers. The grain is ground to produce maize flour for consumption.

7.4.4 Challenges PHM in Naivasha

Several challenges experienced in relation to post harvest storage technologies were reported. Farmers sell most of their maize immediately after harvest at throwaway prices in order to avoid PHL. In relation to sale of maize, alcohol and drug addiction mainly among men and male youth leads to sale of maize for quick access to money to buy alcohol or drugs. The Maasai and Agikuyu women reported that men lease family land to large scale farmers leaving them without land to farm and this situation is not only causing problems in the households, but also creating food insecurity and discouraging them from farming. Most households do not have stores/granaries to keep their produce after harvest. They are therefore forced to store the produce in gunny bags in their houses which have little space and some reported storing their maize in the bedrooms. As a result, some farmers reported being forced to farm small parcels of land.

The gunny bags used for storage are made of synthetic plastic and are easily torn by rats and wear out faster when moved and carried around constantly, making it very expensive for farmers since, they have to purchase new ones every seasons. Women reported that the bags are heavy (weigh approximately 90 Kg) and when piled on top of each other it is difficult to see what is happening between them or the levels of destruction by weevils and rats. Chemicals for dusting grain for storage, seeds and pesticides are expensive, and women reported that they are not able to afford.

Farmers reported not making profits and this is why many of them, especially the men have opted to get alternative sources of incomes by looking for employment as labourers at the Naivasha flower farms. Men farmers are increasingly leasing their farms to ‘outsiders’ for example, to large-scale farmers or sell their produce to avoid post-harvest losses. This creates food insecurity not only in the households but also in the whole area. This practice is mainly experienced among the pastoral communities among the Maasai and Kalenjin. The weather in Naivasha is mostly cold and chilly and the crops are prone to frost and causing or forcing the

farmers to buy more pesticides for preserving the maize. Use of these chemicals is reported to be hazardous their health and many women attributed this, to the high rates of unexplained illnesses.

7.4.5 Gender Issues in PHM of Maize

Small-scale faming, as indicated above, is pre-dominantly the domain of women, however, many times the men, only comes in for commercial purposes and this usually coincides with the introduction of new technologies a factor that seems to attract more men and male youth into farming. Many of the farmers attributed this to gender roles in post-harvest, given the different roles that men and women play within the household to patriarchal culture and traditions. This has implications of who does what in the family, who is making decisions and who controls and owns family resources.

In both Nakuru and Naivasha male-headed households whether polygamous or monogamous, men generally own and control storage structures and the stored crops, even if they may not be actively participating in the farming. Women reported that even though husbands consult them on post-harvest issues, the men still have the upper hand in decision-making especially with regard to the selling of the produce. Others reported situations where husbands are employed elsewhere and whenever they need to raise money, for example, to pay school fees, they have to consult the husbands. However, husbands who stay at home and depend on the farm as the main source of income control all the resources making stringent decision-making with regard to the farm produce and post-harvest management. Both women and men farmers reported that, spouses consult each other on grains to be sold, proportion to be kept for food and what to do with the income from the sales.

In many of the household, especially in Naivasha where maize is mainly grown as a cash crop, once the family has separated what goes for sale, what is left for food and usually the food part is controlled and management by the wife. All the same, women said that men still have the final say, on storage and sell of maize. Other women also reported that though they control portions left for home consumption, husbands who are addicted to alcohol might use force and sell the maize. Given such experiences, some women preferred owning a metal silo and storing the maize as a group, in a safe place rather than store individually in their houses.

In the majority of cases in both Nakuru and Naivasha where produce is pooled together, a larger percentage (on average about 80 percent) is usually sold and a smaller one (on average about 20 percent) kept for household consumption given the estimates of the wife in terms of household use. Men prefer to keep the grain in places where they can lock them and keep the key so as to control access, while, women prefer gunny bags or milk cans from which they can count the number of bags or cans that have been used and also estimate the amount of maize still left in storage for home consumption.

Most of the communities interviewed in both Nakuru and Naivasha are largely monogamous apart from the Kisii, the Luo in Nakuru and the Maasai in Naivasha. Among the polygamous communities every wife has their own storage facility. The wives do not have access to each others' stores but the husband has access to all them. In de-jure female-headed households which are few both in Nakuru and Naivasha, respondents from all the communities apart from the Maasai stated that they make all the decisions independently regarding how much of the produce to sell, how much to store and how much to give away. Contrary to this, women from the Maasai community in Naivasha whether widowed or married have to consult with their husbands who maybe living and working away from home, or the eldest sons or brothers in-law.

Few Agikuyu households in Nakuru, (husband and wife) farm different farms and storage facilities and each controls their own. Separate farms are usually rented by the wife without the consent or awareness of their spouses. The produce from these leased farms are directly under the control of the woman farmer, and when the maize is sold the money is used according to their own priorities which is mainly to meet family and individual needs.

Maize is usually alternated with other produce like potatoes and green grams to last until the next harvest. Because of the regular poor harvests in Naivasha, male farmers are often forced to seek alternative employment as laborers in large-scale farms in the neighbouring Narok sub-County in exchange for maize and beans or cash or seek relief from the government.

8.0 Gender and Traditional and Improved Storage Technologies

8.1 Introduction

This section presents gender relations in the use of traditional and current storage technologies and households that have adopted the new storage technologies. It also examines whether gender roles have changed with the different technologies and who in the household has access, control and ownership of the improved storage technologies. We also assess forms of improved technologies in the study areas for households; dominant forms in which post-harvest is managed for each technology especially metal silo; and level of knowledge and access to information on improved PHM technologies. Also presented are the case profile of ownership, access and control of household assets especially metal silo inter-household storage practices, design preferences, marketing and access to information and; improved PHT management at community level.

In Kenya, grain post-harvest issues are addressed mainly through the National Cereals and Produce Board (NCPB), a state corporation under the Ministry of Agriculture. The Board has 110 Silos and depots countrywide comprising of warehouses. It is the government's arm for: intervention and stabilization of the grain market in the country; buying and maintaining grain on behalf of the Government Strategic Grain Reserves (SGR); distributing Famine Relief Stock (FRS); distributing farm inputs; providing logistical support services to SGR and FRS and; commercializing trading in grain.[62] Reforms are anticipated in the Kenya Vision 2030, to transform NCPB into a major National Warehousing Institution to stock grain produced in the country, sell the grain at the right time, and enact a National Warehouse (with a receipting system) Act to ensure international standards.

8.2 Traditional Post-Harvest Storage Technologies and Practices

Traditional post-harvest storage technologies refer to homegrown technologies locally developed and that are passed from one generation to another. In most cases, they are appropriate, simple and represent the use of non-cost materials fashioned with simple tools or woven by natural

[62] http://www.unctad.info/upload/SUC/LusakaWorkshop/WarehouseServicesKenya.pdf

material such as reeds and sisal which are tested in the laboratory of survival and; form the fabric of culture.[63]

The terminology 'traditional' is broadly used in this study to cover the evolution of post-harvest storage practices from traditional to modern method; and their access and control of both female and male farmers. The following types of PHTs were identified in the study areas; traditional granary (cylindrical), improved granary (wooden wall), improved granary (wicker wall), gunny (sisal) bags, baskets, storage over fire/smoke, large pots, traditional crib (round bottom), separate structure, adapted bags, e.g. hermetic and rooms in the house.

Findings reveal that farmers store their grain in various structures including bags, baskets, in the house, stores made of wood with iron sheet-roofs and raised from the ground or traditional granaries (cylindrical and wicker wall and traditional crib) only found in Embu, especially among the Mbeere. Other**,** types of granaries used in Embu include improved granary wood-wall (made of timber and roofed by iron-sheets) and; a timber store with iron roof which is an improvement from the traditional granary. The choice of storage facility and method of storage varies with the intended purpose of the storage. For example, most smallholder farmers store their maize seeds by hanging the unopened cobs under the kitchen roof over the fire place. The soot accumulates over the cobs to prevent attacks weevils and other pests and thus the seeds are preserved for the next planting. On the other hand, grain meant for consumption is rarely treated with chemicals, but this depends on the amount stored and the length of time it will last.

The Maasai interviewed in Naivasha, have traditional stores called *gala* and these are now modernised and made with timber and raised several meters from the ground with an iron sheet roof. The stores are made and maintained by the men in all the other communities except, among the Maasai and Turkana where the women construct the stores. The cleaning and arranging of the store is the work of women across all the communities. Traditional granaries are constructed separately from the main dwelling house, but this is changing, due to the increased rates of theft in the areas. Traditionally, men constructed granaries, in all the communities under this study, and they still do, while women maintained them (smearing the walls with mud, and cleaning) and managed the stored grain. Questions were asked about type of post-harvest storage facilities

[63] The Gender Variable in Agricultural Technology: A Case of Rural Farmers in Machakos District- Eastern Kenya.

used in the last 10 years and those used earlier and the answer to this question is illustrated in Mueni's story.

Mueni is a farmer at Katitu Village, Riakanau sub-location, Mbeere South District, and is using a traditional granary made of sticks to store her maize. Her husband made the granary at a cost of 1,000 Ksh (USD 10) and she has used this granary for the past 15 years and this is where she stores maize, green grams and cow peas. She also controls and makes all the decision over the stored food and no one, including her husband can access the granary without her permission. Mueni does not use any pesticides on her stored grain. According to Mueni, the granary is good, "*I can store grain without threshing, it is cheap and the materials for making it are locally available"*. But the problem is that anybody can steal the food because the store is outside and is not lockable. Weevils and rats also attack the grains and sometimes when it rains heavily, water gets into the granary'.

In the past (more than 10 years ago) Mueni and her family used another type of traditional storage granary shaped like a pot and smeared with mud inside. It was very cheap to make and it only cost them 200 Ksh (USD 2) to construct. However, according to her, this type was very cumbersome and tiresome to make and maintain. She recognises that these traditional granaries are slowly disappearing because of improved types that are now available in the market.

This division of responsibilities between the different members of a household on the use and management of stored of grain continue to-date. However, sale of grain (i.e. paying school fees) is often negotiated between members of a household to address a need. Farmers reported that, local maize is rarely attacked by weevils and are stored in the local traditional granaries. However, challenges of the traditional granaries is that they are built outside, and the stored maize may no longer be safe and therefore farmers prefer to store maize in bags and then kept in the house.

Storing in-house, improved granary (wooden wall) and, the use of gunny bags and separate storage structures were more popular in Nakuru than Naivasha. In Naivasha, most of the farmers

grow maize for sale, and little is left to be stored. The outside structures are found desirable by the farmers who own them because of the space it provides for storing gunny bags outside the dwelling place; secure when under lock and key and easy to access and retrieve the grain. Women also felt that improved stores outside the main house are not always easily accessible especially when a male spouse keep it under 'lock and key', and controls access, even for food. In all the areas under this study, families did not generally bulk their storage with grain, men and the male youth stored the maize for sale while women stored for food. It was observed that outside structures for grain storage are mainly found among farmers of higher social status because they are more expensive to construct and maintain. The use of metal silos was more popular among better farmers (higher social status) in Embu, and public or private institutions such as schools, hospitals. The use of metal silo was also rare in Nakuru and Naivasha, since the technology recently introduced in 2013.

The gunny bags (sisal) bags were found to be the most popular, in Nakuru, Naivasha and Embu. The bags usually come in different sizes 25 to 100 Kg bags. The most common ones are the 90 Kg bags, which are used for maize storage. The gunny bags are preferred by both women and men farmers because of their ease of access, if the grain are to be used regularly to process for food. Both women and men like the bags, because of their sizes, they can easily fit in the house so that the maize is not kept in the outside stores. The bags enable farmers to plan on the distribution of the number of maize bags for food and for sale. The gunny bags are also affordable (approximately 50,000 ksh (USD 60) and easily found in the local market. In order to use store in the bag, the maize grain goes through a process of shelling, drying, and winnowing and pesticide treatment. Women reported that storing in bags increases their labour especially, if the grain is stored for more than 3 months. This is because the grain is regularly taken out to dry in the sun, re-dusted, put into the bags again or washed before taking to the *posho-mill*. Men complained of the cost of buying insecticides to dust the stored maize. Women also use other traditional methods of managing pests such as dusting with ash, herbs and, pepper or Mexican marigold. Maize storage in bags occupies space in the house and since small-holder houses are generally small, the practice was found only feasible with small-scale maize producers whose stored maize was meant for immediate consumption and not to last for more than six months. Some of the undesirable attributes of the bag are that the maize is prone to weevil attacks. The

bags also tear easily, the grain is treated regularly with pesticides and, this is harmful to health, while pesticides are expensive if one has to buy them regularly. In addition, the rats easily tear the bags, they are not durable and water can seep into them and cause aflotxin. In all the traditional storage facilities, grain loss is experienced due to pests, rats, weevils and theft.

The evolution of the storage over the years is based captured in the story of Sabina, who is still using traditional storage technologies and at the same time she has adopted metal silo.

Sabina is married to Peter and both reside in Kanduku Village, Gecheche sub-location, Mbeere South District, Embu County. Sabina (38 years old) and her husband (48 years old) are full-time farmers. They have 3 children and their main sources of income is farming and providing casual labour mostly done by her husband.The household earnings estimated at Kenya shillings 40,000 (USD 500) per month. Sabina and her husband own 25 acres of land (4 acres is arable and 21 used for grazing). They grow:

- Maize in 1 acre of their land, and in total harvest 10 bags of maize every year,
- Cow peas grown on 1 acre harvesting 6 bags,
- Green grams are grown on 1 acre of land harvesting 2 and a half bags,
- Sorghum on 1 acre producing 2 bags and,
- Millet is grown in half an acre of land and 1 bag is harvested.

Both Sabina and her husband manage and make all the decisions regarding their farm and harvests. They use traditional granaries to store millet and sorghum. Peter constructed it at a cost of 5,000 Ksh (USD 70) and while Sabina manages what is stored. According to her the disadvantages of the traditional granary are, grain can be stolen by thieves; it needs constant repairs and also prone to attack by weevils. They also store maize and sorghum in gunny (sisal) bags but do not use any pesticides. Gunny bags to her have two advantages ‘they are easy to access and also cheap, however, they do not last long and one has to keep buying new ones, and they are also prone to attacks by weevils’.

Sabina adopted two metal-silos of a two bag capacity and this directly under her control. She says that with the metal silos, she does not use pesticides to treat the grains, the weevils and rats cannot attack the grains and it is durable and lasts for a

long time. The silo was bought from Caritas at 3000 Ksh (USD 40) in 2008 after selling a goat to buy the silo. They store maize and sorghum in the silos and this lasts up to 6 months. Sabina is the one who loads the silos, cleans and checks the moisture content. Since adopting the metal silo their food security has greatly improved and they no longer experience post-harvest losses. She however reported that she did not receive any training on how to use the silo when she bought it and would like to be trained to use the silos better. She recommends that the silos should be made wider and shorter to make it easy to use and keep in the house.

Nothing changed in Sabina's household in terms of gender roles since they acquired the metal silos She is still in charge the silos just like with the other traditional storage facilities. Within this household, all grain is owned and stored jointly, and both are in charge marketing or selling the grains while the money from the sales is openly discussed and used accordingly.

Sabina story shows that, the gender roles in post-harvest management of traditional and new storage technologies within her household are well defined, and that although both herself and her husband are farmers, she is the one who manages and controls the stored food. She acquired two metal silos through her women's group and although the technology is new, this has not brought about any conflict as she is the one who controls and manages its use. The researchers also observed that, Sabina has not done away with the traditional granary because she still finds it still useful. It was also observed that metal silos are stored within an improved granary (wooden wall) which is under her lock and key.

8.3 Improved PH –Technology, Awareness, Access and Preferences

Appropriate information given and received on a timely basis is critical to the development and use of technical innovation.[64] Social norms and cultural practices can prevent women from participating in a technological intervention or information campaign. Using appropriate channels to create awareness is one way to addressing this situation and especially providing information that is more relevant by specifically addressing gender aspects of post-harvest management of cereals.

8.3.1 Metal Silos (MS)

The field extension officers use the following approaches to inform farmers on the metal silo technology:

- Awareness campaign meetings held prior to silo introduction and farmers mobilized in the targeted areas and, when Farmers' Group receive the metal silo,
- Demonstrations- Caritas distributed metal silos to individual and Framers Groups and,
- Farmers training sessions- Farmers are made aware through training sessions, in which they are taught how to use and manage metal silos.

In Nakuru out of the 14 key informants that were interviewed, all of them were well aware of the metal silos (8 men and 6 women), but only 8 had adopted them (6 men and 2 women) (table 4). In Naivasha all 15 key informants that were interviewed were aware of the metal silos (8 men and 7 women), and only 4 had adopted (3 females and 1 male) (table 4). The respondents became aware of the metal silos through the following channels:

- From Caritas the implementing partners of CIMMYT;
- Agricultural fair held at Kabarak;
- Agricultural extension officers;
- Sensitization meetings including one held in Nakuru;
- Pictures, pamphlets handed out at the agricultural offices in the various locations;
- Word of mouth – farmer to farmer and;

[64] Ragas, C. 2012

- Exchange visits – Caritas organised Naivasha farmers to visit Embu metal silos adopters to see and learn how they were being effectively used.

Table 4: Adopted and Awareness of Metal Silos in Nakuru and Naivasha

	Nakuru				Naivasha			
	Aware of MS	**Not Aware**	**Adopted**	**Not Adopted**	**Aware of Metal Silo**	**Not Aware**	**Adopted**	**Not Adopted**
Male	8	0	6	2	8	0	1	7
Female	6	0	2	4	7	0	3	4
Total	**14**	**0**	**8**	**6**	**15**	**0**	**4**	**11**

In Nakuru more men than women have adopted the metal silos while in Naivasha, more women adopted the metal silo. In Nakuru and Naivasha more men than women are aware of the metal silos (table 4).

Metal Silos were introduced in both Nakuru and Naivasha late last year (August 2013). Few farmers are aware of the metal silo and even fewer have adopted them. Further inquiries regarding problems encounters generated the following responses:

- ***High cost of metal silos:*** The metal silos, which were being piloted, are too expensive (8000 to 12,000 Ksh) and most of the smallholder farmers cannot afford to buy them.

- ***Lack of Knowledge of where to get the metal silos:*** Some farmers were not aware of artisans who could fabricate metal silos and the cost of buying one and therefore most farmers have not adopted it.

- ***Size of the piloted 10 bag metal silos:*** The piloted silos were too big to fit in their houses so if they adopt them, they would have to build new structures to store them or break parts of their houses for it to fit inside. Men recommended that artisans should make the

metal silo inside to avoid destroying the house. Women prefer smaller silos that can easily be moved around in case there is fire.

- ***Timeliness of awareness on metal silo***: Respondents stated that metal silos were introduced after most of them had already harvested and either dusted their maize with actellic super or sold it and therefore they could not use it.

- ***Metal Silo outlet:*** Some farmers noted that the silo opening is too near the floor making it very difficult to access the grain stored inside the silo.

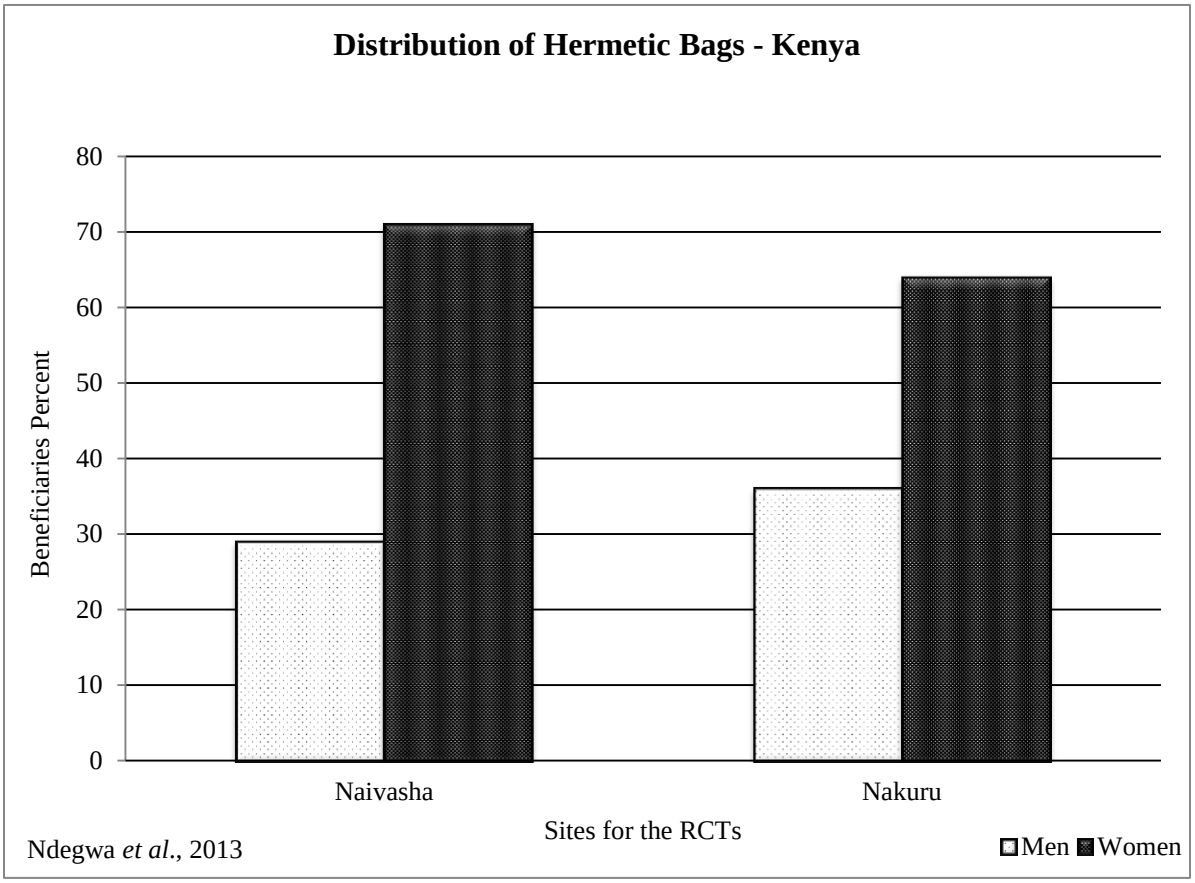
In a bid to counter some of the unavoidable factors that would discourage small-scale farmers from adopting metal silos especially the price (Ksh 18,000 for 10 kg bag silo), Caritas has come up with alternative strategies for fostering adoption. For instance, Caritas pays half the price of the metal silo, while the farmers pay the other half, thus enabling farmers to buy the metal silo on loan and pay back by instalments of Ksh 700 (USD 10) for two years or arrange for collective buying and ownership of metal silos through women's groups.

8.3.2 Hermetic Bags

About 50 percent of the population in both Nakuru and Naivasha are well aware of super grain bags. Just like with the metal silos the respondents became aware of super grain bags through: the agricultural fair held at Kabarak organised by Caritas; agricultural extension officers during; pamphlets handed out at the agricultural offices in the various locations and; word of mouth (farmer-to-farmer).

More men (39 percent) in Nakuru have adopted the super grain bags while in Naivasha it is more women (71 percent) who have adopted super grain bags (figure 1). In Nakuru and Naivasha more women (64 and 71 percent respectively) have adopted super grain bags than men (36 and 29 percent respectively) in both areas.

Figure 1: Distribution of Hermatic Bags in Naivasha and Nakuru in Kenya



More men and women farmers in both Nakuru and Naivasha have adopted super grain bags compared to metal silos. This is because the hermetic bags were introduced to the communities a little earlier than the metal silos in 2013, before they had treated their harvested produce with chemicals for storage. Women, are likely to adopt super grain bags because they are affordable (between 100 -180 Ksh per bag), easy to use and maintain and are available in the market. Women are also familiar with gunny bags hence they are more receptive to the hermetic bags than metal silos; they are the same size as the gunny bags; and easy to fill, carry and know the number used or in-storage as opposed to maize stored in metal silos. Again, the super grain bags keep weevils and rodents away, and women do not have to dust the grains with chemicals. Women also felt that unlike metal silo super-grain bag is accessible and the use of the maize remain will remain under their control (Figure 1).

Women identified the following as the disadvantages of using hermetic bags: the bags can attack by the rodents and because they are made of synthetic plastic it can easily wear out so they have to buy new ones every season. Men on the other hand, do not like the super grain bags as much as the metal silos because their capacity is small hence they need so many bags to store the same amount of grains that they would store in one silo. In addition the bags take up a lot of space and are cumbersome to maintain and arrange. The bags are also cost effective since they are destroyed by rats just like gunny bags, unlike the metal silos. In spite of these disadvantages, farmers agreed that these new technologies are far much better than traditional ones because they store grains more efficiently, thus enhancing food security and incomes in the household and at community levels.

8.4 Improved PH-Technology Management at Household Level

Most farmers interviewed in Mbeere North and South have adopted metal silos and therefore they are profiled as cases providing an in-depth understanding of the gender dynamics at the household level which has been brought about by the improved post-harvest technology (metal silo). Some studies have shown that wealth is associated with adoption of new technology, because wealthier farmers are able to bear the risk and are more likely to try new technology.[65] Assessment was also made assets ownership in the household. These were grouped into three, household assets, livestock assets, land assets, and then respondents asked to identify what they own and control (table 5). These assets were valued to see the correlation between ownership, control and economic power among the members of the household. Generally, in male-headed households, women owned the less costly asset such as: forked/ordinary hoe, machete *(panga*), improved cooking stove, and solar panel bought through, merry-go-round, table-banking of women's groups.

[65] Morris, M.L. and Doss, C.R. How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. CIMMYT.

Table 5: Asset Ownership in Farm-Households in Embu

Farm-Household Assets		**Livestock Assets**	**Land Assets**
sickle	Donkey/Ox-Cart	Cows	Trees
Fork Jembe	Bicycle	Oxen	Others
Hoe	Motorbike	Calves	
Spade/Shovel	Wheelbarrow	Goats	
Axe	Improved Charcoal stove	Chicken	
Pipes	Gas Cooker (Meko)	Donkeys	
Ox-plough	Radio, Cassette, CD	Bee Hives	
Water Pump	Mobile phone		
Spraying Pump	TV set		
Panga/Machete			
Generator or solar panel			

The male-headed households are the one who bought and owned more expensive, highly valued household assets such as water-pipes/pumps, ox-plough, bicycle/motorbike, radio and so on. Both women and men owned mobile phones. For livestock assets, women only owned chicken while men own the rest of the livestock, and make the all the decisions regarding sell or slaughter. Land belongs to the men who have either bought, but mostly inherited. Thus, women's access and control over resources need to be carefully addressed and accounted for in the design and planning of the technology interventions.

The following criterion was developed to identify eligible households for receiving metal silos in Nakuru and Naivasha:

- Household whose members are between 25-60 years;

- Those households who have planted maize in 2012/13 season;
- Households with maize stores; and own livestock;
- Households whose maize storage period lasted more than 3 months in 2012.

However, the study found that there was a poor communication strategy for reaching different categories of farmers - women, men and the youth and; especially in Naivasha, where there was no active participation of farmers in the programme. As a result, this has left knowledge gaps of what metal silos are and how they can be used. Problems encountered in trying to obtain a metal silos include: high cost of metal silos; lack of knowledge about where and how to get it; lack of knowledge about the effectiveness of the technology and; low grain production especially in Mbeere North, Embu.

Findings from adopters in Embu revealed that women carry out most of the farming activities including planting the crops, harvesting, drying and storing. Women are the ones who put the grains in the silos, clean them and retrieve the amounts they need for sale and for household consumption. In Embu it was suggested that marketing of the metal silos should be by word of mouth from one farmer to another; demonstrations at the chief's *barazas*; community group meetings; in churches, at schools during the parents meetings; field days hosted by Caritas; through agricultural extension staff the Catholic Diocese; and through brochures and pamphlets. This study reveals that those who have adopted the technology see their benefits over traditional storage methods:

- ***Protection against pests and water:*** Adopters of metal- silo agree that the stored grain are fully protected from rats, weevils and termite attack and cannot allow water to sip through the grain,
- ***Storage for long-term create food security and better market prices:*** The metal silos serves as a long term measure for food security, reduces postharvest grain loss, and help avert hunger in the households and also in the community. Women reported that, owning a metal silo reduces their labour burden not frequently drying maize in the sun or dusting with pesticides and this allows them to engage in other activities. Men appreciated, that the long-term storage of grain enables them to sell their grain at high prices during the planting seasons (February to March) and this helps in spreading household income over

the year. Thus, metal silos have the potential to improve food security and household incomes,

- ***Metal silo cheaper in the long run:*** Farmers reported that they no longer have to buy pesticides or bags to store the maize and therefore in the long run using metal silos saves money. Women also pointed out that their health status has improved; because the no longer use chemicals to dust the maize and neither do they consume food that is contaminated by the use of pesticides,

Inquiries about respondents' viewpoint of how to improve metal silos gave the following suggestions on:

- ***Size, shape and weight of silo:*** The farmers see the need to fabricate different sizes of silos from 1 bag capacity to fit inside the houses and not only 10 to 20 bags capacity. Women prefer a variety of sizes from, 1 bag to 6 bags with most of them settling for a 6 bags capacity to store maize; 2 bags capacity to store beans and; 1 bag capacity to store flour for home consumption. Some of the women suggested that the silos should be one unit, but made with different chambers to help determine amount used or remaining. The men prefer the 8 to 13 bags, so that all the grain is in one place. Some preferred a silo with the capacity of 20 bags so that they can use it to store maize until the next harvest. Therefore farmers do not sell maize when it is still green to middle-men at low prices but, wait and look for markets on their own in order to fetch better prices.

  The women complained that the silo capacity of 10 bag are too tall and to store the maize, one has to use a stool or call for male assistance and this, they thought was insensitive to women adopters. The women suggested that, the silo should be made shorter and wider rather than thin and tall as it is now, for easy access without assistance and placed on raised surface for easy access to the opening and removal of grain. Again the size is too enormous to fit in the house and some of the adapters had kept their silos outside the main house, built a new structure to house it or destroyed part of the house to enable the silo to fit.

- ***Metal Silos with locking systems and transparent window for monitoring:*** Most men would prefer a lockable metal silos for increased control and access to the grain so that food is secured throughout the year and for increased security of the locked grain. Women felt strongly that, once the maize is stored, it is opaque and therefore one cannot monitor what is happening inside. Women suggested that metal silos should have windows from which one can look through to monitor the maize, and check whether it safe and not rotting or already sold out.

- ***Improving the strength of the metal silos and other packages:*** Most men felt that the metal sheet in use today for the silo is very light and can easily be damaged and therefore suggested using a thicker iron sheet. One adopter of the metal silo recommended the promotion of a portable drier and moisture tester as a package with the silo to ensure that maize is dry enough before storing.

- ***Metal silo outlet:*** Both men and women want the opening at the bottom to be a tap so that it can open and close easily, safely and controllably, and the inside of the bottom part to be slanted so that when the grains are about to finish, they can just flow through once the tap is opened instead of one having to insert their hands and scoop them out. Other suggested making the inlet and outlet of the silos tighter in order to avoid air getting into the silos and causing the grain to rot.

Intra-household preferences are clearly different with regards to metal silos. Men prefer bigger metal silos that will go towards improving their trade in maize whereas women prefer smaller sizes for storing different produce for consumption and enhance food security. The key respondents in Nakuru and Naivasha who have adopted the metal silos have seen many of its benefits in: providing sufficient storage; it safety (keeping weevils, rodents and water away from the maize); no use of chemicals to dust the maize therefore clean and healthy; no more buying of bags every season and; it does not wear out easily giving the farmers real value for their money. The use of metal silos also saves time by not moving sacks around to check whether weevils and rats have attacked the maize or regularly removing the maize for sunning outside while applying chemicals repeatedly hence wastage or spillages. The metal silo can store maize for a long time up to 5 years enhances food security and the farmers noted that they can now plan how to use the

maize and; look for grain markets and sell at a good price. Given these advantages, brought about the metal silos, farmers are planning to grow more maize in the next season and also foresee getting more profits and returns.

Farmers who have adopted post-harvest technologies corroborated that metal silos and super grains bags are more effective compared with traditional ones, though men, prefer metal silos to the super grain bags because of their durability over a long period, cost effectiveness capacity or size and safety. The metal silo also helps farmers in planning better in terms of how much grain to store, when to sell and at what price. This they say, will enable them become more effective, be able to generate better incomes from farming and therefore enhance food security at the household level. Some households prefer to use both metal silos and super grain bags so that they can store maize for immediate consumption in the super grain bags (within 3 months) and maize for later consumption in the metal silos.

In terms of technology dissemination farmers recommended that: non-profit making institutions such as village polytechnics and agricultural technologies development centres (ADTCs in ministry of agriculture) should be used for fabrications since, metal silos are slow moving products and made mostly on order, therefore agro-vets or artisans do not make easy profit either from making or displaying them. Since the cost of making silos is too high, buying of the silos should be subsidised up to 50 percent and payments made by instalments for over one year. Farmers recommended the need to train local artisans to lower the cost of buying while dissemination should be done through churches and schools to effectively reach the women and youth. Other recommendations include: fabricating the silos on site (in the house/store) in order to avoid breaking the door or roof upon purchase; reducing the prices of the super grain bags that are currently 5 to 8 times higher than the ordinary gunny bags; making available cheaper credit source for men, women and youth to buy metal silos and; making metal silos lockable.

Farmers talked of issues they see as challenges in the context of adopting the metal silo and these include: lack of awareness; improper use of the technology; lack of access to credit to buy the technology; high cost of metal silos; the perception that it is an ‘expensive technology’ and; also low maize productivity in the area.

8.5 Improved PH Technology Management at Community Level

Community storage facilities are not in Nakuru or Naivasha given the following reasons:

- Communities mistrust of each other - farmers said that some people may take advantage of common stores to get more maize than that which they put in;
- People have different needs and others may require to take their maize before the rest therefore creating a problem in terms of distribution and prices;
- In case the maize is destroyed by aflotoxin, fire or is stolen then everyone will suffer losses;
- Who is to finance and maintain community stores;
- Division of roles and responsibilities between men and women regarding the facility. Men may gain total control over the cereals, while women depend on them to access it.

Many of the respondents were well aware of community storage facilities. In Nakuru the agricultural extension officers (AEOs) carried out several campaigns sponsored by national agricultural, livestock and environment programme (NAALEP) regarding community storage facilities and their benefits to the community members. Respondents agreed that community storage facilities have several advantages including: reducing wastage per family; the maize can be stored for longer periods of time and sold when prices escalate; the costs for storage maintenance will be distributed among the community members hence it is cheaper and; most important, food security will be improved at both the household and community levels.

Several farmers from Naivasha have seen storage facilities in Narok and are aware of the benefits that farmers accrue from using them, pointing out that these were successful because they were run and managed by NCPB. They therefore suggest that NCPB should introduce a depot where farmers can take their maize to be dried and stored until the market prices increased then sell them with good profits. In Nakuru there is a privately owned storage facility in Lanet called Lesiolo where farmers can take their maize for drying and storage after harvest over some duration of time and then take them and sell when supply is low and the prices are up. However,

none of the respondents have taken their maize to this plant as it is expensive and can only yield good returns if one is farming large tracts of land.

Some of the women groups in both Nakuru and Naivasha farm communally but once their maize is ready they are sold to middlemen and then the profits equally distributed among group members. This is in addition to having their own separate farms and therefore they are able to compare the two and have concluded that in-group farming they distribute losses and share the gains.

Nevertheless, farmers from Nakuru were adamant that they would not want to venture into community stores and since there are no such facilities available to them at the moment, the costs of building one is inhibitive incurred and also they do not have the incentives to venture into one. A large number of farmers in Naivasha however, stated that they would like to have a community storage facility for their maize as this would help them counter many of the losses that they are presently experiencing especially in drying the maize given the cold weather in the area. The few that are not of the idea of having community storage facilities indicated their greatest fears are; improper management of such facilities and distrust among the farmers.

In order to encourage farmers to adopt the metal silos the following issues should be addressed: affordability of the metal silos for the different categories – women, men and the youth; credit facilities to motivate more potential buyers especially those who own limited household assets; awareness campaigns and demonstration targeting all farmers equally; size of the metal silos addressing the different preferences for women and men; regular exchange visits to learn from other farmers; and finally follow-up visits to solicit views to guide improvement of the technology.

9.0 Improved Post Harvest Technology Delivery and Promotion

9.1 Introduction

This section presents approaches used by EGSP partners to deliver the improved technologies and artisans' activities, their levels of awareness and capacity to reach women, men and youth. An audit of EGSP partners is conducted to assess, organisations' gender capacity; staff capacity and knowledge to address gender in PHT and; gender designated budgets in programmes. Artisans provided insights into strategies used for marketing, promotion, and market segmentations; knowledge of design preferences by women and men and; challenges of metal silo business, opportunities and key gender aspects.

9.2 Gender and Improved Technology Delivery – EGSP's Approach

The CIMMYT partners are: Agricultural Development of Caritas Embu, Nakuru and Homa-Bay. In Kenya, EGSP is being implemented by Caritas at community level including, the promotion and dissemination of effective grain storage technologies; consulting with stakeholders on effective postharvest technology, policy environment, and market issues and; creating awareness.[66]

Caritas 'Agriculture and Rural Development Programme (ARDP) works with smallholder farmers, marginalized and vulnerable communities especially women and displaced persons in Nakuru, Naivasha and Kipkelion. Although, this approach is meant to be inclusive to reach both women and men, in reality, the ARDP ended up working with more women (90 percent) than men, but this was rather by default, and not by designed strategies or activities targeting women.

Statistically more women than men are engaged in rural agriculture (60 to 70 percent); have mobilised themselves into groups (i.e. women's groups). Using lessons learnt from ARDP, Caritas in EGSP are using the same approach and the entry point is through groups composed of both small and medium scale famers. According to field extension staff:

> *"Women are also the ones more engaged in farming. These women are mostly found in women groups who are registered, structured and involved in one form or another in community development activities. They are therefore the easiest, safest and most*

[66] Effective Grain Storage Project (EGSP) Phase II – Background Document

effective avenues to target and engage with the community. The men, on the other hand, are usually involved in activities outside the home and community. ”

Thus, promotion and dissemination of post harvest technologies is mainly done through groups, organised farmers trainings; meetings with farmers in their farms, field days and exhibitions. These are effective but with an obvious bias toward women smallholders. For example, targeting the youth in EGSP is easier said than done, since the youth still prefer office employment to farming and enterprises that bring quick incomes, while the female youth is almost absent from the targeted women's groups or male youth groups. In order to reach the different groups, women, men, female and male youth there is need for EGSP to develop and use innovative strategies for disseminating these post-harvest technologies.

The research team found that in the initial EGSP implementation in Nakuru and Naivasha, the metal silos and super grain bags, first targeted male farmers. This is also reflected in the way women in those households that have adopted the post harvest technologies. Women give the men the upper hand in the ownership of the metal silo, leaving them to maintain, clean and to make the necessary decisions. Focus group participants made the following recommendations on how the different groups can be reached through in the dissemination of agricultural technologies:

- Use of chiefs *baraza's* (meetings**)**, extension officers, DOs, chiefs, extension farmers, groups, and agro-vets, CBOs, FBOs and NGOs and local religious grouping such as churches,
- Extension visits to women's groups particularly during their regular meeting day,
- Pamphlets, brochures and leaflets,
- Field demonstrations by agricultural extension officers,
- Exchange visits by farmer groups among adapters and future adapters of the technology (i.e. Nakuru, Naivasha to Embu),
- Displaying samples of metal silo or super grain-bag at agro-vet shops,
- Broadcasting in local vernacular radio stations,
- Farmer to farmer - testimonies who have successfully used the technologies,
- Train artisans locally to encourage more farmers to buy the technology and,

- Set up fabrication centres in the villages (youth polytechnics) and distribute the technologies through the state department of agriculture.

9.2.1 Gender Audit of EGSP Implementing Partner – Caritas Nakuru

A partial gender audit was conducted for Caritas Nakuru to examine gender integration in EGSP activities; tools and approaches used to ensure that the programme equally benefit both women, men and the youth; and capacity, experience and attitude of staff on gender programming. Agricultural Rural Development Programme (ARDP) Nakuru is composed of 14 members of staff (11 males and 3 females out of which 2 females are support staff and 1 is a community resource person). The men hold the entire senior positions in management and programme (Table 6).

Table 6: Staffing Level and Structure

	Females	**Males**
Senior management staff	0	6
Programme staff	1	5
Support staff	2	0
Total	**3**	**11**

ARDP does not have a gender policy but they have a gender officer who was recently employed (2013) to address and mainstream gender issues in the programme. Measures have been taken to integrate gender issues in the programme by collecting sex disaggregated data; gender capacity building and training of staff; and gender awareness and sensitization in the communities. Staff members are aware of issues of gender relations in the household given their interventions, especially asking questions like, who does what in the farming arrangements. ARDP has an annual budget of about 16 million Kenyan shillings per year, none of which is used in gender mainstreaming activities. Yet, it has become evident in the EGSP programme that the technology is embraced by different members of the community women and men; and that, these post-harvest technologies will impact differently on the gender relations among members of the household. Consequently, it is important for the programme staff to understand and take into

consideration these dynamics as they promote metal silo and super grain bags. Staff members should recognize the need to get more training in gender planning and programming so that they can be more effective when disseminating and promoting agricultural technologies, especially within the EGSP.

A clear and agreed principle on gender staffing policy that promotes gender balance within the organisation and fosters a culture in which women interact on the basis of equality has important benefits and consistent with internal sustainability and attainment of greater diversity in the organisation. Gender-aware male staff members are central to reaching men within the communities and changing their attitudes, and this can also help women, in dealing with men's hierarchies and thus breaking down cultural barriers.

9.3 Gender and Improved Technology Development and Access- Insights from Artisan

Criteria for selecting artisans to be trained on metal silo fabrication took into consideration: age; experience in technical work especially in metalwork; occupation at the point of training and main professional training; and ownership of a metal-workshop at the point of training. A study carried out in Kenya by Ndegwa *et al*. (2013) showed that, ownership of a workshop at the point of training increases the likelihood of one starting a silo business and receiving tenders directly and a strong positive relationship between years of experience in technical work and ownership of a workshop by the time of first training.[67] About 200 artisans have been trained in 2012 and 2013.

Artisans were interviewed from different villages in Embu- Mbeere North and South. Other than making metal silos, the artisans also engage in various metal works such as making water, milk cans, and metal suitcases. Most of the artisans interviewed have not received formal training in the trade but learned through apprenticeship and mentorship. In 2003, 2009, and 2013, CARITAS with support from CIMMYT trained artisans and awarded them with certificates and toolboxes. The trained artisans were organized into groups to fabricate the silos, sell and then split the profits. The trained artisans are the ones who provide the untrained artisans apprenticeship in their workshops. CARITAS still provides follows-up assessment of the trained

[67] Michael K. Ndegwa, Hugo De Groote and Zachary M. Gitonga Centre ' 89- Assessment of Metal Silo Business Up-Take among the CIMMYT-Trained Artisans in Kenya' CIMMYT Contributed paper prepared for submission to the 4th Conference of the African Association of Agricultural Economists (AAAE), 22-25 September 2013, Tunisia

artisans, providing additional coaching on the making of metal silos. However, the artisans prefer to make the silos individually to get adequate profits given the varied expenses that they incur when fabricating one and therefore most of the artisans disbanded the groups under which they were trained.

Some successful artisans reported that there is an adequate market for metal silos in Embu especially among institutions such as schools, churches and orphanages. A few progressive artisans have spread their trade beyond Embu County, to the neighbouring districts such as Machakos, Makueni and Nyeri. Others have diverged into training other artisans in fabricating the metal silos. One artisan, Benjamin Njue has become a best example of a successful artisan, who is called to other African countries to train metal silo artisans.

Benjamine Njue comes from Mbeere South District, Embu. And he has been in metal fabrication since 1991. He has been making metal silos since 2003 after having been trained by CARITAS. Njue owns a metal workshop at Kiritiri Market, and employs two artisans to help him namely,Moses Mugendi and Japhet Muthee. Their main role is to design and fabricating metals. Metal fabrication is Njue's only business and source of income. He started with making metal boxes, water gutters, dropping pipes, feeders and drinking metal troughs for poultry, boilers for washing hands in hotels, brooders for chicks and metal silos. Njue was trained as a trainer of trainers (TOT) in metal silo making and has been provided opportunity by CIMMYT to train outside the country – Ethiopia, Zambia, Malawi, Uganda and Zimbabwe. Whenever Njue gets large order, he recruits other trained artisans to help him. Most of his customers are individual male farmers interested in gutters due to water problem in the area, metal boxes and mainly preferred by school children and large size metal silos used in schools and institutions.

Njue explained that making metal silos is expensive. The galvanized sheet gauge 24 for making small silos and gauge 22 for making big silos are bought from Nairobi (approximately 130 km away from Embu) and added to transport cost, makes the silos too expensive just for display in his workshop and so he makes them only on order. Njue receives an estimated 100 metal silo orders per year of different sizes. The silos cost as follows according to capacity of 90 Kilogramme bags:

- 1bag Ksh 4500 (USD 56),
- 2 bags Ksh 6500 (USD 81),
- 3 bags Ksh 9000 (USD 112),
- 5 bags Ksh 12000 (USD 150),
- 10 bags Ksh 18,000 (USD 225),
- 20 bags Ksh 25,000 (USD 312),

- 30 bags Ksh 32,000 (USD 400),
- 40 bags Ksh 45,000 (USD 562).

Njue's buyers are institutions such as CIMMYT, Catholic Diocese which use them for demonstrations/experiments and distribution to farmers; NGO such as ACDI-VOCA buys and distribute to farmers in arid and semi- arid lands -Machakos, and Kitui; individual farmers and; institutions such as schools who mostly prefer 30 bags capacity. According to Njue, the silos preference is different for men and women. Men prefer big capacity metal silos for business and women prefer small silos for domestic use to store grains for home consumption. Male heads of households are some of his best customers, but not the youth. Adoption is nearly equal across gender, but institution such as schools makes most orders. Adoption amongst farmers is generally low for the reason that the area has poor harvests because of poor lack rains and therefore the farmers have nothing to store.

His strategies to reach more customers include using the internet (connect with CIMMYT) to advertise the metal silos and disseminating the information in *baraza* (chiefs meeting). Njue displays one silo at his workshop and targets all the farmers whether male or female. He has not done any promotional activities even though he plans to mobilise other artisans to form an association of metal silos fabricators. The future market according to Njue is promising, as farmers become aware of the technology, more would adopt to avoid losses and use of chemicals. He thinks that due to the high cost of the material which can only bought from Nairobi makes the silos too expensive and unaffordable for many farmers and also there is inadequate information on the different sizes of the silos and generally most farmers only know the big silo of 10 bags.

His personal challenge is that his business is not registered, not formalised and the workshop built on a road reserve; and again his workshop is too small to store fabricated silos. He recommends metal silos technology should be standardization by Kenya Bureau Standards to minimize sub-standard silos; that training at youth polytechnics will increase the skills of more artisans; continuous dissemination of the technology is critical and; and the government should be lobbied to wave tax on materials (metal sheet) will lower the cost of fabricating metal silos.

Some of the artisans have dropped out while others are subsidising their trade by making other metal products. Artisans face several challenges: lack of initial capital to start the business; low level of education; lack of entrepreneurial skill; lack of workshop and tools; poor networks among artisans themselves and; poor record keeping. From the artisan's perspective, the challenges of the metal silos include:

- ***High cost of material and limited working finance:*** The artisans reported that the cost of raw materials (galvanized iron sheets) were very expensive (e.g. highly taxed) and not available locally in Embu escalate the prices making the silos unaffordable for most small-scale farmers and to set profit margin for themselves. Limited working capital creates a challenge in the silo fabrication business,

- ***Low demand:*** Metal silos do not move fast and this is another challenge artisans' face in silo fabrication business. Artisans therefore only make the metal silos on-order - once deposit is paid. Low demand is explained to arise from low grain production in some areas such as Mbeere North, lack of purchasing power among smallholder farmers; lack of information and understanding the use of metal silos and; suitable markets selling the metal silos,

- ***Premises for trade and lack of tools:*** Most of the metal artisans interviewed are either employed by other artisans or are doing other businesses to get incomes. Most of the artisans run their own workshops informally occupying land not registered. Most of the times, tools are borrowed and this makes the business not reliable or profitable,

- ***Training package:*** Other artisans also reported that the trainings they have received only deals with the technical part of making the silos, but not on any other related issues such as marketing or gender relations in household. The artisans reported that they have noticed that women are more inclined to buy the silos but most of them reported not being in control over family fund, hence if they need to have a silo they ask their husbands to buy and,

- ***Poor communication:*** After the trainings, metal silo artisans do not have a forum for meeting and follow-up on their trade. Artisans cited poor communication network among themselves as a challenge in the business.

In order to address these challenges the artisans made several suggestions. First, artisans need to lobby the Government to remove the taxes pegged to galvanized iron sheets in order to make the metal silo affordable to most smallholder farmers. Second, to further cut costs of fabrication and transportation to and from Nairobi; the iron sheet materials should be readily available in the

local markets. Third, to be able to lobby government effectively, they should form Artisans Association, a forum for sharing experiences, and addressing other issues affecting the trade, such as access to credit or secure land tenure for their workshops. Fourth, since, metal silos were distributed directly to farmers without involving the artisans they are proposing that their linkage with agricultural extension officers be strengthened, so that when the extension staff meets the farmers they are also with them to promote the metal silos and their trade.

Fifth, the artisans training package should include: business management; marketing strategies; gender and record keeping of adopters. Gender training will enhance their business/trade in terms of targeting the different categories of farmers- men, women and the youth. Artisans also see that, without well and inclusive targeting will not promote their businesses. When trained on gender issues, and they are made to be aware and sensitised, this will assist them in fabricating the metal silos according to the different needs of women and men and as a result sell more and grow their businesses.

Sixth, training more artisans in the village polytechnics could improve general awareness of metal silos in the communities. Demonstrations held on market days and artisan's workshops will create more awareness among farmers. A deliberate effort has to be made to: market the metal silos; to target women men and the youth and; to encourage more women to become artisans and to join the trade.

10.0 Discussions of Major Findings

This study has delved into the gender relations in the crop post-harvest sub-sector, and efforts made to obtain a better understanding of gender norms that shape women and men's post-harvest practices and experiences across the different socio-cultural farming contexts. Also investigated is how effective is gender equality ensured in the technology development, promotion, dissemination and adoption and; how are the post-harvest technologies benefiting women and men. Several key findings emanate from this study: first, members of the household have distinctive tasks to perform. Thus, sexual division of labor in post-harvest management of maize was very explicit and women and men perform different tasks as follows:

- All members of the family (women, men, youth and hired male labor) take responsibility over de-husking, stalking of the maize; and transporting from the farm to the homestead. Shelling using machines and marketing is a task carried out by men and male youth. On the other hand, women put more of their labour in winnowing if this is being done manually; drying; storing and; preparation for consumption,

- Cultural prescription on what women or men do still do influence these tasks but some of them are slowly eroding and in some instances men are involved in maize winnowing when using the shelling machine a task which was exclusively done by women only. On the other hand, in the absence of the male headed household, women perform all the other tasks traditionally, only done by men such as cutting or piling of maize stalks and transporting from the farm to the homes,

- Division of labor vary among the pastoralists and agricultural communities. In the pastoralists communities (Maasai and Kalenjin) women perform all the tasks related to post harvest activities; while among the Agikuyu, Luyhia, Luo, Kamba, the division of labor is generally, still by gender,

- Thus, division of labor is cultural-specific and is also affected by individual farm household characteristic, levels of income; access to technology; and appropriateness of the specific technology.

Second, the metal silo as a post-harvest technology seems to be modelled as package from elsewhere without considering its appropriateness to the cultural context. The perception of the local communities about their active involvement in the metal silo development is largely lacking and consequently, the farmers both women and men have given several recommendation on how to improve on it. The key ones being that: the metal silos be made small to fit inside the houses without destroying walls and doors; women prefer shorter and wider ones to access the grains without assistance; and most men would like lockable metal silos.

Third, Promotion and dissemination of post-harvest technologies is mainly done through; women's groups, organised farmers trainings; meetings with farmers in their farms, field days

and exhibitions. Although, a larger number of women are reached, this is by default and not by design since the implementers do not have gender strategies for ensuring gender equality in the promotion, dissemination and adoption of the metal silo. In this report we have reasoned that, limited adoption can reflect a number of factors including lack of consultation among potential beneficiaries to identify their needs and preferences or socio-cultural constraints encompassing the various gender norms and social barriers women face in accessing and adopting new technology.

Finally, among the communities in the study areas, both women and men are generally involved in decision-making regarding various farm issues like on-farm purchases or marketing of maize. However, men remain the key decision makers on the farm. However, since women and men have distinctive responsibilities, each make decision in the various spheres of post-harvest sphere that they control. This agrees with Agarwal's theory, that while some decisions maybe made by the man or woman alone, others maybe arrived at, after consultations with other members of the farm household, especially the spouse. It is also revealed that decision-making on the farm (including those to do with the choice of technology) though influenced by sex, are also influenced by other factors such market value of the commodity, availability of post-harvest technology, household level of income and socio-cultural setting. Socialisation process for women and men in the community also influences to a great extent, the attitudes, perceptions, preferences and these in turn determines choices made in the use of the metal silo or hermetic bag.

In this gender analysis study, we have argued that greater attention be paid, to how the new technologies are going to affect household relations; affect existing division of labor in post-harvest management of maize; and how the project should deliver and equally benefit women and men. Despite the complexities that prevail in relation to gender and agricultural technologies, there is lack of gender strategies guiding EGSP to effectively mainstream gender in post-harvest activities. This study provides empirical evidence, gives a holistic overview of the gender relations in grain post-harvest management and informs the development of a gender equality strategy that will ensure equitable processes and outcomes for men and women farmers in EGSP.

11.0 Suggestions for Gender Strategy for Post-Harvest Management

Drawing from the simultaneous gender analysis studies carried out in Kenya, Malawi, Zambia and Zimbabwe a gender strategy was developed at the CIMMYT meeting held in Zambia in May 2014. In this gender strategy suggestions are made for addressing the different aspects of post-harvest management (table 7):

- Training of artisans;
- Business development strategies by artisans for promoting women, men and the youth;
- Different market segmentation targeting the different groups;
- Strategies for customer satisfaction and support;
- Technology design addressing the different storage technology preferences

Training of artisans on gender issues is critical, so that they become more sensitive to the different needs of women, men and youth when fabricating the metal silos. Capacity strengthening of the artisans will make them become effective in developing, disseminating and marketing the metal silos. The gender training will also increase the artisans' awareness on the gender dynamics at the household levels; help them in terms of promoting and marketing the silos. Therefore, gender should be part of the main artisan's training package, which should include efficient market strategies reducing transaction costs; business skills; manufacturing; distribution; utilization and dissemination. It will be important to plan refresher courses to ensure that the artisans are up to date on the materials and markets. Various capacity strengthening efforts beyond training (e.g. mentorship, exchange visits) used to ensure outcomes that are more positive and tailored to local context to better respond to the needs of both women and men farmers, the end users of the technology.

Business development strategies by artisans include: mapping the number of women groups FBO's and NGO's in the region; linking up with agricultural extension officers; visiting individual farmers and market days to demonstrate metal silo model and its attributes in post harvest management, encouraging women, men and youth to buy. Private sector, including NGOs and church-based organisations are playing an increasing role in many communities to compliment public extension services in rural areas. It is useful to understand existing social networks among women and men farmers and support them in the process. Women organising themselves into women only groups, show potential to empower women, gain better access and

use of technology and improve livelihoods. Thus, collective action and social capital among women is one of the major factors that can influence adoption of the technology. Men can be reached through, Chief's meetings, farmer associations and cooperatives.

Other forms dissemination is through the media vernacular radio stations, newspapers, documentaries, television, pamphlets and brochures. Community radios provide opportunities for dissemination information about technologies and educating rural population. The use of information and communication technologies (ICTs) enables broad information sharing and has been shown to play a key role in empowering women and strengthening men and women's knowledge base and; are increasingly being used to disseminate information about technologies, markets and management practices.[68] Mobile phones also offer great opportunities for women and men, especially in the rural areas, to get connected with information relevant for their livelihoods and social welfare. The youth can mainly be reached through the internet and social media while message alerts sent to farmers' mobile phones can be very effective in reaching the different categories of the targets.

The market segments for metal silos are diverse and include individual women farmers, men farmers and youth farmers; women's groups; farmer groups; associations or cooperatives; institutions -schools, hospitals, orphanages and NGO's providing food relief; -individual cereal business owners; Ministry of Agriculture, County and sub-County governments.

Strategies for customer satisfaction and support after sale services include delivery of the metal silos and demonstration of how to use it by loading the first batch of the grain in the silos and ensuring that it is working well; and providing pamphlets clearly demonstrating how it is used and maintained. The different needs of men, women and youth should be taken in consideration in the design, size and price of the metal silos; and these groups be targeted during promotion and dissemination. Alternative methods of payment allowed when farmers buy the metal silos, such as use of crops instead of cash to pay or buying by instalments. Create incentives such as reduced prices in certain seasons; guaranteed repairs and cleaning of the metal silos. Establishment of an Association of Artisans provides a forum for the artisans to share information; set standards for fabricating the metal silo; support each other; provide feedback

[68] Ragasa, C. 2012.

from adopters; and advocate to address policy issues affecting their industry i.e. high taxation on galvanized iron sheets used and availability of materials in the local markets. For the design of the technology, consultations with the different groups of farmer's women, men and youth are important to establish storage preferences.

Further research and assessment will reveal the impact of metal silos on gender dynamics in the household and post-harvest management; and build on the farmers' experiences and suggestions on ways to improve the design of the silos and expand the market and adoption by farmers. Training women artisans (to-date there is no woman artisan trained in metal silo fabrication) and involving women in its maintenance can be one strategy for challenging rigid gender roles so that women as men may own and benefit from the new technology.

Table 7: Gender Equality Strategy for Post-Harvest Management

Training for Artisans	**Business Development by Artisans**		
	Strategies for Promotion for the Different Sub-groups		
	Women	**Men**	**Youth**
- Gender sensitivity/awareness - Efficient market strategies Business skills, manufacturing, distribution, utilization & dissemination of the metal silos - Provide refresher courses-update on materials/markets - Deliberate efforts to train female artisans -The government should set up loan schemes for artisans -Facilitate formation of Association Of Artisans to advocate for policy changes i.e. removal of tax on metal silos materials	- Map women groups in the area - Identify organizations working with women groups i.e. FBO's and NGO's -Target women's groups with information /promotions of post harvest technologies i.e. metal silos - Carry out Field Days with Women's Groups/Networks -Extension visits to individual women -Farmer to farmer technology transfer -Use alternative disseminations approaches i.e. markets places -Subsidized mobile telephone transfer of messages	- Demonstrations on the use of metal silos in Chief's baraza's (Kenya) -Display metal silos at the artisans' metal workshops -Disseminate information through pamphlets -Hold demonstrations through farmer associations/cooperatives -Promote PHTs through Ministry of Agriculture and Extension -Train/inform vernacular radio stations, newspapers, documentaries and television - Use of mobile phones i.e. message alerts	-Disseminate information through ICTs i.e. telephone alerts; internet; social media
Market segmentation	**Technology Design**	**Strategies for Customer Satisfaction/Support**	
- Map different market segments i.e. individual women, men,	-Hold consultations with the different	- Demonstration on use of metal silos	

youth farmers - Farmer groups, associations or cooperatives - Institutions including schools, hospitals, orphanages, NGO's (i.e. World Hunger and Catholic Relief) - Individual cereal business owners -Ministry of Agriculture, County & sub-county governments	groups women, men, youth farmers - Carry gender research on the impact of metal silos	- Pamphlets showing loading, cleaning, maintaining of metal silos - Identify different needs of men/women/youth design, and preferences in size and price of metal silos - Target women youth, men in promotion, dissemination of post-harvest technologies - Link farmers with credit facilities to buy the metal silos and alternative methods of payments i.e. use of crops instead of cash; payment by instalments - Provide incentives to farmers buying metal silos i.e. price, guaranteed repairs; cleaning for a period of time etc. - Feedback - visits and follow-ups with farmers; - Artisans to keep records of the buyers for feedback

12.0 Study Limitations and Areas of Future Research

This analysis used both quantitative and qualitative approaches to understand the issues in post-harvest management; technology development and delivery of metal silo by artisans; technological testing, promotion and awareness creation by implementers and; to identify knowledge gaps for future research. While, using qualitative methods for in-depth understanding of post-harvest gender issues, careful consideration was taken to identify respondents, to ensure that the results obtained are as accurate as possible. These methods are extremely useful in carrying out the complex gender relations in post harvest management of grains and especially when personal issues are interrogated; while case profiles have generated meaningful results with small sample groups of metal silo adopters and artisans. However, limitations of these methodologies are recognised, that most of it is personal opinion and judgment, which are documented and observations made.

Quantitative data was collected through individual interviews with key informants purposively sampled and not randomly selected. However, it was difficult to obtain results through structured questionnaire, particularly on a sensitive topic such as gender relations in the households. While this study was on gender analysis of post-harvest technologies development, promotion and adoption, future studies should assess the impact of metal silos on gender equality in the household, division of labour, ownership of the technology, benefit and overall gender relations in the households.

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14.0 Annexes

14.1 Kenyan Study Context – Ethnic Composition

Study Location	Ethnic Composition	Percentage
Embu	Embu, Mbeere	
Naivasha	Kikuyu	86
	Kalenjin	5
	Maasai	5
	Luhyia	2
	Kamba	2
Nakuru	Kikuyu	93
	Kalenjin	1
	Kisii	3
	Luo	1
	Luhyia	1
	Kamba	1

14.2 Field Sample Nakuru and Naivasha

Study Area	Approach	FGD by Ethnicity and Gender
Nakuru	10 Focused Group discussions	2 FGDs with Kisii -1 Female composed -1 youth (both male and female)
		3 FGDs with the Kalenjin -Female/Male combined 4 1 Male

		5 1 Female
		1 FGD Luo/Luhyia -1 Female (Luo/Luhya combined)
		4 FDG with Agikuyu 2 1 Female 3 1 Youth 4 1 Male 5 1 Combined
	Individual Interviews	
	4 Extension workers	2 Females and 2 Males
	8 Key Informants	4 Females (Kikuyu), 4 Males (3 kikuyu and 1 Luhya)
	Partial Gender Audit	
	CARITAS - Nakuru	Coordinator- Agricultural Rural Development Programme (ARDP)
		Caritas Director – Catholic Diocese of Nakuru
		Coordinator - EGSP
		2 Community Resource Persons (ARDP)
Naivasha		
	8 Focused Group Discussions	4 FGDs with Kikuyu 6 1 Female 7 1 Youth 8 1 Male 9 1 Combined
		3 FGDs with the Maasai 10 1 Female 11 1 Male 12 1 Combined
		1 FGD with Turkana/Borana

		combined
	Individual Interviews	
	4 Extension workers 8 Key Informants	2 Females and 2 Males
		2 with Kikuyu – 2 Males
		5 with Kalenjin –2 males and 3 females
		1 Akamba Female
	Partial Gender Audit	
	CARITAS - Naivasha Brunch	2 Community Resource Persons (1 Female and 1 Male)
Embu	**Individual Interviews**	16 Artisans - all male
	Case Profiling of Farmers	8 Females and 7 Females