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Drought Disaster Risk Reduction through Agriculture Development, the Role of Appropriate Technology Transfer: Experiences from Swaziland

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Abstract
Agriculture is vulnerable to climate change posing challenges for development and poverty reduction. Recurrent droughts have affected Swaziland significantly more so because many households depend on agriculture for their livelihoods, and to compound to this, the country has been affected by general economic decline and the impact of HIV and AIDS, creating vicious cycles of vulnerability, poverty and food insecurity for the poor. Drought in the Lowveld agro-ecological zone affects household economy and food security, with major impacts being reduction in agricultural production and water availability for domestic purposes. This study evaluated the impact of drought mitigation programs and the nature of the farming community response to the droughts in the Lowveld between 2007 and 2012. The study involved use of both qualitative and quantitative approaches where primary data were collected from Non-Governmental Organizations' drought mitigation programs beneficiaries. The findings show that drought was a major contributor to food insecurity which in turn impacted on the health and productivity of the farmers. Communities resorted to reactive planning and response to drought and its impact, which was compounded by inadequacy of the extension support services especially such as lack of media for disseminating early-warning information and drought mitigation information. The uptake of drought mitigation programs have been slow, attributed to poor beneficiary targeting as well as a high food aid dependency syndrome. Most NGOs still use top down approach for agriculture extension as well as having a tendency of giving relief assistance without thorough sustainability planning, which has affected overall uptake of development programs.
Keywords: Climate Change, Drought, Disaster Risk Reduction, Resilience, HIV/AIDS, coping strategies, climate smart agriculture.

1. Introduction

Addressing the needs of the vulnerable communities of Swaziland is critical, especially because the society is still bearing the brunt of the serious impact of HIV and AIDS, economic decline, poor agricultural production due erratic rainfall, cyclical droughts, lack of arable land, and diminishing capacity of national institutions to cope with the decline in social services which have become a burden especially in their impact on food security. Compounding to this, the impact of climate change and variability is threatening food production systems, livelihoods and food security of the country as livelihoods are mostly agro based, considering that 70% of the population is living in rural areas and are resource poor farmers. The resilience and ability of the communities to face and manage these challenges is continuously being compromised thereby continuing the vicious cycle of poverty and vulnerability.

Consistent warming trends and frequent and intense extreme weather events (such as floods and droughts) that have been observed across the country in recent decades (GOS, 2013) are evidence of climate change and variability, which is threatening Swaziland's quest to achieve sustainable development and therefore the livelihoods and food security of the population. In 2007 a severe drought affected all the regions of Swaziland, to the extent that the government declared a national disaster. Over 410,000 people in that year required humanitarian assistance, including food aid and agricultural inputs, water and sanitation, health and nutrition services and early recovery interventions. Most of the affected emanated from the South east of Swaziland, the lowveld Agro ecological zone (AEZ) that historically has the lowest precipitation levels in the county ranging from 500 mm-750 mm. In 2008, out of the 287,634 people in need of food aid, 129,221 came from the Lowveld AEZ (SVAC, 2008) representing 45% of the total beneficiaries. The SVAC, 2012 also highlighted that the Lowveld AEZ faced a severe crop loss hazard which resulted in low yields.

1.1 Context and Justification

It is estimated that 80 per cent of poor people in Sub-Saharan Africa continue to depend on the agricultural sector for their livelihoods, but the region is characterized by very low yields due to varying climatic condition and varied agro ecological zones, lack and loss of knowledge and unavailability and high cost of inputs, and low

levels of investment in infrastructure and irrigation and devastating impacts of HIV and AIDS. Under such circumstances potential climate change could cause serious deterioration of rural livelihoods and increased food insecurity in Sub-Saharan Africa.

The majority of the farmers in Swaziland rely on subsistence farming for their livelihoods and consecutive years of drought have undermined crop production, particularly maize. In an effort to mitigate and improve the deteriorating livelihoods, the Government of Swaziland and development partners (NGOs, international organisations and private sector) have dramatically increased the growth in development programmes in the lowveld AEZ over the past decade. A huge amount of this development funding was directed at improving livelihoods and mitigating impacts of drought through transfer of agriculture technology.

Non-Governmental Organisations (NGOs) have been used to bridge the gap between institutional extension services and research and development. Despite the strengths of techniques promoted by NGOs, the sustainability of projects in the agriculture and food security sector is very low. Several years have passed since the influx of NGOs in Swaziland and one would expect that agriculture production, HIV/AIDS prevalence and others factors affecting livelihoods would have improved, however to the contrary, the households' livelihoods status is declining. It is therefore necessary to understand why so much investment in human and economic development is not correlating to improvement of rural communities livelihoods in Swaziland.

There has been little analysis done to assess the impact of the drought mitigation programs and the resulting increased farmer preparedness and resilience. This study evaluated the impact of drought mitigation programs and assessed the nature of responses by the farming community to the droughts in the Lowveld between 2007 and 2012. The outcome of the research envisages to support policymakers, DRR Planners, and researchers to better plan for climate change through climate smart DRR response strategies to improve agriculture and vulnerable households' livelihoods in the region.

2. Drought disaster risk in Swaziland

Out of 100 disasters reported worldwide, only 20 occur in Africa, but Africa suffers 60% of all disaster-related deaths. Of the total natural disasters that meet EMDAT[1] criteria, almost 90 % are of a hydro meteorological phenomena such as droughts, storms and floods. Drought is affecting the livelihoods of millions of people worldwide in many different ways, and specifically the 200 million people living in southern Africa (FAO, 2004) causing billions of dollars in loss annually especially for the farming communities. Disadvantaged people in Swaziland are feeling the impacts of climate change and variability, this is partly because so many depend on agriculture for their livelihoods. Poverty is concentrated mainly in areas where the climate is most unfavourable and agricultural productivity is lowest. Swaziland is predominantly an agrarian country as more than 70% of its population is dependent on rain fed agriculture.

Between 1979 and 2013, Swaziland has experienced two major droughts and long dry spell which all impacted the communities differently. Data from EMDAT (2005-2007), Swaziland Vulnerability Reports (2005-2013), show the differentiated impact of droughts and dry spells on community livelihood. The drought in 1983 had the largest human loss of 500 people, whereas the 2006-2007 drought affected 410,000 people. Based on simple analysis on frequency of droughts and the number of people affected, the drought trend shows the likelihood of 3.1 droughts per decade with an average of 184,900 people being affected per drought. With a population estimated at 1,403,362 (CIA, 2013), it indicates 13% of the population being affected, which is significant considering that Swaziland is affected by many other hazards, most significantly HIV and AIDS.

2.1 Drought disaster risk reduction (DDRR) programming in Swaziland

Drought is a normal part of southern Africa's climate and one of the most important natural disasters in southern Africa. It is highly unusual for drought not to occur somewhere in southern Africa each year whilst having varied impacts among them food insecurity. Most of the DDRR activities involved establishing and utilizing early warning systems, strengthening agricultural livelihoods to mitigate the impacts of drought and food insecurity, livelihood diversification and improved farming techniques and managing and reversing environmental impacts of land degradation. The main programs implemented in Swaziland are Conservation Agriculture, Holistic Land and Livestock Management, Multi Use Water Supply, Use of Drought Tolerant Seed, Crop Diversification, Livestock Management, Access to Inputs, Rain Water Harvesting and Small Scale Irrigation. Funding for these programs has been sourced from multinational, multi-lateral donors that included USAID, African Development Bank, European Union, and IFAD amongst many others, and individual donors that come through faith based organizations.

[1] Emergency Events Database, an initiative aimed to rationalize decision making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. EMDAT distinguishes two generic categories for disasters (natural and technological).

3. Technology transfer for agriculture development

Effective and improved rural agriculture output ensues from constant flow of new adaptive technology. Developments in agriculture technology will remain the fundamental source of growth in crop and animal production, with almost all increases in agricultural production in the future coming from agricultural intensification on limited land currently dedicated to crop and livestock production (Mousa, 2002), limited rain, increased temperatures and labour and input shortages. The adoption of new management and production practices is therefore key to maintaining profitable and sustainable agricultural operations, as such, identification of new technologies through research is an important available resource for farmers. Of importance, however, is that information is disseminated and used by farmers. Several approaches of technology transfer exist for agriculture development, the "top down" approach where technology moves from research and development in a linear manner, to the farmer. The other approach, the "bottom up", which is participatory, whereby communities contribute in decision making and in the selection of the priorities to be pursued in their local area. Governments and NGOs are using a combination of both approaches depending on the technology being transferred.

3.1 Role of NGOs in technology generation and transfer

It is widely known that unless the results of research technology improvements are disseminated effectively and timely, technology transfer will not succeed. Government, private sector and NGOs technology transfer mechanisms are vital in connecting research institutions, extension systems and farmers to improved agriculture products. With the faltering economies, increases in dependency ratios, climate change, farmers have to adapt and be competitive, which makes the development and use of improved and alternative agriculture technologies, that allow effective utilization of limited financial, natural and human capital more relevant. The financial and human challenges facing governments in responding effectively to needs of rural communities has given NGOs the opportunities to provide a supporting role to the traditional institutional support mechanisms. NGOs are important agents of change and development in the country especially at the grassroots (Angba et al., 2008). NGOs are now involved in the development of new and dissemination of old technologies.

In their quest to improve livelihoods through use of increased productivity, NGOs have used a variety of mediums to transfer technologies, from short courses, skills development, demonstration plots and community based research trials, farmer field schools, role plays, media etc., combining both top-down and bottom-up approaches. While most government institutions are affected by low staff morale and apathy, NGO personnel are motivated and most of the time well remunerated. Of note worth is also the holistic approach by NGOs which integrates the social, economic and spiritual aspects affecting human beings thereby allowing them to deal with development issues systematically.

3.2 Performance of Non-Governmental Organizations in agriculture development

Over the last decade there has been a dramatic growth in the number of NGOs involved in humanitarian and development aid in Swaziland. The total amount of public funds being spent through NGOs has grown dramatically and the proportion of development aid going through NGOs, relative to bilateral or multilateral agencies, has also increased. Non-Governmental Organizations have played remarkable functions in rural development in the Swaziland agriculture sector from activities such as human capital development of small scale farmers, financial capital support, supply of seed inputs, and provision of technical advice, research, monitoring and evaluation, promotion of good governance, poverty alleviation, education, and health.

NGOs are better equipped for rural needs by virtue of their simplicity, the proximity to the grassroots, their ability to identify felt needs of the people and their efficient and cost effective mode of operation (Angba et al., 2008). It is, however, widely recognized that despite some level of progress, the rural farmer's agriculture development has not been achieved to desired levels in spite of the large volume of investment in Africa (Mousa, 2002). This is attributed the scale of assistance by NGOs which is limited to the targeted communities unlike governments that look at national scale. NGOs however, have some advantages over governments and international donors in their ability to deliver humanitarian programs. Despite the powerful NGO record on agriculture and food security issue, their enormous potential has not been fully harnessed in much of Swaziland.

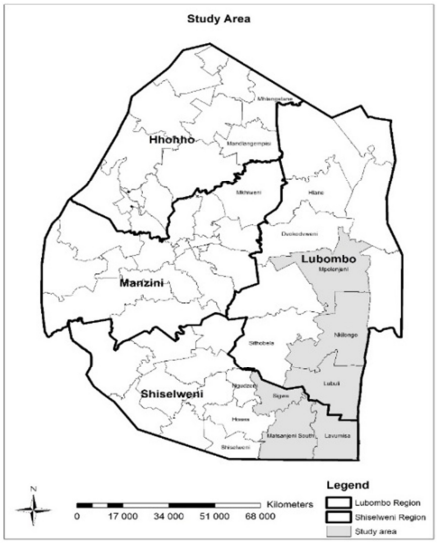

Figure 1. Map of study area

4. Research Methodology

The study was conducted in Shiselweni and Lubombo regions of Swaziland in six constituencies (Matsanjeni, Lubuli, Somntongo, Sigwe, Nkilongo and Mpolonjeni) where food security and agriculture programs were implemented by Non-Governmental Organisations. The study area is located in the lowveld agro ecological region which is the hottest and driest zone and the most vulnerable to drought. The researcher made use of purposive sampling of beneficiaries of climate change and drought mitigation programs. Data collection from 200 households was conducted through structured and unstructured interviews and questionnaires and focus group discussions. Key informant interview participants for the interviews were drawn from international and local NGOs, the government ministries, district and provincial bodies, the community and traditional leaders.

The research also involved going through literature produced on Swaziland in the recent years, literature on agriculture, food and politics and the impacts of NGO and government interventions. Data was also collected through looking at historical data, micro and macro socio economic, environment and political data from secondary sources books, articles, local and national government reports, published interviews and newspaper clippings. The research involved a period of six months of field work and interviews

5. Results and Discussion

5.1 Demographics of the projects

Demographic data is normally analysed and used for vulnerability classification, targeting and administering of emergency and development projects.

Age distribution

Almost half of the households (HH) (49%) were above 55 years old with 73% being women. Those aged between 36 and 55 years comprised 41% of the sample.

Marital status

The majority of the household heads were married (63%) and 32% were widowed and only 3% were single household heads. Of the widowed HH heads, the majority were women. Despite 63% of the HH being married, the participation in development activities is biased towards women. Males seek formal activities as compared to community activities.

Education status

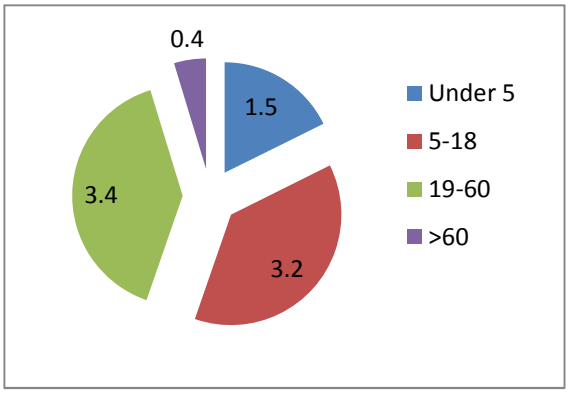

Figure 2. Composition of the household

According to a CI, 2014 statistics, the literacy rate in Swaziland stands at 89%. The study however showed, the majority, (63%) of the household heads were illiterate and 34% had low level of education (up to 6 years of primary education).

Household Composition

The mean HH size based on the Demographic Health Survey 2006-2007 (DHS, 2007) was 5. However, the study indicated the average household size as 8. In each household the largest age group was the 19-60 years (Figure 2) with a mean of 1.68, majority being women (mean=1.78) compared to men (mean=1.59).

5.2 *Main causes of food insecurity*

Figure 3 shows that 34% of the respondents cited drought as the main cause of food insecurity. 22% of the households cited the general economic crisis that affected the country as the main cause of food insecurity whilst 16.5% cited the impact of HIV/AIDS. With a population of 1,370,424[1] (July 2011 est.), Swaziland is besieged with the highest HIV and AIDS prevalence in the world at 26% of the adult population being infected. The

[1] CIA Factsheet – 2011 Estimates

combined effects of climatic variability, the impact of HIV and AIDS, reduced industrial and agricultural production capacity, following the high input prices, as well as the impact on economic meltdown (reduced SACU[1] receipts coupled with lower internal revenues, high levels of corruption, low GDP, high labour turnover), resulted in a decline in the economy and agriculture sector and led to a critical food security situation in that period.

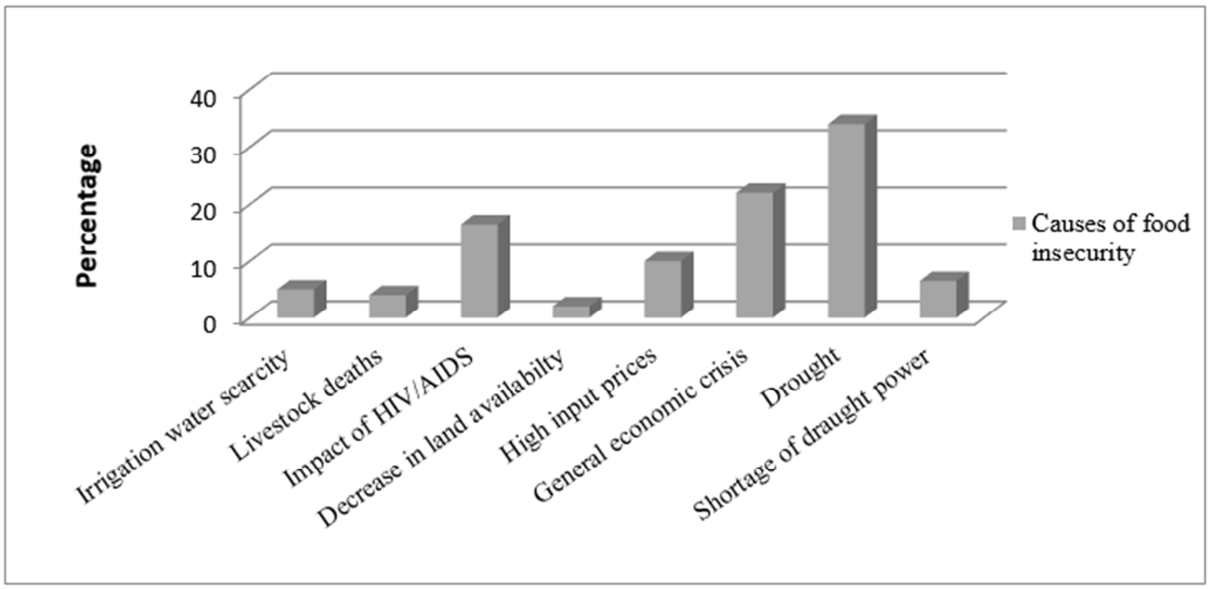

Figure 3. Main causes of food insecurity

5.3 Main shocks experienced during drought period 2007-2012

In the period 2007-2012 Swaziland faced droughts of varying intensities. Communities were exposed to a combinations in different ways and their responses and recovery periods were also varying. Figure 4 shows that 98.5 % of the respondents experienced reduced crops yields whereas 90% experienced decrease or loss of income, 79.5% experienced reduced grazing quality, 72% experienced a decrease in food availability and 44.5 % experienced livestock disease outbreaks and deaths

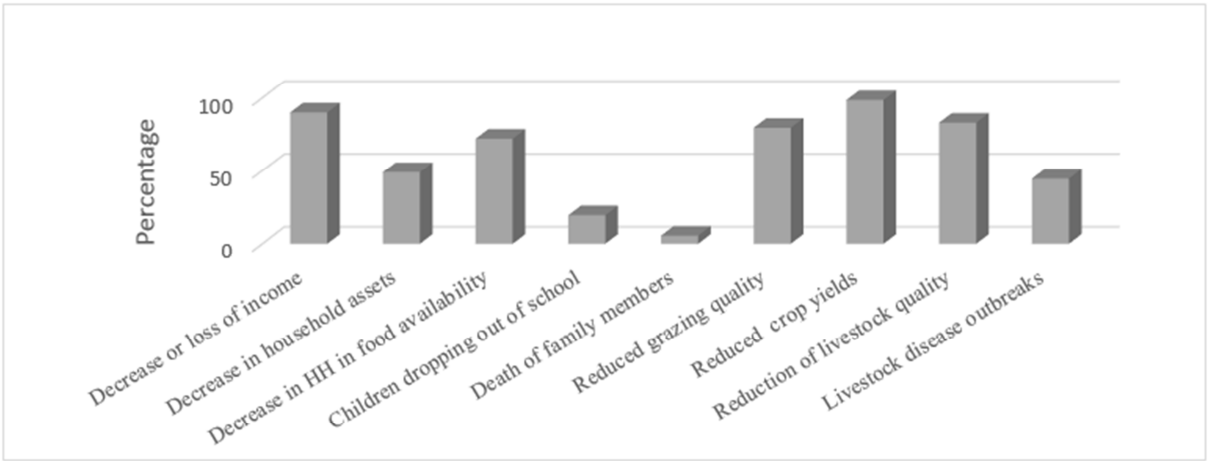

Figure 4. Shocks experienced drought 2007-2012 drought spells

[1]Customs and excise collected in the customs area are paid into South Africa' Revenue Fund and then shared among members.

5.4 Adoption of DRR programs -2007-2012

Early recovery, building resilience and disaster preparedness efforts occur simultaneously, but their objectives, mechanisms and expertise are normally different, however, are key to survival of affected communities. Different programs were initiated by government and NGOs communities adopted a combination of programs. .

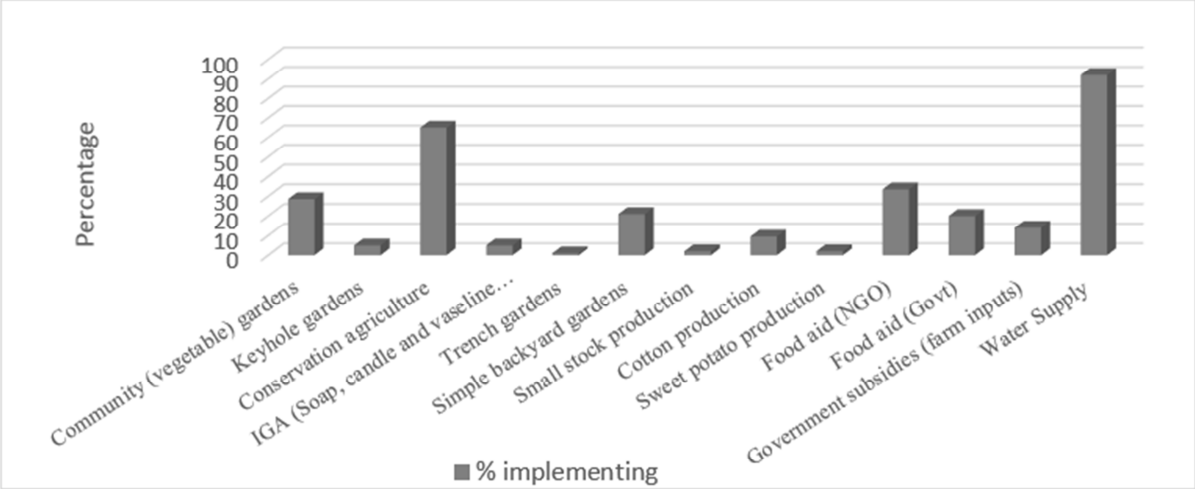

Figure 5. DRR programs adopted during 2007-2012 drought spells

Figure 5 shows the main programs adopted by the respondents. The majority (92%) of the respondents adopted water supply projects, 65% conservation agriculture, 33.5% and 20% received food aid by NGOs and government respectively

5.5 Community involvement in program design

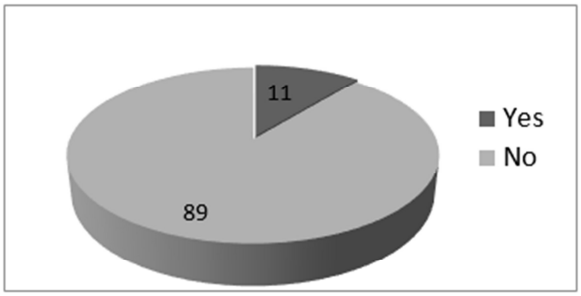

Figure 6. Beneficiaries consulted in program design

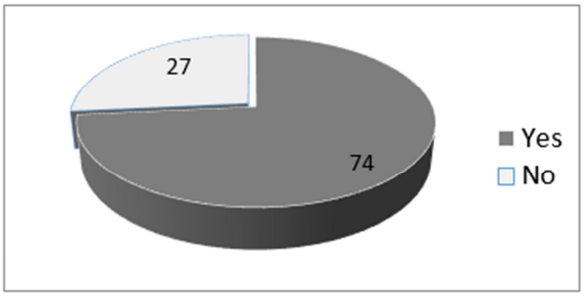

Figure 7. Program imposition

A study on relevance, accessibility and effectiveness of agricultural extension services (Keregero, 2000) revealed that agricultural extension services are only relevant to the extent that the objectives reflect the needs of clientele and activities are targeted to these needs. Involvement of beneficiaries at different levels of program therefore allows local people to present and manage their own priorities thereby improving the efficiency of development work and ensuring ownership of development activities at the community level.

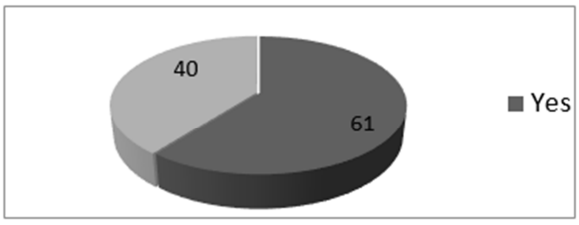

Figure 8. Appropriateness of promoted programs

Between the period of 2007 and 2012 for all the programs implemented in the targeted area, 89% of the respondents (Figure 6) indicated that they were not consulted in the program design. Further to this, 74% of the respondents (Figure 7) indicated that the programs they are implementing were imposed to on them and to a certain extent they do feel ownership of the activities. Community involvement can greatly increase the motivation and level of mobilisation in support of the project. Of noteworthy, however, is that 61% of the respondents (Figure 8) noted that the programs promoted in their area are appropriate for the challenges that they are facing

5.6 Technology transfer mechanisms

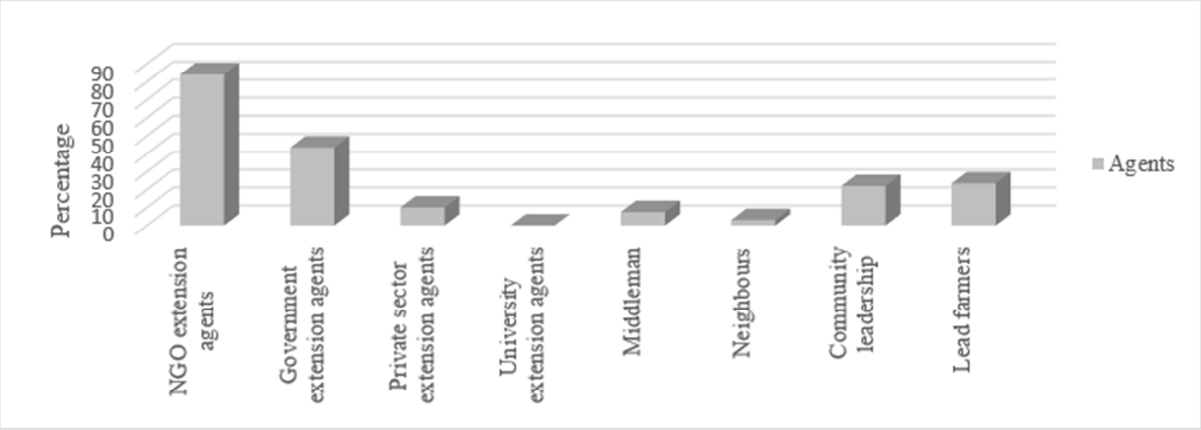

Figure 9. Agents involved in technology transfer

Eighty four percent of the respondents highlighted that their main source of technology was extension staff from NGO where 43.5% (Figure 9) highlighted to have received information of agriculture development from government extension agents.

5.7 *Sustainability of DRR programs implemented between 2007-2012*

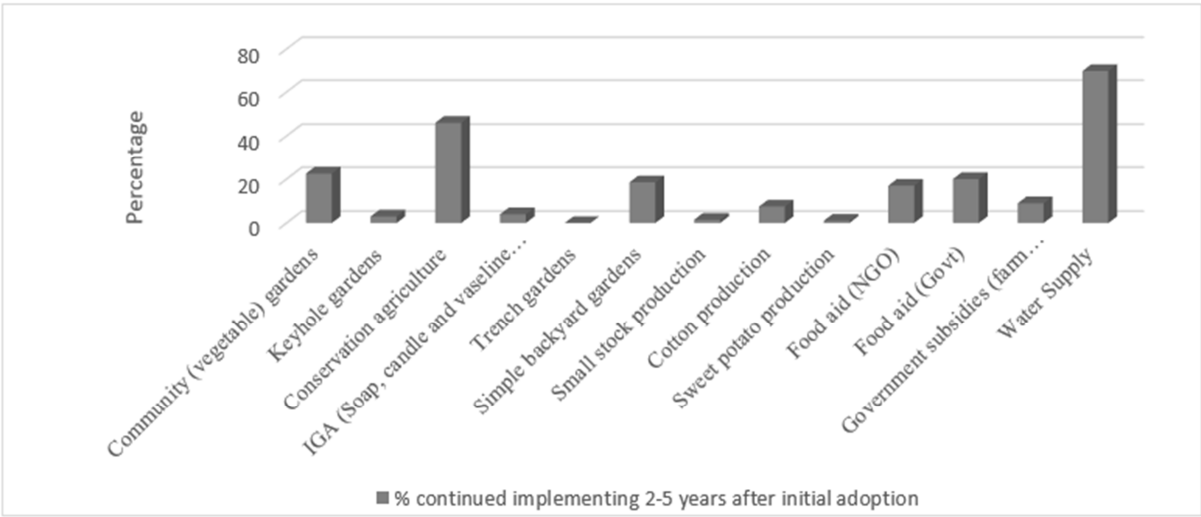

Figure 10. Sustainability of DRR programs

Of all the programs that were implemented between 2007 and 2012, the most sustainable projects were water supply as indicated by 70% of the respondents and conservation agriculture as indicated by 46 % of the respondents. Water supply projects were more sustainable (Figure 10) because the projects involved installation or construction of hardware material, therefore the role of the beneficiaries was just use and maintenance of the hardware infrastructure. All other projects required change in attitudes and practices. It is however, worthy to note that 17% of the projects were still being implemented 2-5 years after initial adoption.

5.8 Reasons for continued implementation of DRR programs

The main reasons attributed to the continued implementation of the promoted programs (figure 11) were that there they saw the benefits, as cited by 59% of the respondents, there was no better alternatives 44.5% and 27% of the respondents indicated, NGOs are still providing inputs. Focus group discussions indicated however that it was conflicting priorities and laziness that led may people to abandon development projects. However, the regular follow-up by the NGOs helped the sustainability of the development projects.

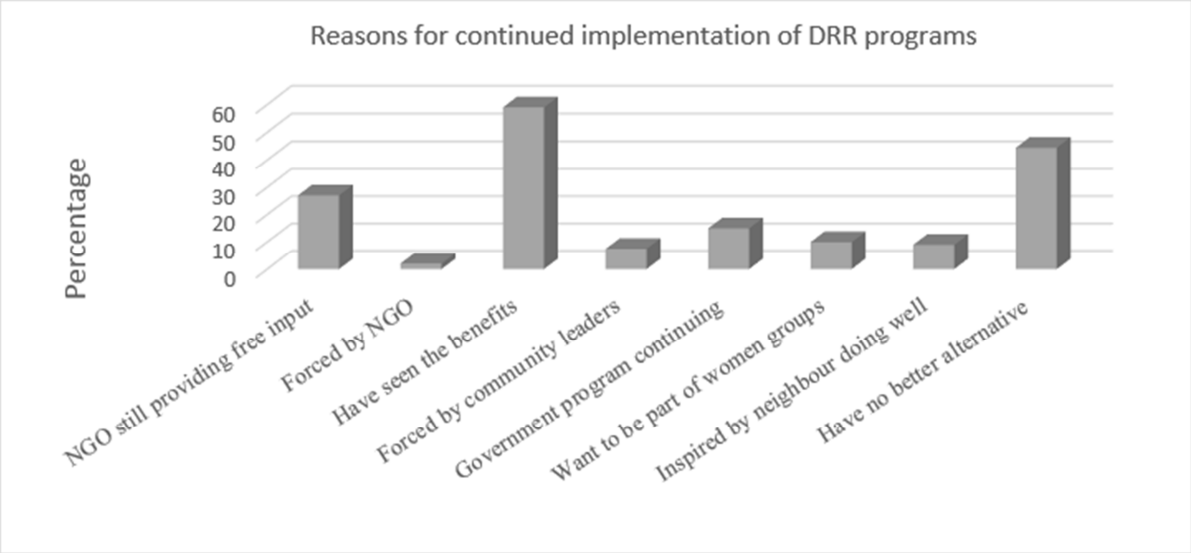

Figure 11. Reasons for continued implementation of DRR programsf DRR programs

5.9 Level of preparedness to future drought

When the respondents were asked if there were prepared for the next drought if it happens, 33% of the respondents (Figure 12) felt that they were poorly prepared whereas 25% felt that they were prepared. The main indicators for level of preparedness according the respondents were the nature of agriculture activities they are implementing and actions that government and NGOs would do the event of a serious drought.

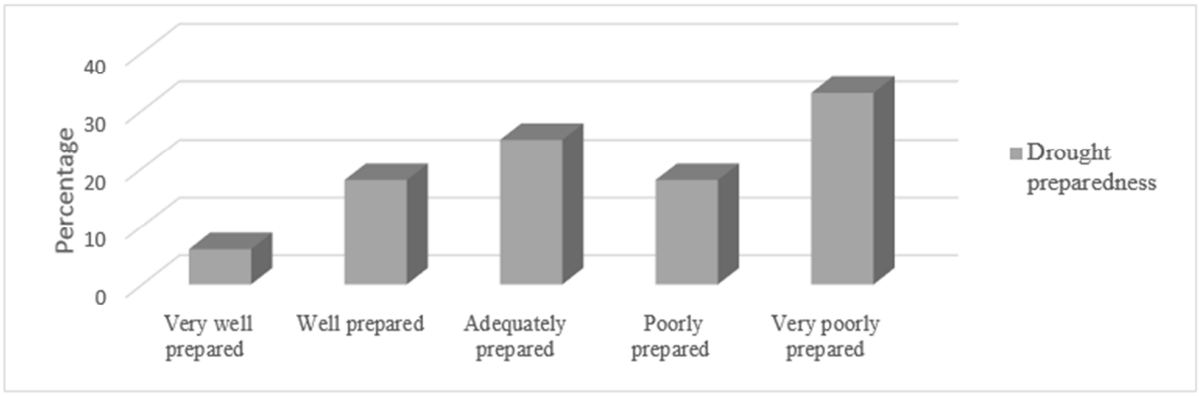

Figure 12. Level of drought preparedness

5.10Main reasons for lack of drought preparedness

The main reasons attributed to the lack of drought preparedness was lack of early warning information with 28 % (Figure 13) of the respondents whereas 22% indicated that there was lack of adequate extension services. Interesting to note was that despite all the DRR programs implemented in the area, 19% of the respondents felt that one cannot plan to mitigate the impacts of drought.

5.11Current preparedness to future droughts

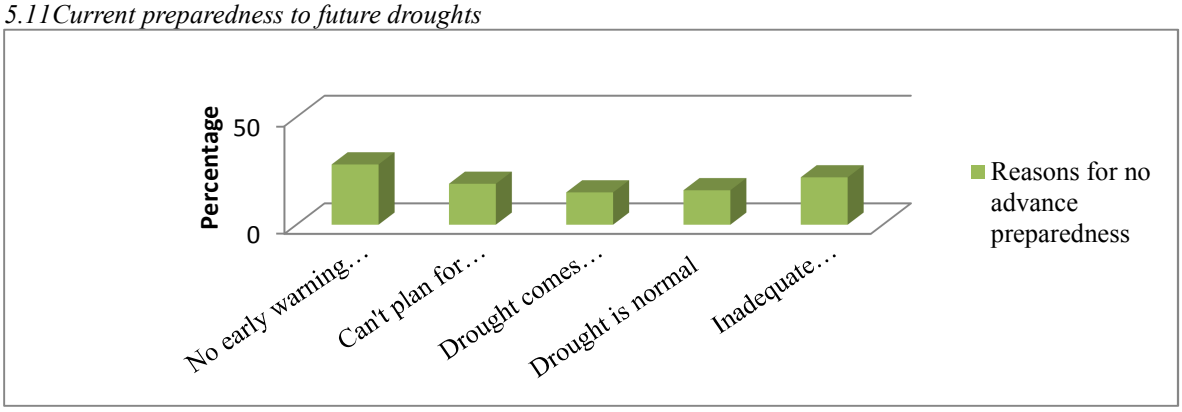

Figure 13 Reasons for no drought preparedness

It was noted through the study that 84% (Figure 14) of the respondents in the event of a drought will expect to receive food aid, 61% will do food for work activities whereas 46% are engaging on conservation agriculture. From this it can be established that, there is a dependency syndrome that has developed, whereby in the time of crisis, respondent will wait for government and NGOs to act as first responders.

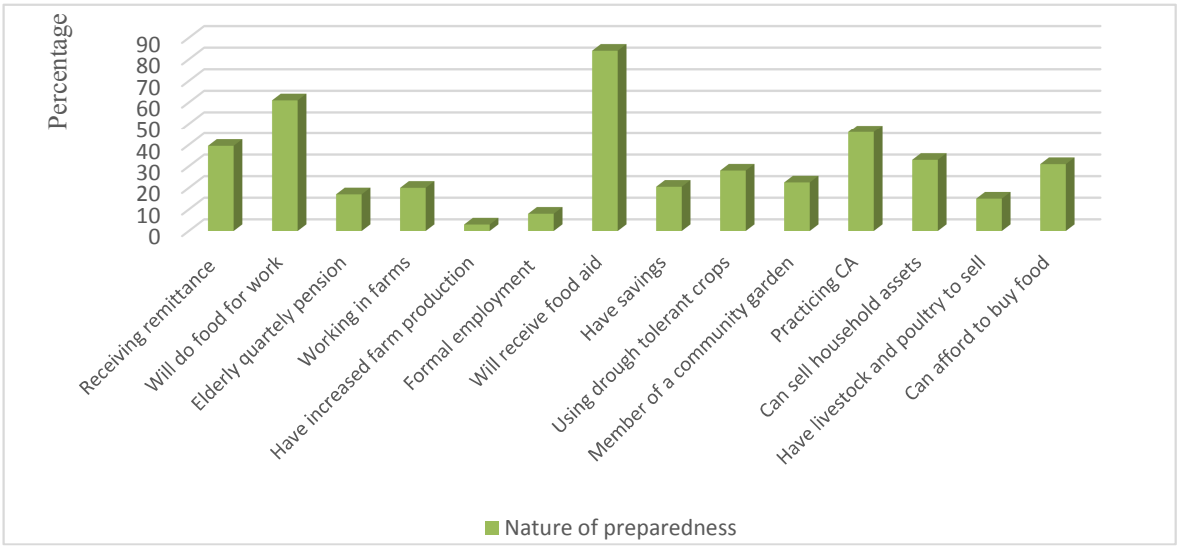

Figure 14 Preparedness to drought -coping mechanisms

5.12Impact of DRR programs between 2007 and 2014

Despite the low sustainability of many of the implemented programs, the respondents admitted that the programs positively impacted their lives. The major impacts were observed in the areas of water supply, with 78.5% of the respondents highlighting that the programs increased water availability in the community, whereas 71.5% had their travelling distances to the water points decreased significantly. Food availability and consumption had also increased. This therefore shows that provided there is proper transfer of technology, DRR programs have an impact on the livelihood of the communities.

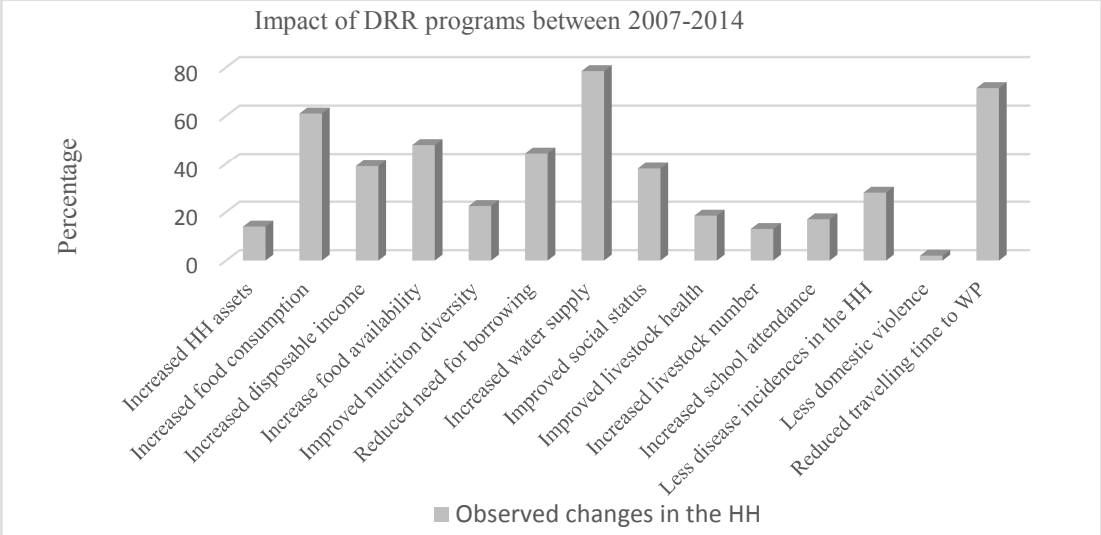

Figure 13 Preparedness to drought -coping mechanisms

6. Conclusion

The study analysis conducted showed that there are various NGO's, private enterprises and state boards that are involved in technology transfer of various agricultural developments projects to communities that have been exposed to various shocks to their livelihood between 2007 and 2012. The major shocks experienced were that of food insecurity and water supply. The major contributor to food insecurity was drought which resulted in loss of income, decrease in food availability and grazing quality. Government and NGOs have introduced various risk mitigation and recovery projects, however, most actions were reactive rather than proactive. This therefore affected communities planning and responses to drought and its impacts. The situation was also not helped by the inadequacy of the extension support services especially as medium disseminating early-warning information and drought mitigation information.

Benefits of drought mitigation programs have been observed by the communities, only a few of the projects have been sustainable besides infrastructure projects that did not require much changes in attitudes and practices. The dependency syndrome attributed to continuous provision of food aid has resulted in the lack of future planning or engagement in drought mitigation measures, as there is expectation that in the event of a serious drought, government and NGOs will provide immediate food aid. Most NGOs still use top down approach without the involvement of the community in designing and planning for the implementation of the development projects. The study also showed that many NGOs focus on short term impact instead of long term sustainability which has affected overall uptake and survival of development programs. To realize long-term, sustainable change, technology providers need to embrace a proactive rather than reactive attitude because changing community norms is a process, not a single event.

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