

LOCAL DEVELOPMENT SUPPORT PROGRAMME



**A STUDY OF THE ECONOMIC AND SOCIAL IMPACT OF THREE IRRIGATION
SCHEMES IN DEDZA AND NTCHEU DISTRICTS**

June 2012

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EXECUTIVE SUMMARY

A study was conducted to assess the extent to which forecasts that were made about the social and economic benefits of rural irrigation schemes were actually realised on the ground. This study was conducted in Mgundu and Livizi 2 irrigation schemes in Dedza district and Upper Masasa (UMA) 6 scheme in Ntcheu district. Data gathered from field research and from interviews with scheme participants has been compared to the intended outcomes as stated in the original technical proposals and terms of references for the schemes. While this study focused on 3 specific irrigations schemes its findings and recommendations are widely applicable to many rural irrigation schemes.

The findings show that the development of the three schemes contributed to increased numbers of households participating in irrigated crop production particularly the female farmers from female headed households. The schemes also contributed to an increased number of households producing one or more irrigated crops per year. The production levels and trends for the three main irrigated crops in the schemes, (maize, tomatoes and Irish potatoes), show that the current levels of production in the schemes are subsistence oriented.

While female farmers cultivated bigger areas than male farmers their average annual production of each of the three crops were lower than their male counterparts. Male farmers produced more because they had better access to farm inputs, skills and time than their female counterparts and as a result achieved higher incomes.

The households noted that irrigation scheme had significantly contributed to dietary diversity in two ways. First, there was increased production and availability of staple foods, vegetables and legumes. Secondly, the money realised from sales enabled household to buy other food products such as fish, meat and cooking oil which were normally not readily available in their household.

Where Persons living with HIV, (PLHIV) and others affected by HIV are involved in irrigation schemes, they derive a lot of benefits in terms of food and nutrition security, economic empowerment, high productivity and social acceptance. However, in the schemes where such people are not involved, there are usually high cases of stigma and discrimination and the PLHIV and others affected by HIV are not benefiting much from irrigated agriculture.

There have been no significant recorded impacts on downstream water quality; this is largely attributed to the use of vegetative filter buffers. Two of the schemes utilised rivers that had flows large enough for downstream quantity not to be affected by the scheme. At the third however the level of river abstraction was higher than the recommended 50% of the stream. The implication was that during minimal flow rate in October-November, the entire flow was diverted to the scheme.

Unlined canals are leading to excessive seepage at two of the schemes. This is leading to inadequate supply to some of the plots. As a result the irrigated hectareage is significantly lower than designed. At the third scheme, over abstraction has made it possible to irrigate over four times the designed area. Poor design and construction of the extra plots however has led to issues with in-plot ponding and soil erosion.

It was revealed through the study that the sustainable supply of inputs, particularly to vulnerable household, remains a serious challenge. The current crop production levels and trends in the schemes are of subsistence nature. If households are to realise food security as well as increased household incomes, there is need for diversification and increase in the levels of cash crop production in order to balance between production of maize for food and cash crops

All of the schemes have established effective management structures. While the households were working together in aspects of maintenance of the scheme and watering, joint production planning was only done in the first two years in all the three schemes and later abandoned.

As most of the households were growing green maize as the main cash crop, and the buyers were vendors from neighbouring villages who could only buy a few hundred cobs, there was no need for the households to work as group to market their green maize. Currently each farmer operates independently in terms of production and marketing of the crops grown.

For the UMA 6 scheme, a thorough feasibility study was completed investigating the suitability for the area for a scheme. This included gathering social, economic and demographic data of potential beneficiaries of the programme, understanding the social-cultural variables in relation to land ownership that will affect the proposed programme as well as environmental investigation into the suitability and impact of the scheme. A cost benefit analysis was undertaken and wider issues such as gender and HIV and AIDS were assessed. For this scheme the majority of its aims were achieved, in particular:

- Increased food security, dietary diversity and household income was achieved
- Gender training led to high levels of gender understanding and equality within the project
- Deliberate inclusion of PLHIV has largely led to benefits for affected households
- The scheme has not had a negative impact on the surrounding environment
- The scheme has an effective management structure which coordinates plot ownership, payments, and a maintenance fund

There were however some areas where the aims were not realised:

- Targets for the number of crops produced per year are largely not being achieved – this is attributed to poor production planning, unfavourable growing conditions such as frost, access to inputs as well issues with the operation of the schemes themselves.
- Insufficient funding has meant that there is a large portion of the main and secondary canals that are unlined. As a result water is lost to seepage which leads to both water shortages at some plots, as well as ponding at other
- In some cases the requirements placed upon scheme members was discouraging participation of PLHIV; such as plots being allocated only to those that participated in the hard work of clearing the irrigation land and developing the irrigation channels. The remaining plots are obtained through annual rental fees, which some of the PLHIV interviewed found unaffordable
- Joint production planning has been abandoned due to limited access to large markets. Farmers are now working independently on crop planning and marketing

In comparison for Mgundu, the project design report included environmental considerations for the project such as water requirements, topographic and soil surveys, as well technical design details. Wider issues such HIV/AIDS and gender dimensions were not included.

The feasibility study for the Livizi 2 scheme could not be obtained. For these two schemes it has not therefore been possible to evaluate the success of the projects comprehensively with relation to the original objectives; nevertheless the successes and short-fallings of these schemes provide valuable information for both contextual understanding and future planning.

INTRODUCTION

Many assumptions are made about the social and economic benefits of rural irrigation schemes particularly in feasibility studies commissioned as part of the project design. This study aims to assess the extent to which those assumptions have been realised and also the perceptions of people who were intended to benefit from the schemes.

Irrigation schemes are often seen as a significant investment in the improvement of rural farmers' ability to increase agricultural production, reduce rural poverty and stimulate economic growth. Feasibility studies tend to focus on the economic benefits of the schemes in terms of per hectare returns on investment and seldom address the broader social issues regarding the impact of the scheme on gender relations, changes in nutritional status, and impacts on vulnerable groups such as children and PLWHIV and so on.

This study has the potential to be an important source of information for policy makers and development practitioners regarding the effectiveness of irrigation schemes, the efficiency of their design and maintenance and the wider social and economic implications. Its objectives are to assess the positive and negative impacts of three selected irrigation schemes on the following areas:

Agricultural Issues

- Agricultural production
- Agricultural Sustainability
- Food security
- Dietary diversification

Community and Social Issues

- Gender dimensions and relations
- Prevalence of HIV and AIDS
- Education and school attendance
- Benefits of the schemes.

Environmental Impacts

- Water quality and quantity
- Prevalence of water-dependent diseases
- Siltation and soil conservation
- Community Resilience - Disaster Risk Reduction and Climate Change

Economic and Governance issues

- Household income and livelihoods
- Cost benefit analysis
- Economic sustainability
- Technical design and maintenance
- Governance and management
- Relation to National Initiatives.

Background of the Study

Concern Universal (CU) is an International Non-Governmental Organisation (INGO) established in 1976. CU's vision is 'a world where justice, dignity and respect prevail for all'; while the mission is 'to work in partnership to challenge poverty and inequality'.

With funding from Irish Aid, CU is implementing a six-year integrated food security and sustainable livelihoods programme, which aims to improve the quality of life of 32,000 households in Dedza and Ntcheu districts. As part of this programme there is a result area specifically aimed to '*Increase CU capability to learn, document, disseminate and influence*'. Under this result area, CU will carry out and

publish at least 12 objective pieces of research that can inform government policy, stimulate discussions and critical thinking amongst government, donors and development practitioners. This is one of 12 studies conducted in Dedza and Ntcheu districts, focusing on the economic and social impact of selected smallholder irrigation schemes.

It is important to note that this is an objective piece of research aimed at informing broad development thinking and is not an evaluation of CU or its work.

CASE STUDIES

The study was conducted in Mgundu and Livizi 2 irrigation schemes in Dedza district as well as in Upper Masasa (UMA) 6 scheme in Ntcheu district.

Mgundu surface irrigation scheme

Mgundu surface irrigation scheme was designed by irrigation officers from Lilongwe ADD in 2006 and was constructed and became operational in 2007. It was developed at a total estimated cost of MK4,692,134 as part of a grant of MK46,913,300 from USAID to Malawi Government for the development of eight gravity fed irrigation schemes and rehabilitation of earth dams in two selected areas. The scheme was anticipated to improve the food security and incomes of its members

Though the scheme had a potential to irrigate more than 10 ha, only 6 ha were developed during the construction phase due a lack of funds and the technical design aspects of the scheme. The scheme was designed to allow households to achieve three growing seasons – two seasons with 100% irrigation and one with supplementary irrigation. Hence the scheme would produce three cropping seasons – growing green and grain maize intercropped with beans and pumpkins.

Livizi 2 scheme

The Livizi 2 scheme was designed by Irrigation officers from the Dedza Irrigation Department and constructed in 2007 located in Mbozi and Mkomera villages in TA Kasumbu in Dedza district with funding from the government.

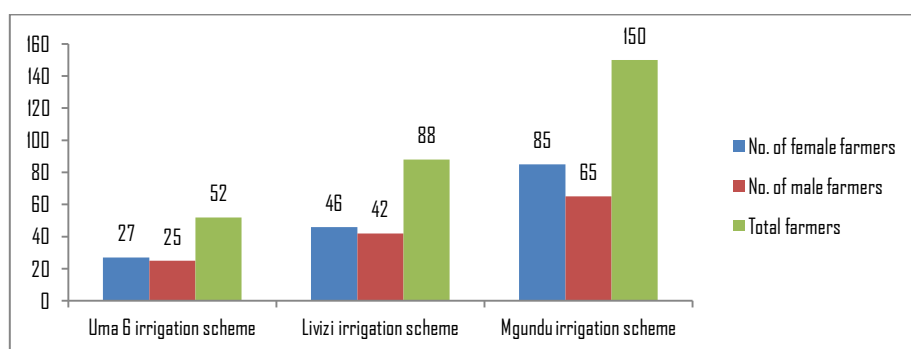
According to its design, the scheme was supposed to allow households grow three crops – two 100% irrigated winter crops - the first from April (mainly green peas, Irish potato and vegetables) and the second from August (mainly grain/green maize) and one partially irrigated summer crop grain maize from December. The primary objective of the scheme was to improve the food security of its members.

UMA 6 scheme

UMA 6 irrigation scheme also known as Tsanthi is located in Dumuka village, in TA Masasa in Ntcheu district. The scheme started as a local initiative by 4 households trying to divert water from the river using plastic bags. The scheme was designed in 2005 by irrigation officers from Lilongwe ADD and was constructed in 2006 with funding from a CU project. The area has been experiencing unreliable rainfall over the past years, therefore the project recognized the importance of small-scale irrigation farming as a way of averting chronic hunger in the area

Inadequate funds meant that the scheme was not fully constructed and the lining of the main and secondary canals was not completed, however, the structures were functioning as designed with some modification of the weir and some secondary canals.

Figure 1: Membership of the three irrigation schemes



Membership in all three schemes can be seen to have slightly more female farmers than male.

AGRICULTURAL ISSUES

The Government of Malawi seeks to “increase agriculture production and enhance food security through irrigation, which will ensure some production during droughts, and the dry season, and this will supplement rain fed agriculture” (*Ministry of Agriculture and Irrigation, 2000*).

Impact of the Irrigation Schemes on Agricultural Production

The construction of the irrigation schemes contributed to significant increases in irrigated hectareage for its members.

Households participating in the three schemes are able to irrigate a total of 45 ha, an overall average hectareage of 0.21 ha per household. Prior to the schemes there was 1 ha being irrigated at UMA6 and a small number of farmers practising minimum irrigation in Livizi using watering cans.

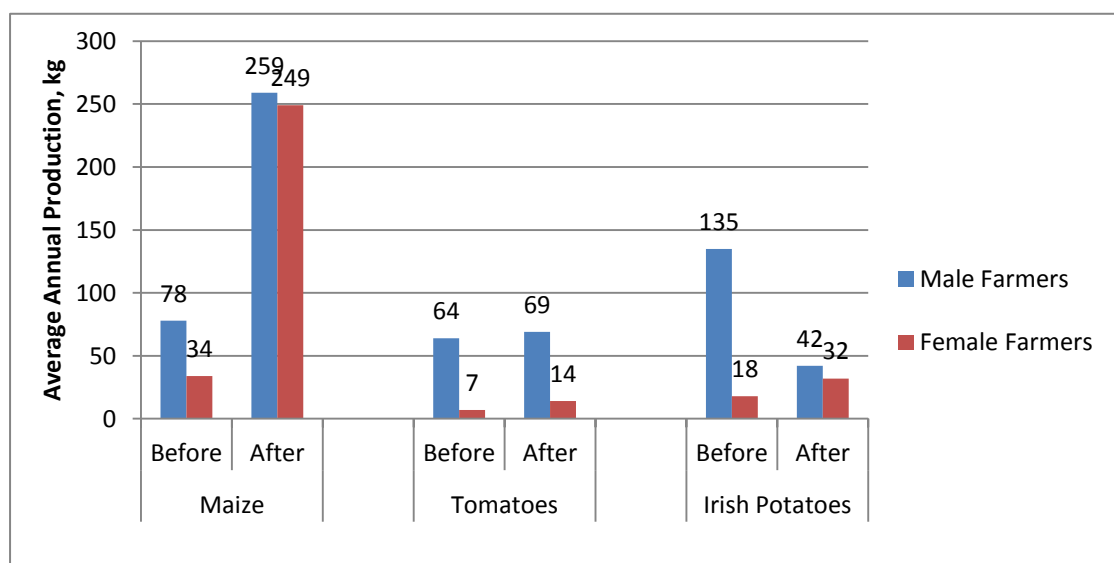
There was a significant increase in the number of female farmers participating in irrigation¹. This might have been a result of deliberate efforts by extension workers to encourage more women to participate in the irrigation schemes This is in line with the Government policy which promotes the greater involvement of women in community organizations and irrigation developments (*Ministry of Agriculture and Irrigation 2000:11*).

The study findings revealed that both before and after development of the schemes the majority of the households were only able to harvest between 50 kg (1 x 50 kg bags) and 350 kg (7 x 50 kg) respectively of maize from their rain-fed crops. These quantities of maize were not enough to take the households to the next harvest. The households attributed this low productivity of their rain-fed crops to poor soils and lack of access to fertilisers.

Almost every household needed other means to enable them access enough staple food throughout the year, consequently the major motivating factor for households to join the schemes was to find alternative means for accessing staple food (maize). Before the schemes were constructed, the majority of the households were mostly depending on *kusuma* (exchanging their labour with food) and *ganyu* (selling their labour for money) to supplement their rain-fed staple food production.

¹ This fits with the general trend in matrilineal societies. Authority over land lies with the women, increasing their opportunity for accessing it as development opportunity arises. It’s also in line with a general trend of higher women participation in development activities.

Figure 2: Average Annual Production of Three Primary Crops Before and After Scheme



The construction of the three irrigation schemes contributed to significant increases in crop production under irrigation particularly for grain maize.

The overall average annual production of irrigated grain maize per household has increased from 56kg to 254kg; approximately 350%. Both males and females achieved significant increases. This reflects the prioritisation by both male and female farmers to the production of maize. Enhancing household food security and ease of access to inputs are the key drivers for this increase, as well as familiarity with the crop. These increases in yield indicate the schemes have been successful in their primary objective of increasing food security.

The schemes contributed to an overall increase in the average annual production of tomatoes of 17.1%, from 35 kg to 41 kg per household. The average annual production of tomatoes per male farmer in 2010 was significantly higher than that of female farmer. This is attributed to female farmers tending to concentrate on the production of grain maize for household consumption rather than on cash crops.

For UMA 6, the production of tomatoes was recommended following gross margin analysis as it was identified as a profitable crop. For Mgundu however the production of tomatoes was not proposed as an opportunity which may be a reason for the relatively modest increases.

The average production of Irish potato has however declined by almost 70% as more households focused on producing grain maize for food. While the average annual production of Irish potatoes in 2010 by male farmers declined significantly, female farmers realised a small increase in the average annual production of irrigated Irish potato.

While the figures reported by both female and male farmers seem to show a reduction in the amount of land dedicated to the production of Irish Potatoes based on observations and the experience of a number of extension and field staff would seem to contradict these figures. Field reports show increases in the hectareage dedicated to Irish Potatoes which contradicts the data gathered from the farmers. This is something that should be followed up by the Government extension services and NGO field facilitators for clarification.

“We used to plant some maize crop in October which was partially irrigated and partially rain-fed. We were planting only small portions of the plots. Most of the maize plants died due to water shortage. The maximum production harvested was only up to a basket full (20 – 30 kg) of maize yet from the same plot we are now able to harvest more than one oxcart full of maize (300 – 400 kg)”.

Secretary of Livizi scheme August 9, 2011.

Number of crops per season

There has been a general increase in the number of times households produce irrigated crops in a year in the three schemes studied, as outlined in Table 1.

Table 1: The frequency of production of irrigated crops per season before the schemes and during the schemes in 2010

	Before the schemes		In 2010, five years after construction of schemes	
	Males (%)	Females (%)	Males (%)	Females (%)
Did not irrigate	31.8	73.7	10.6	13
Producing at least one irrigated crop a year	47.7	21.1	66.0	63
Producing at least two irrigated crops a year	20.5	5.3	23.4	19.6
Producing up to 3 irrigated crops a year	0	0	0	4.3

Despite the increase in number of times households produce irrigated crops in a year, the three schemes are failing to achieve the design specifications of producing two 100% irrigated crops and one partially irrigated summer crop in a year. Households mostly failed to produce a second or third irrigated crop mostly because of poor planning and in some cases inability to follow their planned irrigation schedules.

To maximise production from the schemes: it is important for households to adopt a culture of crop production planning for the purposes of commercialisation, as well as helping households realise food security. This could be facilitated through the existing scheme committees with the support of external support services, and should be one of the major focal areas in building the capacities of the households in the scheme.

Livizi scheme households are restricted to producing mostly one crop per year because of the problem of frost between the months of March and July leading households to only start producing irrigated crops in the month of August.

To minimise the effects of frost and maximise irrigable hectareage in Livizi 2 scheme: and any other current or future schemes affected by frost, there is need to development appropriate strategies for averting the problem of frost such as planting frost resistant crops, developing strategic planting schedules, as well as adopting technologies and practices which could minimise crop damage by frost.

Agricultural Sustainability

There are issues associated with rented irrigable plots. The households renting plots are largely unwilling to invest in developing the plots and introducing measures such as manure application and planting of trees and vetiver grass in the buffer strips below the plots. They argue that it is not feasible for them to invest in land improvement or conservation measures as the following year they may not

be allowed to cultivate the same plots again so they would not fully benefit from such interventions. It is difficult for farmers to make long-term plans and investments, this has affected the longer term potential sustainability of benefits realised from irrigation schemes.

In such cases, it is difficult for irrigation schemes to comply with the Government policy which promotes proper management of soils subjected to irrigation development in order to ensure their sustainable productivity and soil conservation measures to reduce the degradation of the catchments (Ministry of Agriculture and Irrigation 2000:5-6).

The findings show that while the irrigation policy advocates honouring of the existing customary land tenure system in the development of self-help irrigation schemes, there are conflicts and issues associated with this system that are counterproductive to irrigation development.

The findings of the study suggest that there is no piece of customary land which is currently unallocated by the traditional leadership. Yet when irrigation schemes are being initiated, as were the cases for UMA 6, Mgundu and Livizi schemes, the chiefs give out land for irrigation development, which is demarcated into plots, which are allocated to as many people as possible.

After the scheme has operated for one or two seasons conflicts emerge as the owners of the land start reclaiming their land and demanding rent. The Government of Malawi Greenbelt Initiative (GBI) recognises land tenure conflicts as one of its risk factors which would affect its implementation. The initiative seeks to minimise this by ensuring an all-inclusive mobilization and sensitization programme to be headed by respective district councils.

To address the customary land related issues outlined above during irrigation development:

- *There is need for policy guidelines and enforcement mechanism to govern use of customary land for irrigation development.*
- *These policies should include mechanisms that compel users of rented irrigated plots to institute long-term development and conservation measures for sustainable management of irrigated plots*
- *The policies should also include mechanisms for legal protection of households who rent plots for irrigation to enable them progress with time for example long term lease arrangements.*
- *Irrigation schemes should include within their management plans by-laws that govern the use and management of irrigation plots regardless of the 'ownership' status.*

Food security

Food security has been recorded to have significantly improved following the introduction of the irrigation schemes.

Prior to the scheme, an assessment in Masasa indicated that in terms of food insecurity, the majority of the households are food insecure for almost half of the year i.e. households aware on average only able to adequately feed themselves for about 7 months.

As a result of the irrigation schemes, field research suggested that approximately 65% of the households had enough energy (staple) food reserves to take them to the next harvest in April. Most of the remaining households indicated that they would not experience the food deficit gap between the months of December and March as this would be filled by maize produced under irrigation. Despite this, some households will continue to experience the food shortage gap in the months between December and March.

The schemes have created mechanisms that enables households avert the food shortage periods in three ways.

- Households deliberately set aside one irrigated maize crop for harvest and storage to be used when they see that their rain-fed stocks of maize are not enough to take them to the next

harvest. If the household has enough staple food stocks from the rain-fed harvest they focus their energy and resources on producing and selling green maize and other cash crops such as tomato and Irish potato.

- Complementarity has been established between rain-fed crops and irrigated crops. Households use money realised from sales of surplus produce from irrigated crops to buy inputs for rain-fed crops and vice versa. This secures the households production system.
- Some of the households are using the money earned from irrigated crops for buying livestock such as pigs and goats. In Mgundu scheme the households have also started incorporating aquaculture in their production system thereby further diversifying their production.

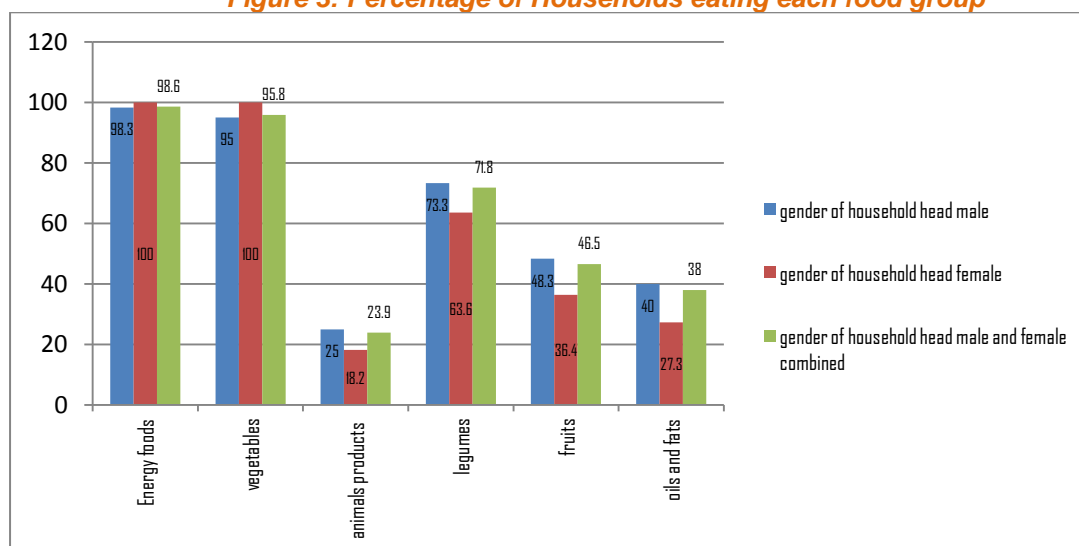
These findings suggest the original aims of the schemes to improve food security for the areas have been realised for the participating households.

Dietary diversification

The households noted that irrigation scheme had significantly contributed to dietary diversity in two ways.

- *Increased production and availability of energy / staple foods, vegetables and partially legumes.*
- *The money realised from the sales of maize - particularly green maize, vegetables, tomatoes, potatoes enabled households to buy other food products such as fish, meat and cooking oil which were normally not readily available in their households.*

Figure 3: Percentage of Households eating each food group



Energy foods (predominately maize and Irish potatoes) and vegetables were the most prevalent food groups in the diets of between 95% and 100% of the households in the schemes. Legumes were prevalent in 71.8% of the households. Fruits, oils and fats and animal products were the least available nutritional food groups in the diets.

Only 7% of households achieved all six food groups in their diet, whereas 42% had three or less food groups. This data suggests that there is limited nutritional diversity in the diets of the scheme participants. This is of particular significance to households affected by HIV and AIDS, where a balanced healthy diet is an important contributor to improved health.

For UMA 6, the scheme proposal recommended variety in production as both an opportunity for improved nutritional diversity, and also for additional income channels. For Mgundu however, the proposal was more subsistence orientated, stating that 100% of the irrigated area was to be used for the production of maize, with beans and pumpkins as an under crop. This provides limited nutritional diversification for the scheme participants.

It is thought that dietary diversity can further improve if within their production plans; households in the scheme diversify and deliberately increase production of lesser consumed crops such as fruits, legumes and oil seeds. During scheme proposals, it is recommended that dietary diversification is considered as a key opportunity for scheme participants, for both improved health and income generating opportunities. Crop diversification can provide increased security against variations in climate and weather, and strategic crop rotation can help improve long term soil fertility. There are however issues associated with access to inputs and practical knowledge on growing some alternative crops. It is important therefore that an integrated investigation is undertaken to assess the available support services and training for the scheme participants.

It is also thought that households need to integrate crop production with livestock production particularly small stocks such as chickens, rabbits, goats, fish and pigs. This would not only contribute to dietary diversification, but could also be a source of further income as well as manure to improve soil fertility for future crops. There is evidence for the success of this strategy, for example some households in Mgundu scheme have already started integrating their irrigation activities with aquaculture.

Limited information was contained within the feasibility studies of the dietary diversification prior to the studies. It is recommended that for any future irrigation projects, a more detailed preliminary study is undertaken to improve the value of data collected following the development of such a scheme.

COMMUNITY AND SOCIAL ISSUES

This section explores some of the wider social implications of irrigation schemes that are often not considered within scheme feasibility studies.

Gender Dimensions and Relations

Government policies on irrigation recognise the importance of taking into consideration gender dimensions and relations in the development and management of irrigation schemes. The irrigation policy for example, seeks to promote greater participation of women in irrigated agriculture (Ministry of Agriculture and Irrigation 2000:17); address specific problems that women face in irrigated agriculture in order to achieve greater participation of women in the small scale irrigation sector. This component of the study sought to assess how within the irrigation schemes gender dimensions and relations were addressed

Division of labour



In all the three irrigation schemes the labour patterns between men and women were different. Division of labour was along gender lines with men taking the more arduous but less frequent tasks like making ridges and spraying chemicals. Women, on the other hand took simpler but more frequent tasks such as tiling land, watering crops, planting, weeding, harvesting etc. While during the construction of the schemes men dug the canals and assisted the bricklayers while women were responsible for transporting and carrying bricks, stones and sand to the construction sites.

The tasks and responsibilities in the irrigation schemes were largely influenced by the cultural determinants such as the belief that the man should make decisions and women should follow. Men therefore decide on what to plant, and when they and the women should go and do irrigation activities. Traditionally women were expected to be more organized as they were also expected to accommodate domestic tasks such as water hauling, firewood collection, cooking alongside the irrigation tasks.

Both male and female farmers interviewed acknowledged that women were more burdened. However, the men were not willing to help their wives with the domestic chores due to the social stigma that existed in the society.

In all the three irrigation sites, while women especially those from female-headed households were mostly involved in growing maize for home consumption; men purposefully diversified production for the market. They focused on growing crops such beans, Irish potatoes and tomatoes which fetched higher prices on the market.

There was less evidence of diversification specifically for consumption, however analysis of dietary trends suggest that male headed households also have a more diverse diet than female counterparts who consume more staple, energy foods and vegetables, but less animal products, fruits, legumes and oils.

Women, especially those from female-headed households outsourced labour especially for the arduous tasks and those which required specialised skills at a fee or sometimes on some 'agreed terms' which they were not inclined to disclose.

Because of the labour challenges most female farmers said that they produced relatively smaller quantities of maize, Irish potatoes, tomatoes and other crops as compared to male headed households.

Access and control of resources

Men in comparison to women have reasonably more access to agricultural resources and it was also observed that control over income was not equal. Men tended to be dominant decision making about the income obtained from irrigated agriculture. Women have limited access to the market and are not free to demand all the income earned from a particular crop from their husbands.

It was noted that women have challenges accessing equipment and inputs such as sprayers, motorized pumps, fertiliser, seed and chemicals and other inputs required for irrigation and rain-fed crop production. According to both men and women respondents in one scheme, men had more income generating opportunities i.e. *ganyu* (piece work). Women said (and men agreed) that it is easier for men to find *ganyu* than women.

“Men have broader social circles; they go out and meet friends who offer them these opportunities. It is not easy for a woman like me, to go out and find ganyu from men, whom in most cases have the resources, and are the ones providing these opportunities. They refuse in fear of creating suspicion for both my husband, and their wives; particularly if their gardens are far away and in isolated places”.
A female respondent.

Participation in decision making

Although efforts were made to ensure the participation of both men and women in the governance and management structures of the schemes, women still remain outnumbered in committees and took minimal role decision making.

Both men and women observed that women lacked the confidence and time to effectively participate in decision making:

“With our multiple roles, we literally do not have time to waste sitting in those meetings, every minute counts for us. We have to go the maize mill, go to the hospital with children what time do we go for these meetings?” A female respondent in UMA 6 scheme.

In all the three schemes women are serving as “second- in-command” of all the key positions, mostly as vice chairperson, vice secretary. In these positions women do not have much decision making powers. In UMA 6 scheme, both men and women said that women did not command the same respect and attention as leaders. A female respondent in the same scheme said that women were not as intelligent as men by God’s design therefore could not make good leaders.

In all three schemes the respondents (men and women) agreed that men made most of the decision on the proceeds realised from the irrigation plots. Socio-cultural norms and practices had a strong impact on women participation.

For UMA 6, the feasibility study stated that Concern Universal should pay specific attention to family decision making processes in the home. It was identified that male farmers tended not to consider women and family needs in disposing of income from irrigation and that family income was often largely spent on beer and other women at the expense of the family.

In interviews following the implementation of the scheme it was found that this remains a key issue. For UMA 6 a male respondent linked an increase in income to increasing drinking and consequently an increase in gender based violence (GBV). There is also a link to the prevalence of HIV and AIDS which is addressed later.

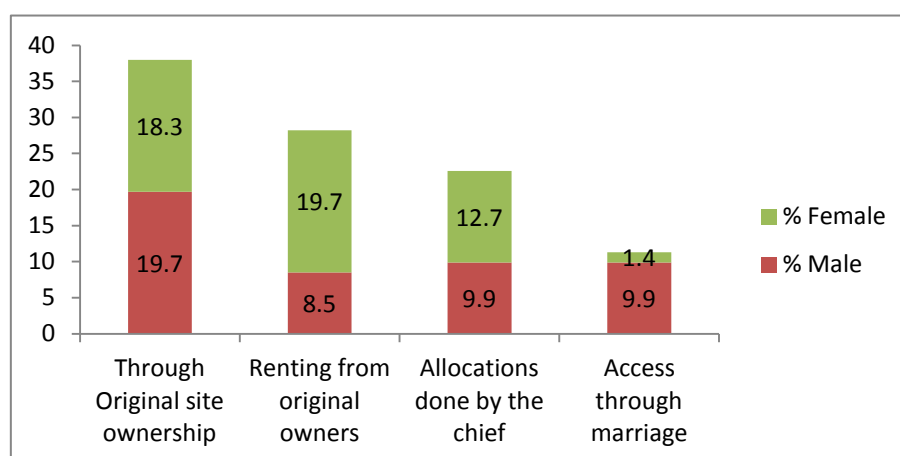
In general however, women and men felt that the establishment of the schemes has contributed to the reduction of GBV as men are now busy with irrigation activities and less time to drink, and that households were under less hardship and therefore violence was less likely.

Gender based violence remains a widespread issue. Increased income associated with irrigation schemes has been linked to increases in drinking, extra-marital affairs and GBV, particularly by men. There is a need for education and focus by extension services to address the issues of family decision making and domestic life.

Land Rights

Women in all the three irrigation schemes owned land by having the traditional right to inherit land from their ancestors. In the three schemes community organisation was based on matrilineal descent system where the husband would move to live with or near his wife's kin. Access to irrigated plots, was mainly obtained through inheritance, allocation by village head, renting and marriage.

Figure 4: Percentage of households according to how the irrigation plots were acquired



It was observed that although women had the majority of land rights through inheritance, in many cases they did not have the user rights in the eyes of their spouses and male relatives.

“We do not have a say, anything our husbands say goes. After all they must be respected as heads of our households. That is how it has been even with our great grandparents”.

It must however be mentioned that in all the three schemes there was abundant irrigable land and there were no reported cases of land disputes. Both men and women had equal access to irrigable land. Access to resources to support irrigation agriculture appears to be the limiting factor in women's participation.

Gender related benefits from the schemes

The feasibility study for the UMA 6 scheme highlighted the need to consider gender based issues in irrigation development and stated that *“including women at all levels of in irrigation farming cycle ensures sustainability of irrigation system”*. When interviewed members said that they had undergone several gender trainings facilitated by Concern Universal which contributed to the men and women's increased awareness on gender and change in their division of labour patterns. Men and women in this scheme claimed that men provided enough time and space for women to do their household chores while they (the men) went earlier to start the scheme activities and in the afternoon most women did not return to the scheme.

Conversely, both male and female respondents in Livizi 2 and Mgunda schemes had very little knowledge of the gender concept. The issue of gender was not considered in the available design report for the Mgunda scheme.

Men and women have different roles and faced different challenges with regards to irrigation in the schemes. Gender analysis should therefore form part of the process of developing irrigation schemes to enable communities and development planners understand the gender dynamics in irrigation farming, and design schemes that will enhance gender equality. Further training has been shown to be effective in increasing community awareness and understanding of gender related issues. It is recommended therefore that training is incorporated into the support framework for community based projects.

Prevalence of HIV and AIDS

The Malawian governments Green Belt Initiative (GBI), emphasises mainstreaming of HIV and AIDS as a crosscutting issue in the planning and implementation of all activities (Government of Malawi 2009/10). The initiative includes implementation of actions to mitigate the negative impact of HIV and AIDS on agricultural productivity.

Prevalence of HIV and other illnesses in the irrigation schemes

Overall 8.5% of the households in the three schemes reported that at least one of their members had tested HIV positive or had openly declared positive HIV status. These findings are close to the national HIV prevalence currently estimated at 10.6% of adults aged between 15 and 49 (Demographic Health Survey, 2010).

Involvement of Persons Living with HIV in the irrigation schemes

For the UMA 6 scheme in Masasa, improving the nutritional status of those affected by HIV and AIDS was highlighted as a positive outcome of the introduction of the irrigation scheme. For Mgundu however HIV and AIDS related issues were not considered within the feasibility study.

At UMA 6 special arrangements were made to ensure the participation of PLHIV, with a special plot allocated specifically to PLHIV. This was done with encouragement from a CU project that was promoting involvement of HIV affected groups in development work.

In the Mgundu and Livizi 2 schemes, there was no particular effort to ensure that PLHIV participate in the schemes. In Mgundu and Livizi schemes, there were no platforms for members to discuss HIV and AIDS issues, which makes it difficult to openly involve PLHIV. As stigma and discrimination towards PLHIV is high at Mgundu and Livizi schemes, there are no HIV and AIDS interventions in these schemes. Where PLHIV and other affected groups did participate, it was largely due to their own initiatives

In some cases, the conditions set by the schemes discouraged participation of those affected by HIV. For example, at Mgundu scheme, only households that participated in the hard work of clearing the irrigation land and developing the irrigation channels were given plots. The rest have to pay rental fees every year, which some of the PLHIV interviewed found unaffordable.

However, at UMA 6 where PLHIV are involved, it was found that the scheme members are open to talk about HIV and AIDS and they have a strong link with Masasa community based organisation (CBO) which operates in the area. This shows that PLHIV were more involved in communities which were open about HIV and AIDS issues, as well as where there was a strong community based organisations presence and interventions.

There is need to facilitate linkages of the irrigation groups with community based organisations, support groups, home based care group and orphans and vulnerable children care groups. This will expose the households in the schemes to the various interventions on HIV and AIDS prevention and mitigation which are already occurring in communities around these schemes.



Lestard Benjamin and his goat khola

52 year old Lestard Benjamin is one of the members of UMA 6 irrigation scheme who is living positively with HIV. In 2001, he became sick and his brother took him to Ntcheu District Hospital where he was counselled and offered an HIV test. He tested positive and was put on anti retroviral treatment immediately. He soon regained his productive health. In 2004, he joined UMA 6 irrigation scheme when it was just being developed. As a member of Tikondane support group of PLHIV under Masasa CBO in Ntcheu, he has been instrumental in his group of 47 members. Using the knowledge and skills gained from the CBO and support group he has been instrumental in sharing his experience as someone living positively with HIV to encourage other members of his irrigation scheme to go for an HIV test.

“Before the irrigation scheme, my rain-fed maize harvest used to finish around October and my family was struggling to get food between November and March – critical food shortage months. But now by participating in the irrigation scheme, my family no longer has lean period as the harvest from the irrigation field bridges the gap and good nutrition has contributed to my good health”.

Mr Benjamin also benefits economically from the irrigation scheme. He uses money realized from irrigated crop sales to engage casual labourers for the rain-fed farming and such arrangement benefits labour constrained households. He also uses some money to buy inputs such as fertilizers and pesticides. Using money that he got through sales from the 2010 winter cropping, he managed to buy a goat, one pig and a radio. He is also planning to rear chickens.

How PLHIV and other HIV affected groups are benefiting from the schemes

The study found that in general the irrigation schemes have improved food and nutrition security among PLHIV and other households affected by HIV and AIDS. Households no longer experience lean period between November and March as the irrigation schemes bridge the gap until they harvest rain fed produce. The households at UMA 6 scheme also plant herbal plants such as ginger, garlic, and other crops that provide medicinal benefits to PLHIV.

They have also benefited economically in that they are able to sell some produce from the irrigation fields such as green maize, tomatoes, and onions. They claimed that they used the money to buy other nutritious food, pay for transport to access ARVs from health facilities that are often far away.

Impact of irrigation technologies on labour constrained households

In Malawi and other countries that have been heavily affected, HIV and AIDS have rendered many affected households labour constrained. The study therefore tried to establish the impact of the technologies used in the irrigation schemes on labour constrained households due to HIV and AIDS. Most of the work in the irrigation schemes is manual and hard. It involves clearing land, digging the irrigation channels, building the water canals which are done manually.

In all the three irrigation schemes, those that participated in this work were the ones given plots for irrigation. The rest were expected to pay rent which in some cases is exorbitant by village standards. From both the focus group discussions and key informant interviews, it was found that both the labour intensive work in the fields and payment of rent were serious constraints that discouraged the participation of PLHIV and other affected groups such as child and elderly headed households.

During the actual process of irrigating the fields, it was observed that a farmer has to open each and every ridge to let water in and then close when it has received enough water. This technology is tedious to people that are physically weak and again time consuming and is not suitable for households that are labour constrained.

There are examples however of PLHIV that have continued to face significant challenges despite the introduction of the irrigation schemes.

"I am HIV positive. When I was healthy and strong I used to rent a plot which I cultivated twice in the season. I used to produce enough food and even sold some surplus. Two year ago I became very sick and there was no one to take care of my plot. It was abandoned. Now that I have recovered I would like to participate in irrigation production again; but the price of rent has gone up. I cannot afford it; neither can I afford fertilisers. Worse, still every month I have to pay for my transport to the district hospital to get ARVs.

It is impossible for me to pay for rent, pay for membership fees in the scheme, pay for inputs, as well as pay for transport to the district hospital when I have no any other means of earning money."

Female PLHIV in UMA 6 Scheme.

During development of the schemes, there is need for thorough facilitated conversations between the original land owners and the rest of the households on land issues to map out appropriate strategies for the allocation of plots in the scheme particularly to the households that may not afford to rent plots in the scheme.

There is need for policy guidelines on rationalisation of access to irrigable land in order to protect the most vulnerable groups who cannot afford to pay rent.

There is need to deliberately introduce measures that will reduce labour constraints on the vulnerable groups such as the HIV and AIDS affected, the aged, the disabled and the chronically ill. These measures would include designing shorter irrigation furrows which are easy to operate, introducing labour saving technologies for planting and management of crops.

Impact of the scheme on people's risk and vulnerability to HIV infection

There are some practices associated with the irrigation schemes that put the scheme members at risk of HIV infection. At Livizi 2 scheme men and women go to irrigate their crops at night. It was alleged that this arrangement provides an opportunity for some members of the scheme to be having casual sex. There were also allegations of some women who were afraid to go to the scheme at night, but asked men to irrigate their fields in exchange for sexual favours instead.

Women alleged some men after selling their irrigated crops were using their incomes on beer and engaging in extra marital affairs. This put them at risk of contracting HIV. Young people, especially girls who participate in the schemes when sent by their parents are also particularly at risk.

A further highlighted benefit of the schemes was that it has helped to reduce male migration to tobacco growing districts as well as to South Africa. Research has shown that a reduction in migration within rural communities can lead to reduced rates of HIV and AIDS contraction as a result of reduced incidence of extramarital affairs.

At Mgundu scheme, there was a reported case of a 15 year old girl whos parents used to send her to the scheme alone to collect vegetables. This provided an opportunity for her to meet a man at the scheme where they were having sex. The young girl who was in primary six, fell pregnant and dropped out of school. The man was charged with sexual abuse and sentenced to 12 years imprisonment and is currently serving his sentence.

To reduce the risks of HIV infections associated with the scheme there is need for creation of awareness amongst the scheme members and incorporation of interventions to prevent sexual exploitation, gender based violence and HIV infections.

There is also a need to incorporate within the irrigation scheme management system some HIV and AIDS prevention and mitigation interventions. These would include scheme members having facilitated conversations on HIV and AIDS related issues and developing plans of action for HIV prevention and mitigation of its impacts, as well as education on wise management of earnings.

The introduction of new water courses and areas of standing water may lead to suitable breeding conditions for snails and mosquitoes, and thus a potential for an increase in associated diseases such as bilharzia and malaria. In addition to this, inadequate sanitation arrangements at the irrigation sites may lead to an increase in other hygiene and sanitation related illnesses.

Within the scheme production plans interventions for preventing and controlling the various diseases associated with irrigation schemes such as sanitation related infections, malaria and bilharzias should be established, through recommendations for preventive measures for the diseases such as controlling mosquitoes, controlling bilharzias snails in the canals as well as hygiene and sanitation promotion.

Education and School attendance

According to the children and scheme members interviewed, increased availability of food in the household as a result of the scheme resulted in reduced cases of children being absent themselves from school. However school authorities did not see any positive or negatives impacts of the schemes on school attendance and education of the children.

A sample of school age children of scheme members revealed that 42.2% of female and 36.8% of male students have dropped out of school before completing secondary school. None of the reasons given for dropping out of school can be directly attributed to the irrigation schemes studied, however it can be observed that participation in the irrigation schemes does not necessarily translate to financial security as almost 17% of secondary school drop-outs reported were due to a lack of fees.

There is reason for concern that the introduction of an irrigation scheme may lead to increased student absenteeism, and drop outs, as students are required to tend to the crops. From this study this does not appear to be the case, however it should be noted that the sample size was relatively small (83 children) and that information disclosed during interviews may not be wholly reliable. It is therefore recommended that further investigation is still undertaken during the planning of schemes to consider this risk.

Benefits of the schemes

Both male and female farmers and their households benefit from the irrigation schemes in different ways. The schemes have enabled households to realise improved health and nutrition, improved food security, pay school fees for their children, buy iron sheets as well as buy livestock. Male farmers realise more benefits than female farmers because they earn higher incomes and their production levels are higher. The results support the findings that female farmers especially those from female headed households tend to put emphasis on household food security above dietary diversification.

Table 2: Benefits that male and female farmers derived from irrigation schemes

Benefits	% of male headed households	% of female headed households
Improved food security	43.3	81.8
Improved health and nutrition	60	18.2
Bought livestock	25	9.1
Paid school fees for children	23.3	9.1
Built a house with iron sheets	18.3	-
Bought farm equipment	13.3	9.1
Money used for house out keep	10	8.5
Bought assets	5	-
Improved knowledge	1.7	-

For Mgundu, increased food security was the only cited benefit of the scheme. For UMA 6, improved food security, health, dietary diversification as well as contribution towards household expenses and school fees were identified. The results of the interviews suggest that to some extent these have been achieved.

The feasibility study for UMA 6 also outlined the use of income generated from existing irrigation before the introduction of the scheme. At that stage, 32% of households were buying food and only 2.1% putting money towards school fees. These have been seen to significantly increase as a result of the schemes.

Male headed households identified improved health and nutrition as the greatest benefit of the schemes, whereas female headed households recognise improved food security as the key benefit. .

ENVIRONMENTAL IMPACTS

This component of the study focussed on the implications of irrigation schemes on the environment with respect to water resources, alien or invasive species, water-dependent diseases and incidences or implications of soil erosion in the schemes and control measures in place.

Water Quality and Quantity

In general, the physical quality of water (colour and smell) at the intake had not changed as a direct consequence of the scheme establishment in all the three schemes. However, in Mgundu Scheme, there was a perception amongst the community members that water quality had changed in that it was now “too clear” as opposed to the productive light greenish colour which prevailed before 2007 when the scheme was being developed.

“Now the water is too clear, it cannot even support fish. This has been caused by people clearing the vegetation above the scheme. These are the people that moved out of scheme land after ceding their gardens to the scheme. They went upland to open new gardens for rain-fed farming.”

Mgundu scheme member

However, when asked to show the new gardens, they were too close to the upland of the scheme for them to be the cause of ‘loss of the productive’ quality of the water where aquatic life is concerned. The change came from a general degradation of the catchment upland but not directly as a consequence of the scheme.

When negotiating ceding of gardens for the sake of irrigation schemes, consideration should go to where the people will move their rain-fed cultivation to so as not to impact on the environment as a consequence.

It was also indicated in the three schemes that the presence of the scheme had not affected downstream water quality. It was observed that this was due to a vegetative filter buffer being in place between the plots at the end of the scheme the main river course. In Mgundu, there were some acres of riverine vegetation between the last garden and the river channel.

Despite the scheme getting excess water through the canals due to overdesign, (too much water is collected at intake than needed, according to the irrigation Engineer), all suspended solids the water carried as it passed through the scheme got filtered off by the riverine vegetation. In Livizi 2 and UMA 6, the flow rates in the main canal were not high enough to have excess water at the tail end mainly due to in-transit losses as a consequence of unlined canals. Some of the water seeps underground before reaching the tail end. This affects irrigation scheduling in that irrigation time takes longer than designed. Consequently some of the households are forced to irrigate at night. The excess seepage is however leading to a secondary problem of ponding in some plots.

In all three schemes, water quantity in the main channel (original river course) was not cited as a problem that would be attributed to the existence of the scheme. In Mgundu scheme, there were some in-line springs within the main river section between scheme intake and tail end such that the quantity of water downstream was not regarded as changed at all despite the abstraction for the scheme. In UMA 6, the river flow volumes were also very high to be of worry to downstream users.

In Livizi however, the level of river abstraction was higher than the recommended 50% of the stream. The implication was that during minimal flow rate in October-November, the entire flow was diverted to the scheme. It was indicated by the respondents that in such cases, the downstream users just accept that the river 'has dried up'. The respondents felt that they could not be challenged because they had abstraction rights given by the government through 'user rights fees' they pay to the Water Resources Board.

In view of this, it would be advisable that scheme abstraction rate designs should be based on projected river flows for October-November wherever this is realistic. Otherwise, during mobilisation process, downstream users should be advised of the potential risk of the river drying out downstream as a consequence of the scheme.

Ponding

Lack of lining (i.e earth canals in Lividzi 2 and UMA 6) and lack of plastering, and the occurrence of cracking (in Mgundu scheme) of the main canals led to water seeping into the ground and stagnating in some plots in the lower parts of the scheme. Such plots are abandoned due to excess water from the ground. This problem leads to reduction in utilisable area of the scheme; hence affecting intended productivity.

Field observations revealed two possible causes of seepage:

- *In UMA 6 schemes; seepage is facilitated by holes made by rodents in some parts of the main canal, as well as loose soil materials in other parts of the main canal.*
- *In Livizi scheme, according to the households, part of the earth main canal was dug slightly too deep. This slows down the flow of water to the lower fields and facilitates seepage, apart from seepage caused by loose soils in some parts of the canal.*

It would be advisable that all main canals should be brick lined and plastered while the secondary canals could be compacted periodically in order to reduce ponding. There should also be deliberate attempts to include a main drainage canal below the plots in the schemes.

Alien species

In all the three schemes, the respondents reported no presence of any species that were alien to the locality. They did however indicate that some types of plants that normally would only be along the immediate river banks can now be found upland due to the ponding problem. This was true for fauna such as tadpoles which were no longer restricted to the main river channel as they could be found in canals.

In Lividzi 2, this was due to poor slope of the main canal owing to the terrain and uneven base due to lack of lining. In Mgundu, tadpoles were in the scheme plots due to poor drainage caused by excess water seepage from the un-plastered main canals. Incidences of snails along canals were also noted as a new development although the snails were not alien to the area. It has not been established whether these were bilharzias carrying snails.

In Livizi however, it was observed that there was a marked increase in the presence of Azolla species (also called mosquito or water fern) in the main river channel and irrigation canals. This was referred to as a natural phenomenon by the respondents. However, this fern is indicative of increased dissolved nutrient levels in the water, particularly nitrogen. Because it was available even at the intake, the dissolved nutrients are unlikely to be from the Livizi 2 scheme. Further enquiries revealed

that there was another scheme further upland on the same river. Judging by the quantities of the Azolla, the nutrients would likely be coming from agricultural activities prevalent in the whole the catchment area of the river.

Azolla is harmless to the scheme crops and people, (it is beneficial if incorporated into the scheme plot soils for improved organic content and nutrients), it is however harmful to other aquatic fauna due to its impact on dissolved oxygen levels.

Water-dependent diseases

In all the three schemes, the respondents indicated that there were no incidences of increased water dependent diseases; (Bilharzias, Malaria, diarrhoea, Cholera, Elephantiasis or Ascariasis) that could be attributed to the scheme. In Mgundu, scheme members said that ponding in the plots had not led to increased incidences of malaria; and closer examination did confirm that there were no mosquito larvae in the stagnant water. This was explained by the presence of tadpoles.

In Livizi 2, the presence of Azolla meant low dissolved oxygen levels in the water thereby making the water inhabitable to mosquito larvae.

Bilharzia however, is an ever present risk in most schemes if cleaning of canals is not adhered to by the households. For example, in Mgundu, the observed snails, being hosts in part of the bilharzias life cycle, are an indicator of potential risk to human health.

To reduce the risk of bilharzias the canal system should be properly designed (i.e maintaining a 1% slope) that supports a healthy water flow that does not allow snails to attach themselves to canal walls, complimented by constant cleaning of the canals.

Siltation, and soil conservation

In all the three irrigation sites, siltation was not a dry-season problem for the main canals. However, the problem arose during the rainy season in UMA 6 and Lividzi 2. In these sites, since the canals were unlined for most sections, caving in the earth happens as well as filling up with silt from rain runoff from upland.

In Lividzi 2, the problems prompted adoption of some soils and water conservation measures in some upland gardens just to limit the damaging effect of the runoff. Attempts were made to limit gully reclamation through use of some soil and water conservation measures as follows:

- *Use of sugarcane - in all the three schemes, this was sporadically used to line the canals in order to increase its stability. The popular practice was that the upper side of a canal would be lined with vetiver while the lower side would be lined with sugarcane.*
- *Use of vetiver - of the three schemes, UMA 6 had the highest use of vetiver grass as a soil and water conservation tool. Unfortunately it was only used in lining the lower side of the canals and not for holistic application in the terracing of the plots in the scheme. Its adoption was even lower for Lividzi 2 and Mgundu schemes.*

It is recommended that the use of vetiver grass should be encouraged through any available channels, to help reduce the problems of soil erosion and siltation.

Disaster Risk Reduction and Climate Change

The combined threat of climate change and the observed increasing trend in floods and drought, one of the key drivers for the implementation of an irrigation scheme is improved community resilience. To some extent this has been achieved by the implementation of the irrigation schemes studied.

The schemes have created mechanisms that enables households to avert the food shortage periods and maintain higher food security in three ways:

- *Households deliberately set aside one irrigated maize crop for harvest and storage to be used when they see that their rain-fed stocks of maize are not enough to take them to the next harvest. If the household has enough staple food stocks from the rain-fed harvest they focus their energy and resources on producing and selling green maize and other cash crops such as tomato and Irish potato.*
- *Complementarity has been established between rain-fed crops and irrigated crops. Households use money realised from sales of surplus produce from irrigated crops to buy inputs for rain-fed crops and vice versa. This secures the households production system.*
- Some of the households are using the money earned from irrigated crops for buying livestock such as pigs and goats. In Mgundu scheme the households have also started incorporating aquaculture in their production system thereby further diversifying their production.

There are limitations in the effectiveness of such schemes however. During the months of October and November, for instance, at Lividzi 2, the river was observed to be completely diverted by the scheme. An increase in upstream abstraction or a late rainy season is likely to lead to difficulties in successful irrigation and the crops may fail.

It is recommended that selection for location of irrigation sites incorporates the vulnerability of the area to climate change and disasters as a factor. Flooding and drought are likely to become increasingly frequent in the future, subsequently low lying/ flat land, and schemes utilising rivers with low flows should be discouraged.



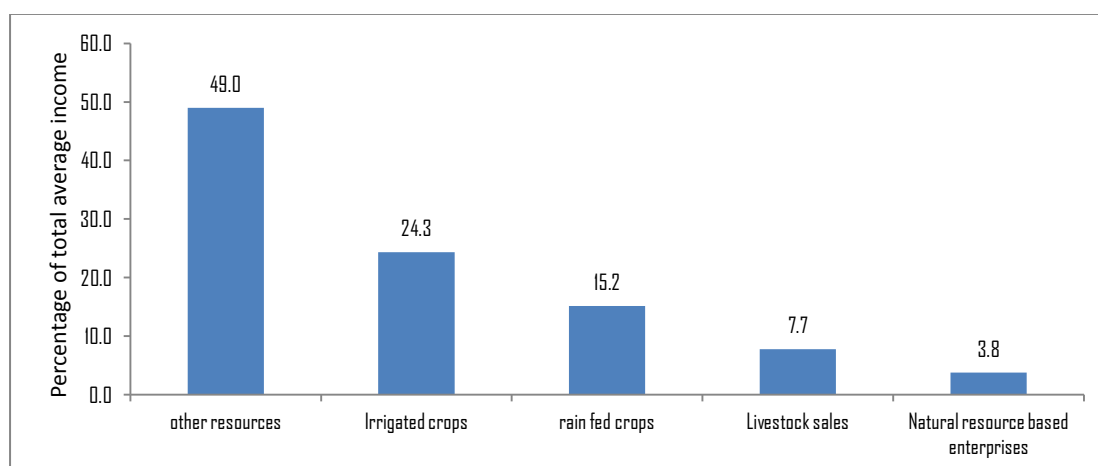
ECONOMIC AND GOVERNANCE ISSUES

Contribution of the irrigation schemes to household incomes

The average annual household (male and female producers combined) income for members of the three irrigations schemes for the period starting from April 2010 to March 2011 was MK86,575. The average annual income for male farmers was about three times higher at MK96,904, than that of female farmers at MK30,232. This is mainly due to fact that men tend to concentrate on the production of cash crops while women tend to produce for household consumption.

While the female farmers, especially those from female headed households, earned some income from different sources such as small scale businesses, *ganyu*, remittances, rain-fed crop, irrigated crops and livestock sales, the average incomes from each of these sources were lower than those of their male counterparts. As already discussed, in both irrigated and rain-fed crop production systems, there is tendency amongst the female headed households to focus on production of staple foods other than cash crops.

Figure 5: Comparative analysis of household income for the irrigation schemes.



Income data prior to the schemes was not contained within the available feasibility studies. Increased income was highlighted as a primary benefit of the schemes; however quantitative forecasts were not undertaken. It is not therefore possible to evaluate the success of the schemes in terms of per capita returns compared to objectives.

For the schemes investigated however, sale of crops produced under irrigation is now the second major contributor to the total annual household income; contributing 24.3%, while rain-fed crops contribute 15.2%. Irrigated crops therefore make a significant contribution to household income even though the current focus and production systems are of subsistence nature, particularly for female farmers in female headed households.

Cost benefit analysis

A comparative assessment of the cost of production versus the total value of produce from 0.1 hectare of irrigated land shows that when households produce grain maize they can realise a net profit of approximately MK 6,220. However if the same crop is sold as green cobs, the households can achieve a net profit of MK 40,000. Households tend to concentrate on grain (dry) maize as the transactions costs of taking and selling green maize to the market is much higher. Household storage of green maize is also more problematic whereas grain maize is processed at the household level for consumption and storage is much easier.

If the households produce tomatoes on the same piece of land, they realise a net benefit of MK 144,562.

Table 3: Costs benefits analysis of irrigating one hectare

	Average production per 0.1 ha	Unit price (MK)	Total value per 0.1 ha (MK) farm gate price	Total cost per 0.1 ha (MK)	Total benefits per 0.1 ha (MK)
Maize (grain) (kg)	280	50	14,000	7,780	6,220.00
Tomato (kg)	3200*	80	256,000	111,438	144,562.00
Green maize (cobs)	4800	10	48,000	8,000	40,000.00

* Production figures are based on the average production for 5 households producing tomatoes in Mgundu and UMA 6 schemes

The expenditure included in the calculations of these benefits include rent, annual subscriptions, registration fees, water-use licence, inputs such as seed, fertilisers, pesticides, packaging materials, and transport from the field to homesteads, marketing costs including transportation costs, packaging, storage and security.

It should be noted that the figures used in this assessment were not based on documented records but on recollections from scheme members. The inherent error in the results may therefore be considerable; however the findings suggest that selling grain maize is not an advisable economic strategy.

With the current level of yields if a farmer can produce three irrigated crops in a year e.g. a crop of grain maize, a crop of green maize and a crop of tomato, the farmer would realise an overall net benefit of MK166,000. This is almost double the current overall average total annual household income.

The current yields for tomatoes and maize are significantly lower than the potential that can be realised from the scheme with better management. In order to maximise benefits households in the schemes need to focus on the following:

- Improving management of their crops in order to increase yields
- Producing up to three crops a year from each of their 0.1 ha plot
- Further increasing the benefits from the irrigation schemes by adding value to their produce.
- An economic assessment of market opportunities which would encourage growers to produce for the market not merely selling their excess production

There is need for households to utilise the potential that exist in the irrigation scheme to increase production of cash crops and to put in place appropriate mechanisms for marketing the cash crops. For example in Livizi scheme, the households need to identify cash crops that are resistant to frost to fill the production gap that currently exist between April to August. In Mgundu and UMA 6 schemes the households should strive to produce up to three irrigated crops in the year. This will enable them balance the production of maize and cash crops.

Female headed households in particular need to be encouraged and supported to diversify and increase levels of production of cash crops. This can be achieved if all households in each of the three schemes started planning together, sourcing inputs together synchronising their planting time, supporting each other in the management of the crops and marketing their crops as a group. In addition, if the households in the scheme (particularly female farmers) are to maximise benefits, they need support from extension services

Economic sustainability of schemes

It was revealed through the study that the sustainable supply of inputs, particularly to vulnerable households, in a scheme remains a serious challenge.

The current crop production levels and trends in the schemes are predominately subsistence level. If households are to realise food security as well as increased household incomes: there is need to diversify and increase the levels of cash crop production in order to balance the production of subsistence and cash crops.

For the UMA 6 scheme, gross margin analysis undertaken in the feasibility study indicated that one of the highly profitable crops to emphasize in the area is the growing of tomatoes. However it was noted that significant investment is required to reduce the disease and pests incidences that hamper production of the crop in the most profitable season (rainy season).

It has been established that the current levels of production and benefits are lower for female headed households compared to the male counterparts.

If productivity for female farmers is to increase, there is need for initiatives such as village savings and loans facilities within the schemes which would allow them to gradually build capital from small savings by members. Such a facility would enable the female farmers to obtain loans for buying farm inputs. There is also need for a critical review of the impacts and sustainability of microfinance loans versus other approaches for supporting provision of farm inputs to smallholder households not only in the irrigation schemes but also in crop and livestock interventions

The deliberate targeting of female farmers by extension services could help enable them build the necessary capacities to effectively participate in small scale commercial irrigation production.

Investment should also be directed towards reducing post-harvest losses. Concern Universal and other key partners (Ministry of Agriculture, other NGOs) in the area need to collaborate to tackle some of these problems. Apart from the use of chemicals to reduce the yield impact of the pests, it is possible for farmers to offset a significant proportion of the yield losses through a combination of better husbandry practices as well integrated pest management. These are issues which would be better articulated by the local extension staff both from the Ministry of Agriculture as well other local stakeholders.

Both male and female members in the irrigation schemes regarded the schemes as a panacea, and not just part of the solution, to food insecurity and income issues in their area. There is need to find integrated solutions to food insecurity and other income issues. There is need to integrate scheme activities with other income generating opportunities i.e. crafts and other vocational skills as well as adding value to irrigated products.

Technical design and maintenance

The designs of the three irrigation schemes Mgundu, UMA 6, and Livizi 2 included a weir constructed at the water intake with pipes conveying water from the intake to the main canal. All the schemes have undergone some minor maintenance work such as replacing the pipeline or repairs of the weirs. This maintenance work has restored water abstraction capacities.

Upper Masasa 6

At UMA 6 sufficient water was abstracted to irrigate all the plots in the schemes, however due to excessive seepage some of the fields at the end of the scheme were not receiving adequate water. The consequence is that currently only ten hectares are being irrigated compared to the designed eighteen. Where the lined canal ends the problem is so serious that it threatens to cause a land slide.

The weir for UMA 6 irrigation scheme has undergone major maintenance works. One side of the weir was undermined because its base was not built on a solid foundation. The weir was repaired by a road construction company in exchange for use of the water from the scheme. The weir is now stable,

however without this intervention the scheme would have been closed as the households would not have managed to carry out such major maintenance works on their own.

In addition the weir had four metal gates. The households observed that they were not able to withstand the pressure of the water and were damaged after a short period of use. Consequently, the households replaced the metal gates with wooden ones, which seem to withstand the water pressure better. In addition, the households requested the company which repaired the weir to permanently seal two out of four gates. Now the scheme is operating with two gates.

Livizi 2

This scheme was not fully functioning as designed. There was less water delivered to the lower part of the scheme because of high seepage in the unlined section of the main canal, consequently only nine hectares were being irrigated compared to the designed eleven.

The scheme has a very solid weir however there is an outlet pipe lower than the three pipes which convey water to the main canal of the scheme. Sometimes, while the households are irrigating their fields, people passing by open this outlet pipe allowing the water to flow into the river course. This disturbs the irrigation process. The inclusion of gates into this design could have reduced this risk.

Mgundu

Mgundu scheme was originally designed by the DOI to irrigate 6 hectares yet over abstraction has meant the scheme members are successfully irrigating 26 acres. The excess water causes ponding of water in the lower parts of the scheme as well as leaching of the plot soils.

During the design phase, an engineer raised the issue that the scheme was oversized, and that irrigating 15 to 20 ha would be more appropriate, however the design was not amended.

Where the households have extended plot layout by 20 hectares, the plots were not levelled and the furrows have not been properly designed. There are plots which have irrigation furrows that are longer than 5 metres, and there are variations in the slopes of the furrows. Consequently water runs faster in some parts of the furrows – up to the extent of causing soil erosion; while in other parts of the same furrow water runs slowly causing ponding as well as uneven distribution of water to crops. This is resulting in uneven growth of the crops and will reduce yields.

Maintenance of the irrigation scheme

As already highlighted above in all the three schemes, members were conducting some maintenance works of their schemes. These included costly operations that required money as well as simple manual works such as clearing and maintaining the main and feeder canals.

For costly maintenance activities, each of the three schemes had established a fund mostly from annual membership contributions, and entry fees for the households who did not participate in the initial development of the schemes.

Using this fund Mgundu and Livizi 2 irrigation schemes were able to buy pipes replacing those damaged by flooding water. UMA 6 has mostly used this fund as a farm input revolving fund, as the need to pay for maintenance works has not yet arisen. The maintenance fund has managed to sustain the irrigation activities in the Livizi and Mgundu scheme otherwise the schemes would be closed.

The pipes for Mgundu and Livizi schemes are not properly anchored and as a result both schemes have experienced incidences of the pipes being washed away by heavy river floods. Mgundu scheme had to replace 8 pipes which were damaged by flooding water. This problem would have been minimised if the pipes had been anchored properly.

Governance and management

The three schemes studied have leadership and organisational structures which include the main committee and several subcommittees. The key roles that these structures currently play include facilitating sharing and use of water, collecting financial contributions from members and in some cases intervening if a particular member breaks the scheme regulations, and facilitating maintenance of the scheme.

The initial agreements for each scheme state that the leadership structure is supposed to serve the following key functions;

- *Development of annual and seasonal production plans, including crop quantities, timings and plot sizes for each farmer for the purposes of crop rotation and marketing.*
- *Facilitate joint marketing to negotiate good prices, arrange transport and reduce marketing costs.*
- *Facilitate establishment of savings and loans facilities that support a revolving system for inputs. This would enable households to take advantage of their numbers to access cheaper inputs.*

While the households were working together in aspects of maintenance of the scheme and watering, joint production planning was only done in the first two years in all the three schemes and later abandoned.

As most of the households were growing green maize as the main cash crop and the buyers were from neighbouring villages who could only buy a few hundred cobs there was no need for the households to work as group to market their green maize. Consequently the vendors were buying maize from individual households. This led to the abandonment of the joint planning and synchronised production system. Currently each farmer operates independently in terms of production and marketing of the crops grown.

Apart from the water user rights certification, none of the schemes is legally registered as a cooperative or association and farmers are producing and marketing as individuals. If the three schemes are to operate as effective commercial entities:

There is need to facilitate a process of transition of the schemes from subsistence oriented production to commercial oriented production. The following would be some of the key interventions to be carried out in this process:

- *Facilitated conversations by members of each scheme to review the current production and marketing systems focusing on strengths, weaknesses opportunities and threats and agree on strategies for improving benefits from the schemes.*
- *Better coordinator between members of each scheme on the various options of marketing systems that they would adopt facilitated by experts on marketing. This should include training on technical aspects of marketing.*

Relation to National Initiatives.

The Government of Malawi seeks to “increase agriculture production and enhance food security through irrigation, which will ensure some production during droughts, and the dry season, and this will supplement rain fed agriculture” (*Ministry of Agriculture and Irrigation, 2000*). The schemes have successfully improved food security for the householders participating.

The significant increase in the average total irrigated hectareage from 0.05 ha to 0.21 ha for female headed households is in line with the Government policy which promotes the greater involvement of women in community organizations and irrigation developments (*Ministry of Agriculture and Irrigation 2000:11*). This might have been a result of deliberate efforts by extension workers to encourage more women to participate in the irrigation schemes.

As well as recognising the importance of gender roles in irrigation in all training programs, the Green Belt Initiative (GBI) promotes gender sensitive technology development and dissemination, mainstreaming of crosscutting issues such as nutrition, gender, HIV and AIDS and environment in the planning and implementation of all activities, as well as implementation of actions to mitigate the negative impact of HIV, AIDS and gender imbalance on agricultural productivity (*Government of Malawi 2008/9*)

There has been mixed success within the projects with the issues of gender and HIV and AIDS. This is attributed to the deliberate efforts of extension workers and community based organisations that have coordinated with the project. Specifically the success of the UMA 6 scheme is owed to the planned inclusion of education and support for these groups as outlined in the feasibility study.

The National irrigation Policy and Development Strategy, (NIPDS), seeks to contribute to poverty alleviation by targeting resource poor smallholder households for irrigation development to enhance farm income and commercialization of the sector (*Ministry of Agriculture and Irrigation 2000:5*). The policy promotes the creation of a business culture in the small scale irrigated agriculture sector, and improvement of the marketing system at national and international levels. This is achieved by facilitating the establishment of a well-coordinated marketing system with considerable local processing and better storage / transportation of farm produce.

There has been limited success with regards to marketing of produce generated from the irrigation schemes. The limited access to large markets and overall marketing strategy has constrained joint production planning and farmers are operating independently. As a result farmers are losing out on potential savings on farm inputs, transportation and marketing.

This is further elaborated by the GBI, which advocates two systems for facilitating market linkages namely:

- *The promotion of market information systems, market extension programmes for maximizing benefits for the households*
- *The establishment of farmer organisations to either venture into activities within the value chain or utilise contractual arrangements with established entities within the value chain to ensure value addition and commercialisation (Government of Malawi 2009:12)*

These elements have not been successfully incorporated into the schemes in this study.

Government policies on irrigation recognise the importance of integrating sustainable environmental management in the course of irrigation development and management. NIPDS advocates promotion of proper management of soils, which are subject to irrigation development with a view to ensuring their sustainable productivity; as well as soil conservation measures to reduce the degradation of the catchments (Ministry of Agriculture and Irrigation 2000:5-6). The policy also advocates for Environmental Impact Assessment to be undertaken for all medium and large scale irrigation development. Similarly, the GBI promotes integration of initiatives to promote sustainable land management including reduction of soil erosion, siltation, and improvement of soil fertility through appropriate land use practices, such as afforestation, protection of marginal and fragile areas (The Green Belt Initiative 2009:8).

The initiative also promotes the integration of irrigation scheme catchment conservation, river-bank and lake shore conservation, pollution prevention, land degradation prevention, among others; as well as subjecting all major projects under the initiative to Environmental Impact Assessment and Audits to ensure compliance with the Environmental Management Act and other related legislations (The Green Belt Initiative 2009:7-8).

It is not clear from the available documentation if these criteria have been fully met, however the assessments following the implementation of the schemes suggests that there have been no negative environmental impacts as a result of the schemes.

The National Environmental Policy (NEP) stipulates that scheme areas must be at least 10m from the main river channel. This guideline is meant to protect the river channel to prevent soil erosion particularly during high river flows. However, this recommendation has a 'one size fits all' approach, in that 10 m may not be the necessary measure for some steep banked or deep rivers like the one serving Lividzi 2 scheme. (In Lividzi 2, there would be no scheme if this guideline was followed).

Of the three schemes, it was only Mgundu that was designed to adhere to the policy. UMA 6 had the potential to be compliant with this provision but it was not followed as individual households had extended beyond the recommended areas.

There is need for policy review to provide guidance for a set of options to categorise the recommended distance from the river based on specific conditions. This could be based on risk factors at the site such as bank slopes, river flow data, soil type etc.

CONCLUSIONS AND RECOMMENDATIONS

The study found that that irrigation schemes can have a significant positive impact on a range of social and economic factors such as:

- *Increased food security, dietary diversity and household income was achieved*
- *Gender training led to high levels of gender understanding and equality within the project*
- *Deliberate inclusion of PLHIV has largely led to benefits for affected households*
- *The schemes have not had a significant negative impact on the surrounding environment*
- *The schemes have an effective management structure which coordinates plot ownership, payments, and a maintenance fund*

There are however areas that did not reach the potential, or the predicted achievements as highlighted within the feasibility studies for those schemes.

- *Targets for the number of crops produced per year are largely not being achieved – this is attributed to poor production planning, unfavourable growing conditions such as frost, access to inputs as well issues with the operation of the schemes themselves.*
- *Insufficient funding has meant that there is a large portion of the main and secondary canals that are unlined. As a result water is lost to seepage which leads to both water shortages at some plots, as well as ponding in other areas*
- *In some cases the requirements placed upon scheme members was discouraging participation of PLHIV; such as plots being allocated only to those that participated in the labour intensive work of clearing the irrigation land and developing the irrigation channels. The remaining plots are obtained through annual rental fees, which some of the PLHIV interviewed found unaffordable*
- *Joint production planning has been abandoned due to limited access to large markets. Farmers are now working independently crop planning and marketing*

A number of recommendations have been made throughout the report that would be of benefit to both current and future community based irrigation schemes:

To maximise production from the schemes: it is important for households to adopt a culture of crop production planning for the purposes of commercialisation, as well as helping households realise food security. This could be facilitated through the existing scheme committees with the support of external support services, and should be one of the major focal areas in building the capacities of the households in the scheme.

It is thought that dietary diversity can be further improved if within their production plans; households in the scheme diversify and deliberately increase production of lesser consumed crops such as fruits, legumes and oil seeds. During scheme proposals, it is recommended that dietary diversification is considered as a key opportunity for scheme participants, for both improved health and income generating opportunities. In addition to this there is a need to find integrated solutions to food insecurity and other income issues. There is also a need to integrate scheme activities with other income generating opportunities i.e. crafts and other vocational skills as well as adding value to irrigated crop production.

Men and women have different roles and faced different challenges with regards to irrigation in the schemes. Gender analysis should therefore form part of the process of developing future irrigation schemes to enable communities and development planners to better understand the gender dynamics in irrigation farming, and design schemes that will influence and enhance gender dimensions. Further training has been shown to be effective in increasing community awareness and understanding of gender related issues. It is recommended therefore that gender training is incorporated into the support framework for community based projects.

Investment should also be directed towards reducing the post-harvest losses. Concern Universal and other key partners (Ministry of Agriculture, other NGOs) in the area need to collaborate to tackle some of these problems. Apart from the use of chemicals to reduce the yield of the pests, it is possible for farmers to offset a significant proportion of the yield losses through a combination of better husbandry practices as well as integrated pest management. These are issues which would be better articulated by the local extension staff both from the Ministry of Agriculture as well as other local stakeholders.

There is need to facilitate a process of transition of the schemes from subsistence oriented production to commercial production. This could be achieved through facilitated conversations between scheme members as well as training by marketing experts.

Policy guidelines and enforcement mechanism should be developed and / or strengthened to govern the use of customary land for irrigation development including rationalisation of access to irrigable land in order to protect the most vulnerable groups who cannot afford to pay rent.

There is need to facilitate linkages of the irrigation groups with community based organisations, support groups, home based care group and orphans and vulnerable children care groups. This will expose the households in the schemes to the various interventions on HIV and AIDS prevention and mitigation which are already occurring in communities around these schemes.

It is important to deliberately introduce measures that will reduce labour constraints on the vulnerable groups such as the HIV and AIDS affected, the aged, the disabled and the chronically ill. These measures would include designing shorter irrigation furrows which are easy to operate, introducing labour saving technologies for planting and management of crops.

To reduce the risks of HIV infections associated with the scheme there is need for the creation of awareness amongst the scheme members and incorporation of interventions to prevent gender based violence and HIV infections. There is also a need to incorporate within the irrigation scheme management system HIV and AIDS prevention and mitigation interventions. These would include scheme members having facilitated conversations on HIV and AIDS related issues and developing plans of action for HIV prevention and mitigation of its impacts, as well as education on the management of earnings.

When negotiating ceding of gardens for the sake of irrigation schemes, consideration should be given to where the people will move their rain-fed cultivation to so as not to impact on the environment as a consequence. It would be advisable that scheme abstraction rate designs should be based on projected river flows for October-November wherever this is realistic. Otherwise, during the mobilisation process, downstream users should be advised of the potential risk of the river drying out downstream as a consequence of the scheme.

It would be advisable that all main canals should be brick lined and plastered while the secondary canals could be compacted periodically in order to reduce ponding. There should also be deliberate attempts to include a main drainage canal below the plots in the schemes.

It is recommended that the selection of irrigation sites incorporates an assessment of the vulnerability of the area to climate change and disasters as a factor. Flooding and drought are likely to become increasingly frequent in the future, subsequently low lying, flat land and schemes utilising rivers with low flows should be discouraged.

Another finding that emerged was that the information included within the scheme proposals was not sufficient to enable the effective evaluation of the impacts of the schemes. Very little information (and in some cases none) was presented with regard to the existing food security, dietary profile, household income, health indicators or environmental conditions prior to the introduction of the scheme. It is highly recommended that for future such schemes, thorough preliminary studies are undertaken to enable more constructive analysis of the successes or constraints of the scheme over time. This is fundamental in developing a culture of learning and improving the potential achievements of future schemes.

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Concern Universal Malawi
21 Link Road, Namiwawa
P.O. Box 1535
Blantyre,
MALAWI

Tel: +265 1 822 705/1 823 761

Fax: +265 1 823 846

E-mail: cublantyre@concern-universal.org
Website: <http://www.concern-universal.org>