Field Work Final Report

Case Study: Irrigation in the Uluguru Mountains- Morogoro (Mlimani Area-Choma)

By Anna Mdee, based on data collected by Chris Mdee, Erast Samwel and Elias Bahati

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Introduction

This case study (Choma in the Uluguru Mountains) was selected as it appears to offer an example of productive small-scale irrigation, using new technology (hosepipes) but organised informally through long-term ethnic and kin relations of the local WaLuguru people. At the same time, this small-scale system is threatened by a broader context of water scarcity downstream, as well as an official discourse which characterises this irrigation as illegal and environmentally destructive.

Choma is situated in the Uluguru Mountains above the city of Morogoro and lies in one of the catchment zones for the Morogoro Municaplity domestic water supply. Further the Uluguru Mountains are a significant catchment area for Dar-es-Salaam and hence the water supply is politically and economically significant. Technical concerns in relation to the capture of water by farmers for irrigation, and the potentially harmful contamination of the water by human and livestock wastes, have led to an on-going debate concerning the future of settlement in the mountains.

In 2006-7 the Local Government attempted to organise the resettlement of the WaLuguru to another location. However, Farmers won a reprieve and have continued to farm and use the river waters for irrigated vegetable and fruit production.

The case is relevant to this research for the following reasons:

- It shows informal organisation for irrigation water access based on kin/ethnic relationships (WaLuguru).
- It shows the evolution of technology use and the influence of external bodies on this.
- It shows competing moral economies of water use and efficiency- between long-term residents of the mountain and those managing the water supply of Morogoro.

NGOs working with farmers on agriculture have been encouraging the use of sustainable and organic farming techniques. One NGO is also piloting the payment of farmers for conserving water sources and farming using environmentally beneficial techniques. Some evidence suggests that these are popular and easily adopted by farmers.

It is very difficult to pinpoint the extent to which climate is changing on the mountain. Farmers are divided in their opinions on this issue and local meteorological data does not provide a clear picture. Although, this suggests that Morogoro Town is becoming hotter and drier, but further up the mountain rainfall may have increased. The population of the mountain and of Morogoro is increasing. However, local academics cast doubt on the validity of both population and meteorological data. The long term future of the small-scale irrigation in Choma is uncertain. This report details the local discourse- evidence and opinions on this matter are often contradictory.

Methodology

This report attempts to analyse, synthesise and identify thematic issues emerging from data collected in the Choma area.
The research questions were guided by the University of Sussex Team.

Initial field visits in May confirmed the selection of Choma as a potentially interesting case study. Several observational and environment scanning visits took place in June and July. A number of key informant interviews were also conducted to build up an awareness of discourse concerning agriculture, water and irrigation on the Ulugurus.

A baseline survey of farmers created by Canford Chiroro was slightly modified and translated into KiSwahili by Chris Mdee. Chris Mdee, Erast Samwel and Elias Bahati conducted interviews with 102 Farmers in July 2013. Chris Mdee collated the results of this survey- these are provided in appendix 3.

This was used to inform the selection of 15 Farmers for extensive semi-structured interviews. Rama Ngoma, a local Guide and Environmentalist, also facilitated introductions and is an important key informant. Additional Farmers were interviewed in November and December on aspects of land inheritance, ownership and cropping patterns.

Key informant interviews were conducted in the period from May-December. These include respondents from Local government, Academics from Sokoine University of Agriculture and staff from NGOs. Some respondents have been interviewed formally in an office setting, others more informally over the course of conversation. A list of interviewees is included in Appendix 2.

This case study has also been informed by participant observation during walks in the mountains and informal discussions with Farmers working in the fields during August-December 2013.

Another useful source of data comes from interviewing the Research Team- Chris, Erast and Bahati as to their impressions, stories and experiences during the data collection.

One FGD took place with the Choma Organic Agricultural Group and further interviews were conducted in December with male and female farmers in order to clarify issues of land tenure and inheritance.

Additional interviews and field visits took place during November with Dr Elizabeth Harrison and Dr Canford Chiroro from the University of Sussex.

All interviews were conducted in KiSwahili and were simultaneously transcribed and translated into English. Interview notes are scanned and stored using dropbox. Most interviewees were not comfortable with audio recording.

Choma Mitaa (Morogoro Municipality, Uluguru Mountains)

1. General description

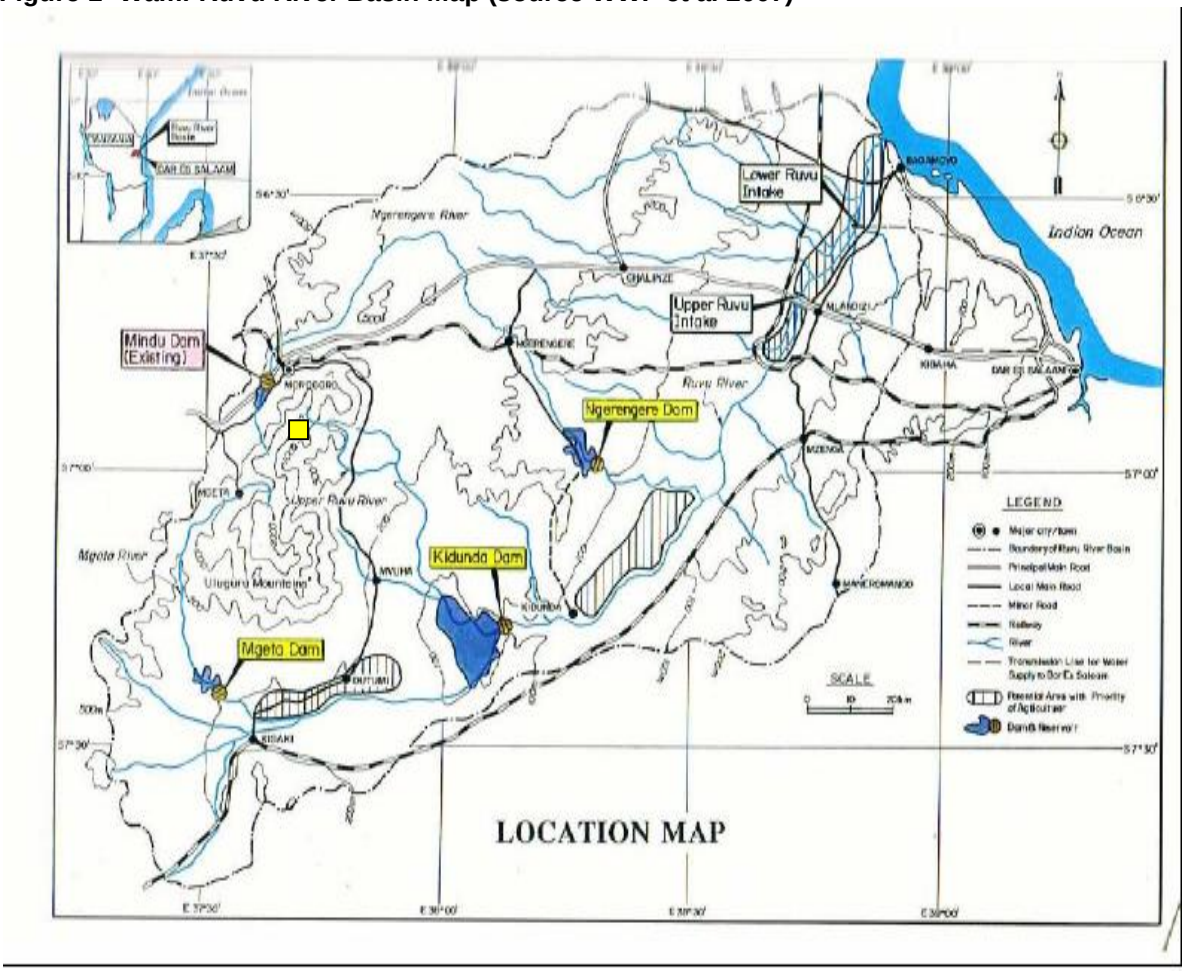
1.1 Location & Physical Geography

The Uluguru Mountains are part of the Eastern Arc Mountains in Tanzania and Kenya. The Ulugurus are an important part of the watershed for Dar-es-Salaam, Morogoro and the Tanga regions. Figure 1 provides a map of the Wami-Ruvu River Basin in which the Uluguru mountains are situated.

The case study in this research explored the local government ward known as Mlimani, which includes settlements known as Choma, Mbete, Paku and Mlali. These are no longer official villages but are part of the Morogoro Municipality, although they are located on the slopes of the Ulugurus above Morogoro Town. They are areas referred to as streets (*mitaa*)

The settlements are not within the Uluguru Nature Reserve but on the slopes below the reserve. Figure 2 shows the Uluguru Nature Reserve with the location of the villages marked on the map with a square.

Figure 1- Wami-Ruvu River Basin Map (source WWF et al 2007)



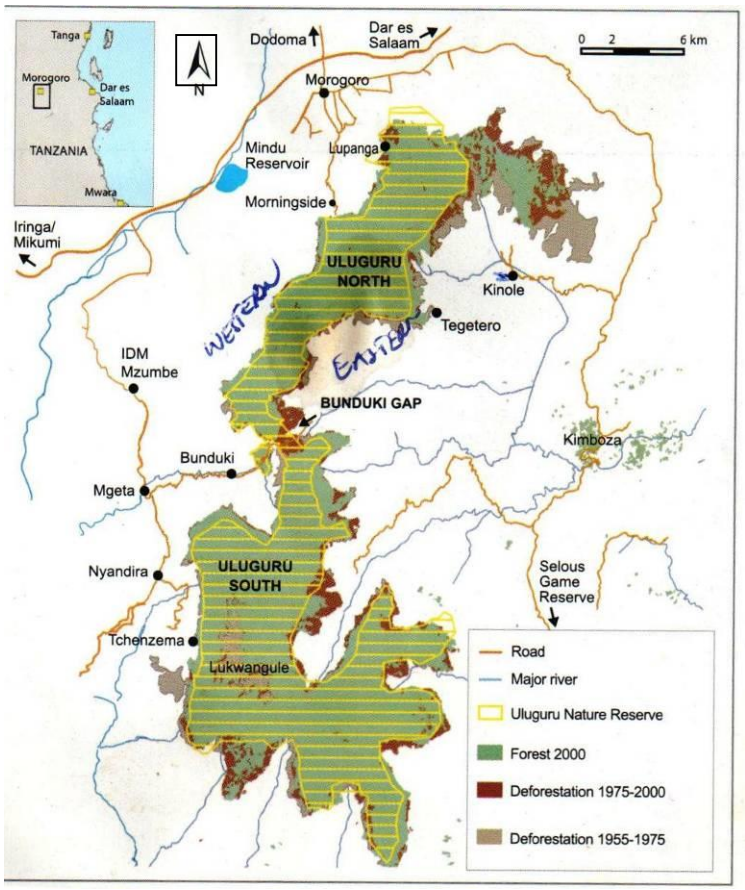


Figure 2- Map of Uluguru Forest Reserve. marks the locations of settlements for this study. (Source: UNR leaflet)

According to URT (2007) “The soils are derivatives acidic litho sols and ferralitic red, yellow and brown latosols, and are considered fertile” p3.

The area within this study is located on the mountainside above Morogoro town and ascending to Choma as the highest point. Rainfall increases and temperatures decrease with the increasing altitude. The map in figure 2 shows the location of Morningside, a farmhouse built by German Settlers in 1911. It is also the location of a small Lutheran Church. Morningside marks the top most boundary for our case study. Farmers practice irrigation downstream from Morningside. The terrain is steep and the road up to Choma has previously only been accessible up to Mbete Primary School. Villagers have recently organised to extend the road further up, so that motorcycles will be able to carry people and produce more easily. The walk to Choma from Mbete takes approximately 2 hours on foot.

The figures below show minimum and maximum temperature trends and rainfall for Morogoro. We can observe increases in average temperature over the period since 1977.

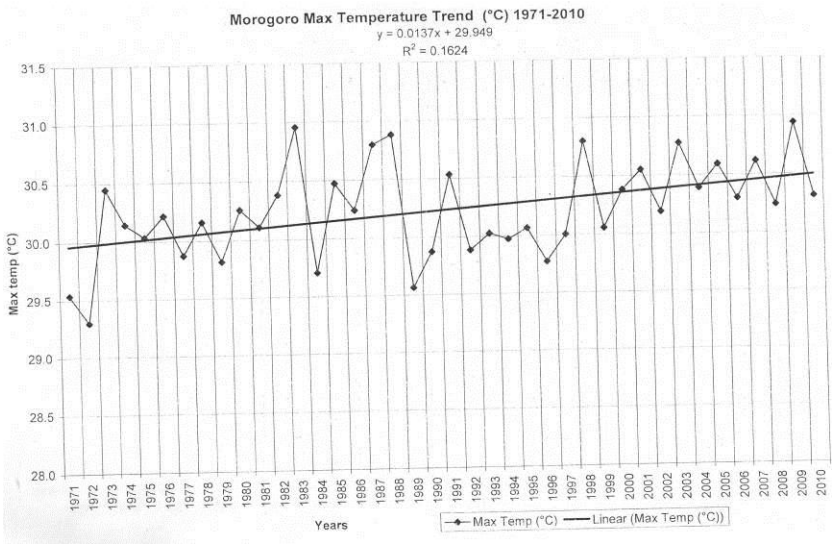


Figure 3 Morogoro Maximum Temperature Trend Source SUA/Tanzania Meteorological Agency

There appears to have been a 0.5 degrees Celsius rise in maximum temperature during the period of 1971-2010.

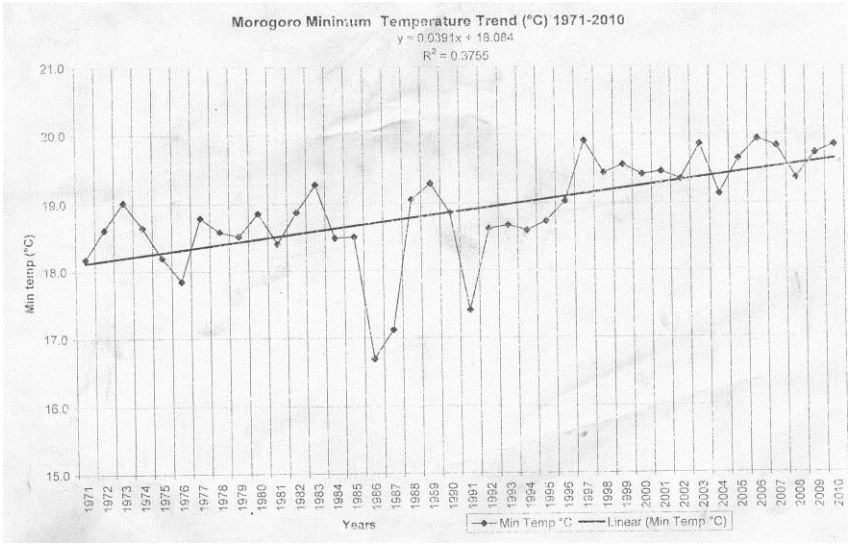


Figure 4- Morogoro Minimum Temperature Trend 1971-2010 Source SUA/Tanzania Meteorological Agency

Minimum temperatures appear to have increased by approx 1.5 degrees Celsius during the period.

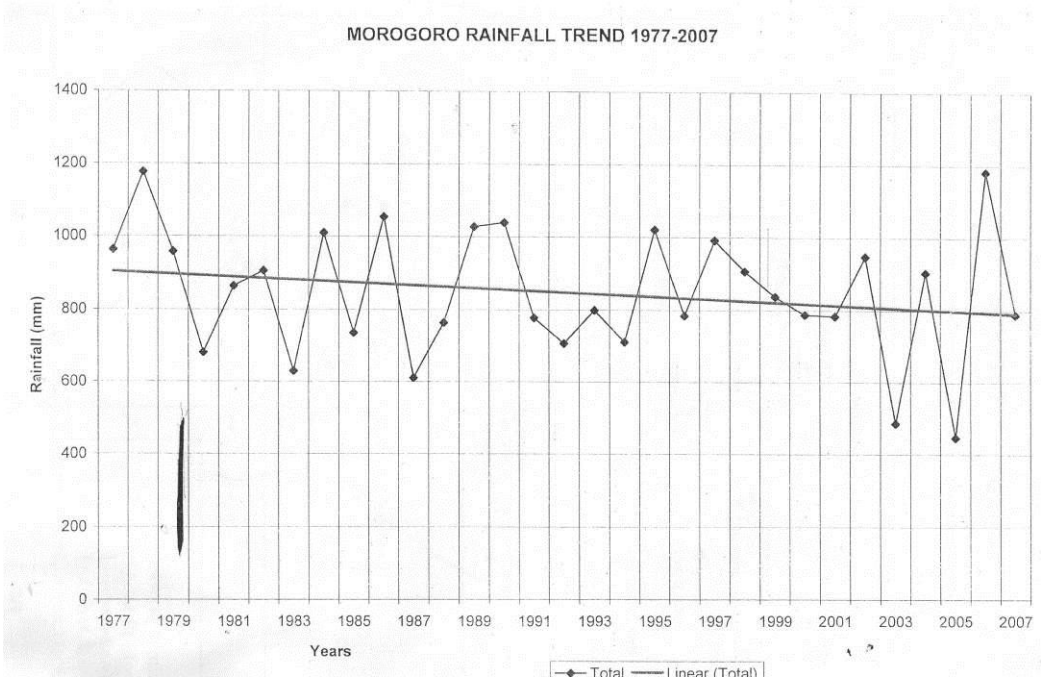


Figure 5: Morogoro Rainfall Trend 1977-2007 Source SUA/Tanzania Meteorological Agency

Data for Morogoro in figure 5 suggests a reduction in annual rainfall of around 100mm.

Morningside (marked in figure 2 above) is shown as having considerably more rainfall than Morogoro Town. It is this rainfall which feeds small streams and rivers on the slopes of the Ulugurus that are used for irrigation by the Farmers in the area. The Farmers in this study are located across the slopes between Morogoro town and Morningside and so the rainfall received and average temperatures will vary according to their position on the slope.

Figure 6 shows that Morningside has more than double the rainfall of Morogoro town and in fact shows a trend towards increasing rainfall in the records up to 2007.

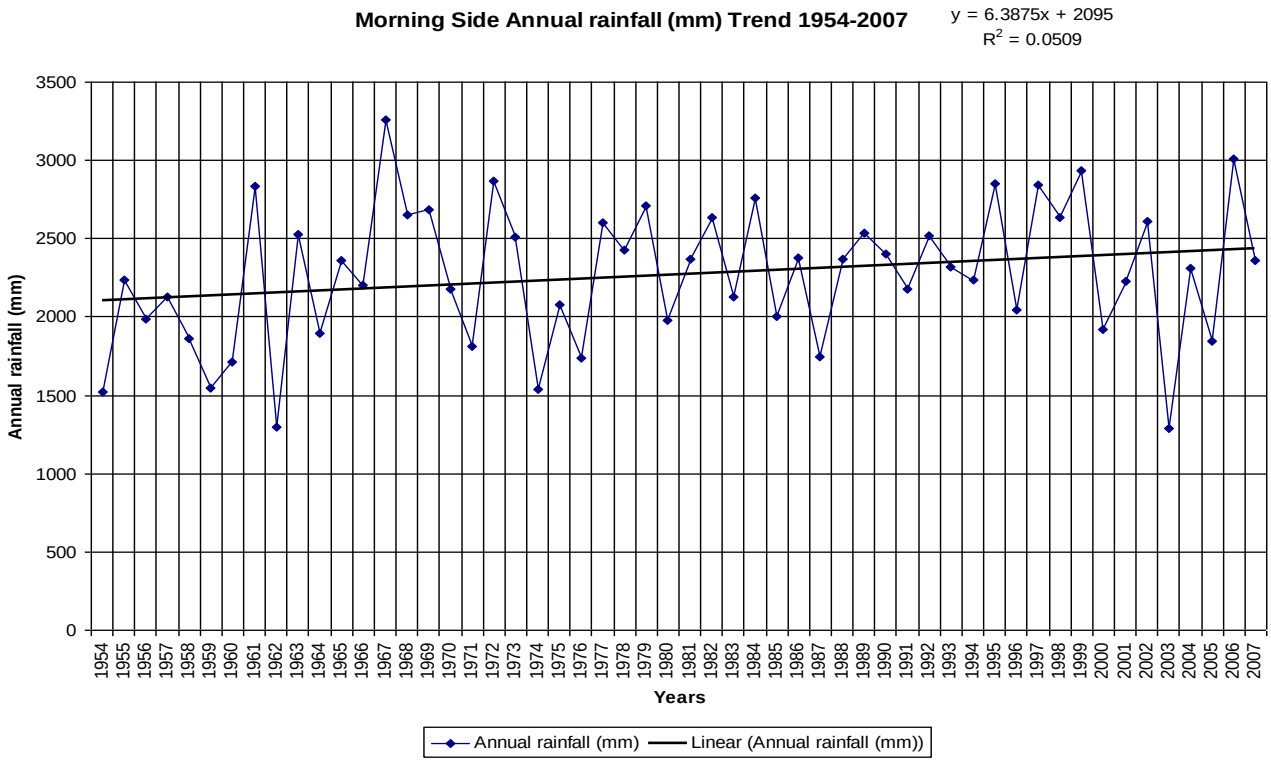


Figure 6 Rainfall recorded at Morningside from URT 2009

1.2 Livelihoods

People living in the settlements are predominantly farmers. According to our survey 66% only do farming. 15% have other business activities as well as agriculture (for example rolling small blocks of soil for consumption by pregnant women throughout Tanzania), 16% practice livestock keeping and 3 % have some employment.
93% of the population surveyed had primary schooling only, 4% had secondary education and 3% had no education.

1.3 Population Dynamics

Our survey suggested an average of 4 people per household- (2 adults and 2 children). It is striking that 97% reported that they had always lived in their current location. This is confirmed by further interviews and literature (URT 2007) which report that the Uluguru population are predominantly from the WaLuguru ethnic group and Muslim.

The 2012 National Census data records a population of 4,893 with an average family size of 4.3 for the Mlimani area, into which our study area falls (URT 2013). There is no accurate population data available for the area known as Choma- the census data is collected at a level of local government above Choma (the Kata (ward) level. Choma is not formally designated as a village but is classified as 'Mitaa' (street) as it is within Morogoro Municipality.

1.4 Land Tenure and Land Use

Our survey indicated that Farmers have an average of 2.5 acres each, comprising of 1.4 acres of dry land and 1.1 acres of irrigated land. 97% of this land is customary freehold and is inherited, although interviewees stated that the purchase of small plots is common. The WaLuguru are said to practice matrilineal inheritance and the plots owned by individuals are often in quite scattered locations due to patterns of inheritance.

The actual practice and patterning of inheritance is perhaps more complicated than some of our stakeholder interviewees suggest. Janet Maro of SAT, along with Prof Andrew Tarimo and Prof Joseph Hella of SUA are definite that the WaLuguru are matrilineal and that inheritance of land is from Mother to Daughter. In fact a recent report written by SUA Researchers for an IMWI project from another part of the Uluguru suggests a strong and uniform pattern of inheritance and the movement of men to the wife's household on marriage. However, interviews with ten individuals in Choma (4 men and 6 women) suggest that actual patterns of inheritance are more complex. 3 of the young men had inherited land from their Mothers and the other said his land came from his parents. The women all said that they inherited land from their parents. Additionally, 3 of the women said they were given land by their husbands, who had in turn inherited it from their parents. All this group of interviewees said that a women moved on marriage to her husbands' family and on divorce the couple's property would be divided equally. They all uniformly said that both their male and female children would inherit their land but that they could also buy and sell the land.
Stakeholder interviews (Prof Hella and Janet Maro) suggested that selling of land in the Choma area always required approval and consent from the wider clan, and that claims over plots could also be multiple and contested. Little official land titling is in place despite the 1999 Village Land Act. 9 interviewees confirmed that they would need the permission of their parents and or a wider group of relative before they could sell any land. 1 interviewee said that she felt she could sell her land as it is her own property. Therefore reports which characterise inheritance in the Ulugurus as matrilineal should be treated with caution and seem to no longer apply to the Choma area.

On the irrigated land, there is a high diversity of vegetable crops including carrots, celery, onions, lettuce, chinese cabbages, cabbages, leeks, coriander and others. Fruit crops include tomatoes, peppers, strawberries, raspberries and other berries. Passion fruit, papaya and bananas are also grown on family plots. The vegetable crops have a good market in Morogoro. Farmers often sell direct to expatriates and wealthier local families living in the Forest area of Morogoro. Fruit sellers from the mountains also sell their produce at the door of the more expensive local supermarkets in Morogoro. Some Farmers, working with the local NGO, Sustainable Agriculture Tanzania (SAT), have collective organic certification and sell their produce in a small shop in the Tushikamane area.

Strawberry production is unusual in Tanzania and these have good markets in Dar and Arusha. A small tub of strawberries can be sold on the street for 3000Tsh or to Tourists for 5000 Tsh. At the farmgate, the Farmer may receive 1,500Tsh per bowl. Production is continuous all year round, depending on the capacity of the plants and Farmers keep no written records. Estimates of gross income made from one acre of strawberries varied from 800,000 - 2 million Tsh. Interviewees report that buyers for strawberries also come direct to their farms.

Interviews with SAT, informal discussions and formal interviews with Farmers suggest that some farmers with good plots of irrigated land can make a relatively good living. At the opening of SAT's agricultural training centre, one farmer gave a public testimony that he was able to buy a motorbike, pay secondary school fees and improve his house through improved cultivation techniques and irrigation. Conversely other NGOs (WCST) and MORUWASA perceive these farmers as chronically poor and uneducated.

On the dry land (often steep terraced slopes), farmers are predominantly growing a more usual mix of maize and beans once per year according to the rainy season.

Janet Maro of SAT suggests that the main producers of vegetables are older women. This may be the case in other areas where SAT have been working for longer. Further interviews with 10 Farmers in Choma suggested that there is no difference currently between men and womens' cropping patterns. A few years ago, strawberry growing had been the preserve of young men, but women also now actively produce strawberries. One interviewee suggests that marijuana production is done by men rather than women, but from observations and interviews we cannot say the extent of this production. Production and sale of marijuana is illegal but informal observations suggest that usage of marijuana is fairly common amongst young men in Choma.

1.5 Irrigation, agriculture and land institutions

Irrigation in the Mlimani area is very informal in nature. Attempts have been made by the Municipality Council and Ward Councils (Kata) to regulate its use but these have not been implemented. In one small area (outside of Choma and not in this study), a traditional furrow system is used for irrigation and this does have more formal management and sharing arrangements. Otherwise the adoption of hosepipes connected via gravity to streams and rivers enables farmers as individuals to access water for irrigation. In the survey, 97% of Famers were irrigating and 97% of those are using the small streams and rivers. 1% reported using a borehole and 2% natural wetlands.

Support to agriculture and formal registration of land is provided through the local government, but the NGO, SAT, appears to be a significant actor in this area providing agricultural extension and supporting farmer groups.

The Uluguru Nature Reverse (UNR), which borders this area, is managed by Ministry of Natural Resources and Tourism. UNR has received various inputs to projects in recent year, for example the 'Payment for Watershed Services Project', funded by CARE and WWF. This covered villages on the Eastern side of the Uluguru.

A local NGO, Wildlife Conservation Society of Tanzania (WCST) a partner of Birdlife International is also active in the Ulugurus, but not directly related to agriculture and irrigation. WCST has received funding from the Civil Society Challenge Fund of DFID to operate a pilot 'Payment for Watershed Services' Project. This covers the Western side of the mountain and includes the Choma area. This project is still in the early days of implementation but it is cited by some farmers as offering useful farming knowledge on organic and sustainable practices. However, interviews with Rama Ngoma indicate some

tensions between this organisation and others operating locally and these will be explored further.

" But the problem with WCST was the one who was responsible for Choma who is called Habib didn't want to operate through formal written processes. He was very selfish and that is why we are not cooperating with them much now".

An interview in October with Rose Kyagando of WCST indicated that they were actively setting up payments for environmental services, particularly they were providing funds to facilitate the construction of terraces for soil conservation. In addition they were also actively training farmers on livelihoods diversification. A second attempt to interview Rose Kyagando was unsuccessful. Neighbours to the WCST office reported that the office had been packed up and shift to Arusha.

An interview with one a Mitaa Secretary in Choma revealed extensive operational problems with WCST and the allegation that there was serious misuse of funds in the organisation which had resulted in the DFID-funded project being abandoned in Morogoro.

Other projects are at various stages of activity under the NGO East Arc- see http://www.easternarc.org/ Again this NGO is interested in the livelihoods of the WaLuguru but is not directly involved in managing irrigation.

Morogoro Urban Water and Sewage Authority (MORUWASA) is working on water catchment tanks and improved inflows on the slopes below Choma (using the same river as used by the Choma farmers). They also have money through the Millennium Challenge Account for this and work on the Mindu dam. A Chinese construction firm is working on this with inputs from contracted expatriate Irish water Engineers. According to these Engineers, the project is very behind schedule and constantly delayed by procurement and contract issues. Interviews with Engineers connected to MORUWASA indicate a number of concerns with land and environmental use in the Ulugurus given their importance as the catchment for Morogoro. However, it was not thought that the small-scale hose-pipe irrigation was so significant in terms of pollution. The potential impact in terms of volume of water used was also uncertain. More concerns were raised as to the unregulated building of large dwellings on the mountainside, which were considered to have a potentially bigger impact on polluting the water courses and using large amounts of water.
Whilst MORUWASA Engineers expressed their concerns they also noted that they have no responsibility for the catchment. This lies with the Wami-Ruvu River Basin Office (WRRBO). They do work closely together and share the same compound.

The Director of WRRBO, Praxaeda Kalageundo confirmed that they are responsible for all water resources management in the catchment, for the registration of water users associations and the issuing of water permits. She admitted that in many areas the registration of water user's associations has not been completed, this includes the Choma areas.

2.0 Irrigation Arrangements

2.1 Nature and organisation

Irrigation practice is informal and determined by access to land and capital to purchase hosepipes and sprinklers to tap the water sources. Most Farmers spoke of the individual needing to buy and maintain the hosepipes. Sometimes this might be done as a joint activity between neighbours but the arrangement continued to be highly informal. Hosepipes have extended the area of land that can be irrigated but there are still technical and topographical limitations.

"The one who is responsible for the pipeline is the person themself. It is their own property. Sharing is important because today you may help somebody and tomorrow you may be helped because nobody knows tomorrow. It is true though that some would like to access water but they fail because they don't have money to buy the pipeline". Faraji Sadiki

According to Government officials, irrigation in Choma is illegal as farmers have not been organised into groups and issued with water permits. The WRRBO Director articulated that the Choma farmers should ideally be organised into Water Users Associations so that they could be managed and educated more effectively.

According to the farmers- the government restricted the use of the old furrow irrigation system. It was argued that the furrow system was very wasteful in terms of water use, and the use of hosepipes also decreases the labour requirement.

"Long ago we were using furrows but the government officials came to destroy them saying that they were using too much water. They haven't tried this since we started using hosepipes".- Mozele Athman

The use of hosepipes is also described as efficient by Prof Joseph Hella of Sokoine University of Agriculture (SUA).

"People are not taking significant amounts of water, the use of pipes is efficient compared to the furrow system like they use in Mgeta".

2.2 Distribution of land under irrigation

Land under irrigation is along the valleys and on the terraced slopes around Choma. Irrigation is limited by the proximity to water sources and the technical feasibility of hosepipe connection.

It has proved very difficult to get good maps of this area, most government offices and NGOs have hand-sketched maps. Same maps were obtained from the Uluguru Nature Reserve but the resolution is poor and they so not show land use. Googlemaps imagery is tricky to orient due to a lack of existing location points.

2.3 Water sources and reliability

The water for irrigation is taken from the small streams and rivers around the Choma area. These sources are reliable as the Mountains receive relatively high levels of rainfall. Farmers report that at certain times of the year, the levels of the streams drop, depending on the extent of the short rains. There is also disagreement in the survey as to whether there is a decrease in water availability. 47% strongly agree that there has been a change in the water levels (in interviews though some say levels have increased and others say they have decreased). A further 21% agree some change has happened. However, 18% disagree that there has been a change and 7% strongly agree. As we can see from the rainfall graph for Morningside that the annual rainfall is highly variable but does show a small upwards trend up to 2007.

30% believe that changes are due to climate change and another 30% blamed drought. 34% did not know or did not agree that there had been a change.

"Sometimes there are small disputes rising especially in December to February because in these months the levels of the river are dropping, then the one who is up is getting a lot compared to the one who is down and the one who is up may refuse to cut off their pipeline, then we take the dispute to our street (village)chairperson". Faraji Sadiki

According to Government officials (MORUWASA/Mtendaji) the water use by human settlement on the Ulugurus does reduce the domestic supply in Morogoro and this is the reason as to why it was planned to remove the farmers from the Ulugurus. However, the situation is inconclusive, and it is unclear if the small-scale hosepipe irrigation is significant in this regard. It became clear during interviews with MORUWASA, WBBRO and Academics from SUA that the really problematic water use was in larger scale construction of dwellings on the mountains

Engineer Kabeya (MORUWASA) says that:

"People are living very close to the intake and they are diverting the water- they are taking more than 50%. In 1999 there were only about 500 people living there and then the government built schools, a hospital and brought electricity. This has encouraged people to come and build."

Praxaeda Kalageundo (WRRBO) argues that:
"there are many illegal constructions in the mountains and we need to preserve the water sources, but also even big institutions like the Universities and Army bases have not been regulated for their water use. We have not been able to do this as yet."

Farmers do not mention any concern for domestic water supplies to Morogoro other than referring to government criticisms of the furrow system as wasteful. Professor Hella argues that the Farmers were targeted for removal from the mountain as they have little voice in local politics and therefore they were an easy target to blame for the insufficient water supply of the Morogoro.

2.4 Key crop produced and productivity (income estimates and market linkages)

Farmers produce a wide variety of crops on the Choma land. Strawberry production is seen as the most profitable. The profits vary according to the size of land owned. Most Farmers sell the strawberries at the farmgate – the price of 1500 Tsh per small bowl was mentioned in several interviews. A bowl purchased in town can range from 3000-5000Tsh depending on negotiating skills.

Examples of productivity from interviews:

Faraji Sadiki- 2500-3000 plates of strawberries from 1 acre of irrigated land
½ acre- 1500 plates
Rahamdani Juma- estimates income of 50,000Tsh in a good year and says he has a very small plot and is limited by lack of capital.

Zaituni Ramadhani
On dryland I might get 1-1.5 bags but in the same size land for tomatoes I can get 21 crates and each of those I can sell for 10,000Tsh

Most Farmers do not keep records and as they produce throughout the year they struggle to give quantities in terms of production. They consistently say that consistent sustained production is only possible on the irrigated land.
Yields of maize on rainfed land are extremely low at 1-2 bags per half acre.

The main market for most goods is in Morogoro Town (except for Strawberries which are purchased by business people for transport to Dar and Arusha). Limitations to markets are the inaccessible terrain which requires produce to be carried. However, motorbikes have made some areas more accessible in recent years.

Professor Hella suggests that the productivity of the farmers is good and they have money to spend. He cites the example of his own establishment – the Mbete Climbers' Club, a small bar and hotel designed to provide accommodation to visitors to the mountains-

"My wife tells me that we often run out of drinks and our main customers are these farmers from the mountains".

2.5 Irrigation Technology & Evolution

There has been an interesting shift in technology in the Choma area. In the past people used traditional furrow systems (Mifereji). These appear to have been abandoned in the Choma area and replaced with hosepipes for two reasons:

1. Government discouraged (banned) the use of the furrows as they were seen as wasteful and taking water from Morogoro Town.
2. Plastic hosepiping became available at a relatively affordable cost. Farmers realised that using hosepipes is more efficient and less labour intensive than the furrow system. Hosepipes also allow more land to be irrigated than with the furrow system.

"Before starting pipeline irrigation, with the furrows we would lose most of the water before it got to the farm. They also used a lot of energy to construct them. The person to start using the pipes was called Pea and soon we all started using them. Using the furrows was the hardest life and this led people to learn a different thing". Ramadhani Issa

2.6 Local institutions in place

There are no formal institutional bureaucratic arrangements for water sharing but there is evidence of informal ethnic institutions deeply embedded in the socio-cultural life of the people of Choma. Individuals purchase hosepipes but might be using them in co-operative arrangements with their friends and families.

Further interviews with Farmers on this shows that they do not reflect on this on being distinctively something of the WaLuguru- they express it as cooperation between friends and family who have lived in the same locations for generations.

However Rama Ngoma does go further to identify certain beliefs and practices of the WaLuguru regarding the use of water:

"Yes there are old beliefs. One Luguru custom is that people are not allowed to cut down some of the trees such as Mkuyu (Ficus) simply because they believe that those trees increase the amount of water. One other tree like this is Msumba (Brideria Miclautna) which also increases the amount of water. Also people were washing at the river and so the trees are very important to hide them or to avoid the other gender."

WRRBO Director, Praxaeda Kalageundo, argues that there should be Water Users' Associations in place. She says there are two in the mountains but they do not cover the Choma area. If these are in place, she argues that is much easier for her office to work with people on managing the water sources and resolving conflicts.

2.7 Institutional bricolage- where are rules/practices drawn from, how have they evolved?

Practice is embedded in longstanding social relationships- people do not articulate these as rules but as their way of being 'together' as friends and family. At the same time, water access is constrained by land ownership (through inheritance or through purchase) and technological limitations. New technology has been adopted into these relationships but Government intervention has been actively resisted.

Most interviewees emphasise fairness and sharing in relation to water use that draws on their social connections:

"The fairness in sharing water is very important since every farmer needs water for irrigation, so unfairness is like selfishness"- Faridi Ally

"I believe in these people that I am sharing the water with since most of them are my relatives and in our tribe we have the system of helping one another". Faraji Sadiki

"For me because I share with my relatives we don't fight over water that much but I have seen people falling out over who's turn it is to use the pipe. This is not very common as most people try to buy their own pipes". Zaituni Ramadhani

2.8 Mechanisms for determining water availability

There is no formal system for determining water availability. Within the cooperative arrangements of neighbours, if it is perceived that water levels to the hosepipes have dropped then they will discuss and agree amongst themselves on a rota to share the water that is available.

If water levels drop very low then they may irrigate at night to improve efficiency.

Government (Mitaa) officials say that MOROWASA is working on a more formalised system for assessing water allocations and access but nothing is yet in place for this.

These officials may be confused as to the institutional responsibilities as it is actually the role of WRRBO to regulate water availability and use. Praxaeda Kalageundo admits that they do not have the capacity to do this. The only mechanism they have available is to organise users into associations for the issuing of permits and ease of communications. She readily admitted that they do not have the capacity to measure and regulate actual water use and changed in availability.

3.0 Irrigation Water Management Structures

3.1 How are formal institutions consitituted?

There are no formal structures in this area. However, local government officials argue that they are required:

"At the moment there seems to be no formal arrangement to manage water access. However they are in the process through MOROWASA of coming up with one. This will help to manage water usage, how much that can be used and formal rules that can be applied." Interview- Mtendaji wa Mtaa

Rose Kyando from WCST also argues that:
The population is growing and even their kids are going into the same business. So with the climate change issues and the amount of rain, even with hosepipes then they can't take enough water to meet their family needs. The approach that Wami-Ruvu is taking is to tell them to pay their bills. They are supposed to establish a water user's association but the people are resisting to pay- they say 'what have you done for us?'

From interviews there seems a little confusion over who should be managing the water. The actual responsibility for water rights sits with the Wami-Ruvu River Basin Office but local government officials indicate they think that it sits with MORUWASA. As noted above there is a desire to extend the registration of WUAs to the Choma area but this has not yet been implemented.

3.2 How do they relate to other local institutions?

This section does not apply to Choma as noted above this currently exists as a discussion only in local government and MOROUWASA and Wami-Ruvu River Basin Office.

3.3 What are the arrangements for assessing water availability, water management and allocation?

In relation to the informal water sharing arrangements, farmers themselves are making collective decisions about water flow and allocation.
They report these relationships as very co-operative as noted in the previous sections and further discussed below.

3.4 What are the limitations and challenges of these arrangements?

The limitation of the informal arrangements exists at a strategic level. Within itself the informal system of purchasing hosepipes appears to be working well, whilst water use is unregulated by external intervention. Farmers report high levels of cooperation and there is little evidence of water shortage or conflict amongst farmers.

The challenge lies not with the internal arrangements for water sharing but rather in the more extensive question of upstream and downstream water use. Local government officials perceive that Choma farmers are in conflict with the urban supply to Morogoro. Attempts to remove them from the land were unsuccessful after the Farmers appealed to the President. The current government position is now that if they cannot force the farmers off the mountains, then they need to be taught to farm in an environmentally sustainable way. This work is seen to be the job of NGOs, rather than of government

agricultural extension officers. Some NGOs such as KIMIMICHO and SAT are active but in our farmer interviews only a few farmers mention their activities as highly influential. We will return to this in section 4 below.

"In 2006/7 there was a huge conflict between the government and the residents from Choma and surrounding areas as the government tried to remove them without consultation. This caused a huge row which ended with the residents going to the President to resist this move. Two years later (2009) they were told that they can stay under certain conditions that they should look after the environment and work with the NGOs". Mtendaji wa Mtaa

At a higher institional level there appears to be several themes to discussions on the challenges of the informal irrigation arrangements in the Ulugurus, but as yet no implementation or concrete action plan proposed following the failed attempt to move the farmers.

The Wami-Ruvu River Basin Office wants to formalise arrangements and make farmers pay for water.

WCST was piloting a 'payment for watershed services' whereby farmers were paid for adopting environmental conservation measures. However Rose Kyando from WCST says that she believes ultimately the farmers will have to be moved. She is a member of a task force established in the Morogoro Municipality to review the issue.

She reports: *" We talked about the options and we think that there around 10,000 households that would need to be moved from the mountain and the costs of compensation are just too high. They did a survey about this but it was disrupted by political things."*

Professor Hella disagrees with this and argues that a payment for watershed services approach could be viable. On REDD projects the current level of payment to the farmer is 30,000Tsh per hectare. The question of whether this is a viable level of payment depends on the conditions set for the farmer given that we have seen that irrigated vegetable and fruit production can yield quite high returns from small plots of land.

Professor Hella hints at the wider political nature of the scheme to move the farmers from the Ulugurus which connects to a wider landscape of hydropolitics.

"The Mayor of Morogoro told me about the pressure that was put on him to move the people from the mountain. The problem is that the Ulugurus are vulnerable as they provide the water for Dar. The parliamentarians are getting pressure from the big industries such as coca cola and Tanzanian Breweries to increase the water supply, but they are also the ones who should be paying to conserve the environment in the catchments"

The challenge for the informal nature of water use by the Choma farmers is that they have little visibility and representation as a group whilst they are informal. They have no official voice within the institutions that manage water. The farmers themselves currently appear to resist formalisation for fear that they will be made to pay for the water they use.

3.5 What is the nature of conflict over water and land?

The conflict over water is at the level of Morogoro Municipal Council and farmers. Farmers said that amongst themselves that conflict is very rare and if it did arise then Village Leaders and the WaLuguru clans would be required to intervene and come to a compromise.

Water and land go hand in hand. Interviewees repeatedly asserted that water access is determined by ownership of land with sufficient proximity to the rivers and streams and within reach of hosepipes. There does not appear to be conflict for land and systems of inheritance are embedded, alongside additional possibilities for purchase and renting for those with additional capital. As noted in section 1, further interviewing on land inheritance found it difficult to conclude a dominant form of inheritance pattern. Interviewees had all inherited land and predicted that they would pass their land to their children of both genders. However, they all said they could sell and buy land but that these decisions required the approval of family members.

External observers such as Janet Maro & Alex Wostry of SAT and Prof Hella of SUA tell a slightly different story. They suggest that purchasing land in the mountain is quite a controversial issue. This appears to link not necessarily to the indigenous farmers but to the incomers who are building large dwellings lower down on the mountain. These are also the unregulated dwellings referred to by MOROWASA/WRRBO as potentially having more impact on water supply and sanitation than the small scale irrigation of the farmers. The new residents sometimes experience problems over land ownership. In the main, plots are not surveyed and titled and ownership is often contested. In order to buy land, permission needs to be sought from the WaLuguru clans.

3.6 Assessment of efficiency and effectiveness

As noted there are no formal arrangements for irrigation in Choma so we cannot make an assessment of efficiency and effectiveness.

However, for the farmer in Choma- the hosepipe system is seen as efficient, fair and productive. Their year round production is a significant contributor to family diet and capital expenditure. People are not growing enormously rich but can have a comfortable lifestyle by local standards- affording secondary school, improving their homes and investing in small businesses.

For Morogoro Municipality and MOROWASA, the use of the water by the Choma farmers is characterised as unfair. Their concern that furrow irrigation was inefficient and wasteful was dealt with by the farmers in switching to the use of hosepipes. So the bigger issue of downstream water availability remains a contentious point for the future.

3.7 Relationship to National Policy and Regulation

The informal arrangements of the Choma farmers are not regulated by National Policy or Regulation. The Farmers have an attitude of '*what has the government ever done for us'...perhaps if they had brought infrastructure here then we might pay something'*. National regulations on the formation of water user associations and on the issue of formal water user rights have not been done in Choma. WRRBO admits that they have not yet

managed to cover the Choma area. Morogoro Municipality simply labels their water use is 'illegal'.

"They have created their own way of irrigation that the government does not approve of. The use of hosepipes is against the law and so they do this illegally. The rule is that they are not allowed to farm within 60 metres of the water sources, however none of the residents comply with this". Mtendaji wa Mtaa- Ward Executive Officer.

"There are no government policies about using water for irrigation and we don't want them because they will disturb us. We need freedom in irrigation" Farmer Ramadhani Issa

4. Irrigation, institutional and local area development

4.1 Identify the impacts of irrigation at the local level (±)

For the individual farmers irrigation has tremendous livelihood benefits- without it they would be dependent on rainfed agriculture and probably could not sustain themselves in their current location.
On the negative side, it could be that the extraction of water on the upper slopes is affecting the amount available for the domestic supply in Morogoro. However, further work would need to be done on the total water available, and the comparative use of the water, alongside mitigating factors (such as more efficient water use in agriculture upstream or deforestation in the UNR; and more efficient use of water downstream by MORUWASA and households in Morogoro).
Farming activities inevitably also have an environmental impact. Farmers do burn vegetation to clear the land, many still farm highly sloped plots without terracing and they do encroach on the forest reserves. This is evident from observations in Choma and confirmed by SUA Professors as well as SAT and WCST representatives. Professor Hella argues that farmers in Tanzania have weak adaptive capacity so that as other areas dry up then an increasing number of people are looking to move to the mountain for agriculture.

4.2 Factors shaping uptake of farming technologies, including for irrigation

Most of the farmers in the Choma area said that they learnt how to farm from their parents and their neighbours. They are also open to new techniques taught to them by NGOs and the District Agricultural Extension Officers- particularly when they improve their productivity – for example with the use of contouring and terracing on the steep slopes. Janet Maro and Alex Wostry of SAT were very sceptical concerning the activities of the District Agricultural Officers. They said, with very few exceptions they were rarely present in the mountainous areas given the severe problems of transportation.

The adoption of hosepipes for irrigation was a pragmatic choice by farmers, which has spread by diffusion. It was forced both by the ban on the traditional irrigation furrows but also on the availability of the hosepipes. Interviews with farmers report that adoption of hosepipes is constrained only by access to suitable land and to sufficient capital to purchase them.

In this area, knowledge of agricultural techniques is discussed by interviewees. Our survey suggests that most people learn how to farm from their family and neighbours as children labouring on the land.

" *I learnt to grow the crops that I am producing through my parents and other people who surround me. I learnt from them about terracing and other techniques. There is not any organisation who provide agricultural information but what I do is use my own experience. To me the best Farmer is one who is irrigating as well as creating terraces, using local fertiliser (samadi- generic term for manure) and is doing organic farming" Interview- Ramadhani Issa*

It is interesting that this Farmer does not identify NGO involvement in his learning but does mention organic farming.

Others suggest that knowledge has been transferred by external organisations and where this has been facilitated by local NGOs, there appears to have been good levels of uptake). It suggests that this knowledge has been appropriate, low cost and effective. Others specifically identify the benefits of organic farming:

NGOs such as SAT and WCST come to talk to us on good farming practices. They provide important information on contours, organic farming- this is good information which we can use. I believe a good farmer is one who can farm organically and using conservation tillage on the mountainsides. They are the best as chemicals have negative impacts on the environment and can even poison the consumers. Ashiri Abdula

4.3 Livelihood sensitivity to water stress and strategies developed for coping and adapting to water stress in agriculture and other ecosystem dependent livelihood sources

Livelihoods are clearly dependent on water. However, farmers state there is always sufficient water. There is seasonality to the flow of water but the co-operative arrangements between farmers are adapted to cope with this.
This is much more of an issue on the rainfed land where farmers talk about their production as being more of a chance. Improvements such as contouring and inputs of manure can be helpful but inputting capital to such land is still risky, as opposed to focusing on the more guaranteed production from the irrigated land.

A small number of farmers in our survey say they make use of weather forecasting- 17% used traditional methods and 8% meteorological forecasts. Another 5% said they used both.

4.4 Constraints and opportunities for learning and innovation in irrigation and agriculture in general.

Farmers are very open to learning. Predominantly they say they get information from family and neighbours and by learning from each other. 62% have learnt techniques from their neighbours. Significantly 53% have learnt from NGOs and this knowledge appears to be relevant and accessible to them.

Farmers are using a high level of environmentally sensitive techniques in the Choma area- in our survey 85% reported using conservation tillage in the form of terraces, 53% use legume incorporation (particularly on rainfed land), 62% practice crop rotation and 84% are incorporating manure or compost on to their land. 4% are using infiltration pits.
More than 85% said that what they had learnt had a positive effect on productivity.

Longer interviews with Farmers and observations show a willingness to learn and practice terracing and water/soil conservation techniques (see photographs in appendix 4)

Conversely though, the Farmers in Choma appear to be branded as incapable of learning in interviews with local government officials:

"The main barrier in knowledge exchange, especially when there has been seminar and training. There is a lack of co-operation, there is no willingness to comply with the new farming techniques that are aiming to conserve the water source since their prime intention if to use water for their farming and not for the people of Morogoro. Also the accessibility to the area is

very restricted and those people have a lack of education so it is difficult to explain and to make them understand the benefits". Mtendaji wa Mtaa

However, the District Livestock Officer has a different view:

"I believe the majority of Farmers are complying to look after the water sources, otherwise we would not have as much water as we do now. Small scale irrigation is and can be sustainable. Government needs to invest in dams and water reservoirs that can collect water in the rains and be used in the drought period."

Field observations do suggest that environmentally destructive practices are being used by some. Terraces are labour intensive, time consuming and expensive to construct and many slopes are still farmed through burning and hand hoe. WCST were attempting through cash payments to facilitate the construction of terraces but with the demise of that project it is unclear as to how this work might be encouraged. An interview with the Mitaa Secretary in November revealed that trust had been lost in the WCST project as repeated promises were made in relation to income generating projects. It was felt that local people had complied in the construction of chicken houses but were never given the chickens that were promised. Now the project had entirely disappeared and he reported that it was rumoured that all the money had been stolen.

At the same time, the interview also suggested that Choma residents were self-organising and raising funds to extend the track from Mbete as far as possible to Choma. Evidence of the new road is visible on walking up the mountain. The aim is to improve transport links to Choma which will help with getting agricultural produce to market.

An SAT group is active in Choma but on visiting their collective plot in November, it looked rather neglected. Janet and Alex from SAT suggest that the group in Choma is a relative new one and is small in number. Their bigger and more successful groups are in other Mitaa such as Ruvuma.

4.5 Role and impact of external partners (government and NGOs) in agricultural research, learning and innovation (politics of knowledge)

Some local NGOs and institutions are very important. SAT has been very active and successful with a group of farmers in Choma- this group are said to be working towards a collective organic certification for their produce, as as been achieved by other SAT groups in the area. They have a demonstration farm in the Choma area. They work very closely with SUA and have a learning by doing participatory approach with farmers. Inputs are low cost and often demonstrate the use of accessible and available local plants to make pesticides or fertilisers (for example the use of chillies as pesticide and Mishomoro (a common hedging plant) as a fertiliser using the leaves). As noted above on visiting the SAT demonstration garden in November it did not appear to be in very active use.

Locally, some enterprising young men have formed KIMIMICHO, a local environmental group. They also earn income by acting as guides for tourists who want to walk in the hills, visit Morningside or swim in the water falls in the Choma area. They are mentioned by interviewees as doing good work in educating farmers on environmental practices.

The Ward officials (Mtendaji) as well as seeing the Farmers as incapable of learning (see above) in informal discussion also revealed that local government officials are very reluctant to go to the mountains as they believe that one of their colleagues died after being bewitched there.

The District Livestock Officers mentions SUA as being a very important player in terms of research on agriculture and environment in the mountains.

4.6 Identify internal and external interventions that have had a positive and negative impact on the status of vulnerability to environmental stresses in agriculture and food systems, and those that have undermined or promoted 'positive' resilience

Whilst there is no water shortage for the irrigated land, it is positive that the environmental farming practices may also be helping the dryland agriculture by conserving more water, and improving cultivation techniques.
SAT, WCST and KIMIMICHO appear to have had some positive impacts in terms of sharing knowledge on low cost and environmentally less destructive agricultural practice. This benefits the farmers in terms of improving their own productivity but also in their attempts to comply with the conditions set for their continued residence on the mountain, following the previous attempt to evict them.

If WRRBO were to impose more formal mechanisms for water access, through the formalisation of water access and creation of WUAs, this could have potentially negative implications for the vulnerability of the Choma Farmers, if it constrains their current water use. Our interview with the Director suggests a problem with the technology and current institutional rules in WRRBO. She says that legislation and the issue of a permit is usually for one collective intake. In the case of the hosepipe intakes (which are multiple and individual) then these would be very difficult to issue a permit for.
The impact of introducing a formal set of rules might also disrupt the informal water sharing arrangements. At the same time, it could give the Choma farmers a more formal voice within the Municipality.

Interviews with farmers suggest a resistance to the formalisation and a high level of distrust towards the Municipality following the forced resettlement attempt.

4.7 Indicators used for monitoring and evaluating progress in irrigation projects

The farmers themselves use their own production levels as the main indicator for the progress of their irrigation..

There is no other formal activity in this regard and so no indicators being used- although local government officials speak of the desirability of monitoring water availability but are not sure how to go about it. Similarly the Director of WRRBO expresses that in an ideal world then her office should be measuring and regulating water use as against the permits issued but she has not resources and capacity to do this. *'I need to seek a donor to help with this'.*

JICA/MoW (2013) notes a concern that water rights are being sold but no monitoring of water use is conducted.

This concern appears to be confirmed by an informal remark from a Wami-Ruvu River Basin employee:

"We just sell water, that is all we do".

4.8 Access to land as a determinant of access to water, and issues surrounding economic access to water for irrigation

As mentioned above, water and land access are tightly enmeshed. Farmers also need to have sufficient capital to purchase hosepipes, however this is relatively low cost technology and so is within reach of most small farmers and their families. The flexibility of the hosepipes in combination with sprinklers has made it possible to cultivate a greater area of land than was previously possible using only the traditional furrows.

As described in section 1 the majority of the irrigated land is inherited, although inheritance patterns are rather unclear in their character (matrilineal/ patrilineal) and maybe changing. Farmers can also purchase land but this must be considered by wider networks of family and clan. Selling to outsiders is also possible within limits but tends to be for building rather than irrigated agricultural production.

4.9 The role of trust within institutions and its implications for knowledge use and growth in the small-scale farming systems

High levels of trust are evident amongst the WaLuguru farmers in Choma- they have lived along side their friends and neighbours for generations. The homogenous nature of the population and a current lack of incomers enable high levels of bonding social capital. This is likely to be linked to the high level of trust that people express with regards to knowledge from their neighbours.

Reasonably high levels of trust in relation to external NGOs are apparent.

There are a lot of NGOs who come here and talk about farming practices such as organic farming, conservation tillage etc. I have seen a lot of benefit with organic farming as my income has increased and they are all techniques that are easy to use. Altuman Bahari.

At the same time the recent demise of the WCST project has diminished trust- negative comments towards this organisation being made by Rama Ngoma and the Choma Mitaa Secretary.

However, there is a consistently high level of distrust towards the local government in interviews with farmers and to MORUWASA given the history of conflict over water use in recent years.

If the government come here and tell me to pay a fee for water, then I will not pay it. Even if they were to come and provide hosepipes. I can manage on my own- Ashiri Abdulla

Farmers make no mention of WRRBO, which is actually the institution with responsibility to regulate their water use.

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Appendix 1

Key Informant Interviews

Name	Designation	Date
Janet Maro & Alex Wostry	Sustainable Agriculture Tanzania	Several- June, July, Sep, November, December
Prof Andrew Tarimo	SUA	29th Sep 2013
Prof Joseph Hella	SUA/Mbete Climbers' Club	11th November 2013
Chris Nikitas	Retired local Farmer	Several- June-September, November
Rose Kyawelo	Wildlife Conservation Society of Tanzania	4/10/2013
Ramadhani Juma	Farmer	24/9/2013 10/10/2013
Faridi Ally	Farmer	24/9/2013 10/10/2013
Hamisi Ally Chegage	Farmer	25/9/2013
Bahati Hamisi (Mama)	Farmer	25/9/2013
Zaituni Ramadhani (Mama)	Farmer	25/9/2013
Siwazuri Khamisi	Farmer	26/9/2013
Ally Rajab	Farmer	26/9/2013 10/10/2013
Mogelly Athman	Farmer	24/9/2013
Ashiri Abdula	Farmer	24/9/2013
Althuman Bahari (youth)	Farmer	25/9/2013
Khalid Said	Farmer	26/9/2013
Ramadhan Issa	Farmer	25/9/2013
Faraji Sadick	Farmer	25/9/2013
Hija Mwakete	Mtendaji wa Mtaa	26/9/2013
Chausiku Luapo	Mtendaji wa Mtaa	26/9/2013
Haikael Mangi	Principal Livestock Officer	26/9/2013
Ramadhani Ngoma	KIMIMICHO- Kikundi cha Mradi na Mazingira Choma	Fieldguide- on going discussions/observations November, December interviews

Mwisho	Chilunga Cultural Tourism Project	4/10/2013
Sean O'Sullivan Water Engineer Engineer Kabeya	MOROUWASA	Several informal discussions 12th November 2013
	Wami-Ruvu River Basin Office	Informal discussions Visit to obtain documentation/formal interview
Praxaeda Kalagenda	Director- Wami-Ruvu River Basin Office	14th November 2013
Hamis	Mitaa Secretary	7th November 2013
Zaina Shaban	Farmer (female)	9th December 2013
Asha Athuman	Farmer (female)	9th December 2013
Wazia Ally	Farmer (female)	9th December 2013
Amina Issa	Farmer (female)	9th December 2013
Waseme Shaban	Farmer (female)	10th December 2013
Salum Juma Salum	Farmer (male)	9th December 2013
Mohamed Yahya Ally	Farmer (male)	9th December 2013
Gabriel Said	Farmer (male)	10th December 2013

Appendix 2

Focused Group Discussions

Choma Sustainable Agricultural Group- July (occurred during meeting of this group)

Meeting of KIMIMICHO Members

Appendix 3

Survey Overview Data

Question	Percentage (n=102)
Gender of the Respondents	29-Female 71-Male
Household position of Respondent	54- Household Head 41- Spouse 3- Children 2- Other
Gender of household head	12- Female 88-Male
Age of household head	Average- 37 Range- 17-75
Highest level of educational attainment	3- None 93-Primary 4-Secondary 0-Tertiary
How many people in the household	Av- 2 Adults Av-2 Children (range from 1-12 in total household)
How many adults are working?	Av-2.01 per household
Have you always lived in this village?	97-Yes 3-No
If not, when do you come here?	All in 2000-2012
What types of food do you consume?	90- Ugali- no change in consumption over the year 10-Banana/Rice
What other economic activities contribute to your household?	66- have no other economic activities 15- Business/trade 16-Poultry keeping 3-Employment
How much land do you use?	Av- 2.5 acres (range 0.25-7 acres) Av- 1.4 acres dry land Av-1.1 acres irrigated land
What is the nature of the landholding?	97- Freehold 1 Leasehold 1 Sharecropping 1 mixed
What fertiliser do you use?	1- Chemicals in dry land 28-manure in dry and wet land

	31- mixed in dry land and wetland 36- None in dry land 4-chemicals in wetland
What crops do you grow?	35 maize in dry land 75 beans in dry land 1 leafy veg in dry land 3 tomatoes in dry land 3 potatoes in dry land 4 others in dry land 30-beans in wetland 9-maize in wetland 90-leafy veg in wetland 60-tomatoes in wetland 93 others in wetland (e.g. carrots, strawberries, leeks, passion, other berries, celery, herbs, chillis, peppers)
If you grow maize- what varieties do you grow on which land?	57- do not grow maize 23- use hybrid maize in dry land 1- local in dry and hybrid in wet 10- Mixed in dry land 9- hybrid in wetland
Are there any crops that you started growing in the last five years?	Yes- 10 (in wetland only) No- 90
Do you irrigate some of your crops?	Yes- 97 No-3
What is the source of the irrigation water?	River- 97 Borehole- 1 Wetland -2
Has water availability changed?	Strongly Agree- 47 Somewhat- 21 Disagree-18 Strongly disagree- 7 Not sure- 3
What do you think is the cause?	32 climate change 32 Drought 0-destruction of water sources 0- deforestation 2- shortage of rainfall 34- no answer
Farming Practice- incidence	Conservation tillage-85 Legume incorporation-53 Water Harvesting-0 Crop Rotation-62 Use of compost/Manure-84

	Infiltration Pits-4
Where did you learn this from? Did it have a positive effect?	61 learnt from neighbours (conservation tillage) 2 from Lead Farmer (legume in corporation 0 Extension workers 53 NGO (crop rotation from an NGO) 70- strongly agreed 16-somewhat agree 4 disagree 0 strongly disagree
Have you used advice through	Radio-32 Television- 1 SMS- 33
Do you own any of these devices	Radio-91 Television- 5 Mobile Phone- 84
Did you use the seasonal forecast in the last farming season?	Yes-32 No-68
If yes-	Local/traditional-17 Metereological-8 Both-5
Does your household provide agricultural casual labour within or beyond this village?	Yes-26 No-74
Are there any farming practices that you have learned through providing casual labour?	82% of those who provided casual labour learnt new farming practices

Appendix 4- Photographs

Choma – landscape with waterfalls

Terracing

Hosepipes crossing the slopes


Terracing

Sprinklers for watering strawberries (gravity fed)