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Stockholm Environment Institute, Technical Report - 2012

Watershed Level Baseline Assessment in the Mkindo Watershed, Wami Basin, Tanzania

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Report for Agricultural Water Management (AWM) Solutions Project

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Cover Photo: © Jennie Barron

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ACKNOWLEDGEMENTS

This report was developed under the Agricultural Water Solutions (AgWater Solutions http://awm-solutions.iwmi.org/) project coordinated by the International Water Management Institute (IWMI) in partnership with SEI, FAO, IFPRI, IDE and CH2MHill. We thank the local communities, experts and the Soil Water Management Research Group of Sokoine University of Agriculture, Morogoro for facilitating and contributing to the development of this work. This work was funded by a grant from the Bill & Melinda Gates Foundation. The findings and conclusions contained within this brief are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

1 INTRODUCTION

This report describes the results of a baseline assessment of current livelihood strategies in the Mkindo watershed of the Wami River Basin in Tanzania. The work is part of the IWMI project entitled 'Agricultural Water Management Solutions' which aims to analyse the impacts and potential of AWM interventions to improve livelihoods at the community, and watershed scales and assess the opportunities, constraints and impacts of the use of AWM technologies. Similar work has been done in two other watersheds, the Nariarlé watershed in Burkina Faso and the Jaldhaka watershed in West Bengal, India. The work in the Mkindo watershed was done during November and December 2009 in cooperation with Soil Water Management Research Group of Sokoine University of Agriculture, Morogoro, Tanzania. After this baseline assessment different AWM scenarios[1] were analysed .

Within four villages focus groups were held with different stakeholders about their current land and water resources, agricultural system inputs and outputs, health issues and different sources of income. The results were summarised in livelihood narratives for the three main livelihood strategies: Farmers with access to official irrigation, those dependent on rainfed agriculture, and livestock keepers. These were presented at an expert meeting aimed to identify the livelihood strategies across the watershed grounded in detailed village level narratives. Participants mapped and discussed the current situation of water management, livelihoods and resilience of different livelihood groups. The participants worked in a part or throughout the watershed, with some involved in livestock, fisheries, and forest management. Others worked in the irrigation and agriculture government departments of Morogoro district and for the Wami Basin Authority.

The livelihood narratives of the villages are first presented after which the baseline of resource based livelihoods across the watershed is described.

1 de Bruin, A.,. Cinderby, S., Mbilinyi, B., Mahoo, H. and Barron, J., 2010. Agricultural Water Management scenarios in Mkindo watershed, West Bengal, India, York, UK: Stockholm Environment Institute.

2 BASELINE OF LIVELIHOOD STRATEGIES AT VILLAGE LEVEL

Focus groups were first held in four villages: Mkindo, Mbogo, Makutule, and Dakawa (see Figure 1) with groups of farmers with access to official irrigation, and those dependent on rainfed agriculture, as well as women, outgrowers for the sugar cane company and livestock keepers. The number of participants is presented in table 1.

Table 1: Participants of Community fieldwork.

Location	Male Participants	Female Participants	Total Participants
Paradizo (Wami Dakawa)	11	11	22
Makatule	12	40	52
Mbogo	11	14	25
Mkindo	14	12	26
Total	**48**	**77**	**125**

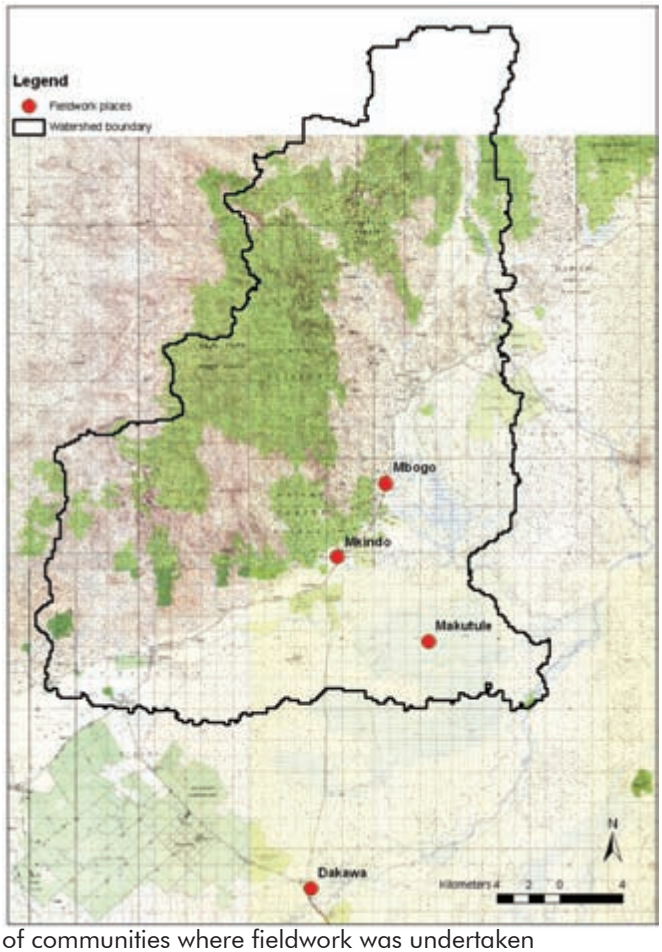

Figure 1: Location of communities where fieldwork was undertaken

2.1 Livelihood narrative for irrigation agriculture

In the watershed a small number of small scale farmers with farms of about 1 acre, depend on irrigated paddy rice as their main source of income.

Most of the farmers buy seeds and use fertilizers, pesticides and herbicides in their paddy rice. They use a tractor, power tiller and hand hoes to prepare the fields.

Most of them have more than one harvest a year of 15-25 bags per acre. They sell unprocessed rice for a low price at their houses. Some wait till the prices have gone up before they sell theirs. Roads to the farms are bad which make the transport of harvest difficult.

The irrigation systems get water from the rivers (Mkindo, Chazi and Divue) and although water is always there, the management is not always consistent throughout the growing season. There is a lack of knowledge on how to manage the water in the best way. In both areas also bad lining of the channels decreases the effectiveness of the irrigation facilities. A gravity system and a pump system are used, but in general the pumps are too expensive for small farmers.

Other sources of income are livestock, chickens, fruits, small businesses and forest products. Sources of food are fruits, groundnuts, beans, cocoyam, cassava and maize. All these are produced in the wetland areas along the rivers.

Malaria, bilharzias and typhoid occur frequently and health facilities are far away in Turiani and Dakawa.

Outgrowers for the sugar cane company also use irrigation and are not very different from the rice farmers. The only differences are that they do not use fertilizers where they grow sugar cane and when selling their crop they get a good price for it but it sometimes takes half a year before they get paid.

2.2 Livelihood narrative for rainfed agriculture with supplementary irrigation

In the watershed the majority of small scale farmers with farms of two acres per family, depend on rain fed or supplementary irrigation rice as their main source of income. Small businesses provide the main income during the dry season. Livestock keeping is the second most important occupation throughout the year. Maize is mainly produced for consumption, but when it has rained too much they sell maize as well.

Most of the farmers do not use inputs as these are too expensive. Some use manure. Also machinery is too expensive so only hand hoes are used to prepare the fields. There are no financial services in the area so farmers cannot get loans to improve their production. There is lack of knowledge of land and animal management best practice.

Rain remains the crucial limit to their crop production. They have one harvest a year of 6-15 bags per acre for paddy and 7-9 bags per acre for maize. Some grow a crop during the short rains and harvest 1-2 bags/acre of maize. When the river floods the harvest is decreased by half. About half of the harvest is sold and the other half is for subsistence. The farms are far from the main road and bad roads make the transport of harvest difficult. They cannot reach the markets and sell maize and unprocessed rice from their houses for a low price. Some wait till the prices have gone up before they sell their crop.

People use the forest for fuel wood, medicinal plants, cultural activities, building materials and charcoal making. Recently the forest has become better managed to ensure no deforestation takes place. The community takes care of safeguarding the forest.

Goats eat the maize stubble during the dry season. During the wet season they feed along the roads. Poultry often gets diseases, decreasing the numbers substantially. Other livestock keepers come into the agricultural area which results in conflict.

Other sources of income are small businesses, forest products, leasing of land, wage labour and coconuts, fish, vegetables, poultry, cattle and goats.

Water for domestic use comes from the river and some wells, but these are often far away from where people live. Malaria, bilharzias and typhoid occur frequently and health facilities are far away in Turiani, Chazi and Dakawa.

2.3 Livelihood narrative for livestock keepers

For livestock keepers their cattle, sheep, goats and poultry are their main sources of income. Milk and leather are also sold but only contribute a little to their income.

They produce some rain fed rice and maize for subsistence but the 2-5 bags of maize per acre and 6-7 bags per acre of rice are not sufficient for the community. They buy the rest of the food they need at the market in Dakawa or from farmers in the area. The crops get water from the catchment of the floodplain and only hand hoes are used to prepare the fields.

The area for grazing is too small and due to overgrazing the quality is not good. Cattle die from too little food. The livestock keepers do not have a reliable source of water in the area where they live. Only during the rainy season water collects in ponds.

Because of lack of water the majority of the livestock migrates to the area of Mkindo village. They lease land from farmers and water the livestock from the local rivers. Some livestock remains in the village and gets water from the ponds next to rivers and a leaking irrigation canal during the dry season. To water their livestock villagers are forced to cross agricultural fields. When too little rain has fallen all livestock is moved even further away from the village.

Although the area where livestock keepers live has trees and they protect them from being cut down, the area just beyond their village is used by people from outside for making charcoal. The open fields that have resulted from this are considered bad management.

Water for domestic use is taken from one shallow well which dries up after the rainy season. During the dry season people get water from Dakawa by bicycle. Tsetsefly, malaria, typhoid and tuberculosis and other water related diseases occur frequently and health facilities are far away in Dakawa.

3 BASELINE OF LIVELIHOOD STRATEGIES AT WATERSHED LEVEL

In the Mkindo watershed the three main livelihood strategies are farmers with access to official irrigation, those dependent on rainfed agriculture, and livestock keepers. There is one main irrigation scheme in the area of about 150 ha where predominantly rice is produced with twice the yield as in rainfed rice production. Households dependent on rainfed agriculture produce rice, maize and vegetables, often with some supplemental irrigation from the river. Livestock keepers are also involved in some rainfed agriculture. Of those who depend on agriculture, 75% of the households depend on rainfed agriculture and 25% have access to improved water management, including official irrigation schemes. Land is very expensive in the area, with farmers holding on to their land as much as possible. The average size of land is ¼ acre in the area of Mkindo and Dihombo but 1 acre in the second irrigation area.

Of the three main livelihoods, participants considered those farmers with access to the official irrigation schemes to do better, financially, than farmers dependent on rainfed agriculture, who were more secure than those dependent on livestock keeping. Women tend to be involved in growing vegetables, men in growing rice and maize. Other smaller groups of people who also live in the watershed and were interviewed in the communities or mentioned by the experts are:

The commercial sugarcane company "Mtibwa Sugar Estate Ltd." uses sprinkler irrigation on the fields of the company. The rest of the sugarcane is produced by outgrowers, farmers who own their land and sell the sugarcane harvest to the company. Outgrowers would like to use irrigation for their sugarcane but often cannot afford to do so. Some do use irrigation for their rice fields and are comparable to the stakeholder group of farmers utilising official irrigation schemes. However, they do not use fertilizers on their sugar cane crop. Selling the harvest can at times be a problem but if all goes well they typically get a good price. It sometimes takes up-to half a year before they get paid by the sugar company.

Root crop and fruit growers who live in the forest reserve areas in the watershed. They grow cassavas and cocoyams along the streams taking advantage of the rivers as a source for irrigation. These producers sell their harvest at the Mbogo market.

Some people in the watershed make a living from selling fuel wood or charcoal. However, the forest reserve on the upper parts of the watershed is not meant to be used for this purpose. Other areas of forest are accessible to all and used by a small number of people who have rights to sustainably cut down a certain number of trees for timber over a period of time. In the Mkindo village, inhabitants have improved the management of the forest by surveying the area more frequently and keeping illegal timber harvesting to a minimum.

Others also undertake illegal hunting in the eastern part of the watershed. This area is managed by the Wami Mbiki Society (WMS), an Association of 24 villages that manage a 2 500 km2 Wildlife Management Area. This National Park is of a relatively lower grade and has been categorised as a game reserve. Some people keep bees as a livelihood strategy and others are petty traders.

Some people in the Mkindo watershed are employed as labourers to work in the Mtibwa sugar cane plantations during the harvest season. They travel to different plantations because the harvest happens at different times in different areas. They move to where there is work. Many come from villages in the area and working on the plantations is their main source of income. A health risk of HIV is associated with them because of their lifestyle.

3.1 Livelihood narratives for those dependent on irrigation agriculture

Irrigation systems

In the watershed three different types of irrigation systems are used corresponding to three geographic areas as can be seen in Figure 2. The first is around the villages of Mkindo and Dihombo and is a well organized, formal furrow irrigation system using canals of which some are lined. It is a gravity based system using water from the rivers Mkindo, Chazi and Divue. Water that flows through the canals is used to flood the fields and drain the fields from water. This area has developed in two phases and a new development is planned to take place in the near future led by the District office of an expansion of 2700 acres of the current irrigation scheme.

Figure 2: Map of the three areas of irrigation

Farmers in the first area have organized themselves in an irrigation association. They are the only association in the watershed with official water use permits issued by the WAMI river basin authority. They use schedules of farming activities to control the uptake of water. The farmers pay through this association for the maintenance of the infrastructure. Farmers irrigate paddy rice and because of the small farm sizes of about 1 acre or smaller they are able to level their fields manually using hand hoes to prepare the fields.

Although water is always there, the management is not always consistent throughout the growing season. There is a lack of knowledge on how to manage the water in the best way. Also, in both areas

bad lining of the channels decreases the effectiveness of the irrigation facilities. A gravity system and a pump system are used, but in general the pumps are too expensive for small farmers.

A similar site with some lined canals is situated north of Dakawa. This is a former National Farm that has been taken over by local farmers. They have also organized themselves, but their water use is not efficient. The farm sizes are larger than in the other scheme. Work such as the levelling of the field should be done using a tractor but these are not used systematically with the result that higher lying fields do not receive water. The schedule for water use is too tight. Some people pay to the group but this is not a guarantee of getting water. For other subsistence farmers near the national farm the fees that the group asks are too high. The irrigation technology that is used in this area is similar to the system in Mkindo and Dihombo. They use diesel pumps.

The second area stretches around this well managed system to the north along the road. Irrigation and drainage is based on an informal network of unlined canals which is not sufficient to manage the water properly. The same rivers are used in this area as the Mkindo and Dihombo area. There is no irrigation association in this area but due to the abundance of water there are no conflicts related to water access. This floodplain has always had a problem of water logging but the Mtibwa Sugarcane company has changed the river course which means that the situation has improved in some areas but also that new areas have become more prone to flooding.

Sprinkler irrigation is used in the third area which is mainly situated near Mtibwa and has the Mtibwa river as water source. Here sugarcane is grown by the commercial sugarcane company "Mtibwa Sugar Estate Ltd.". The company has water use permits but these are not monitored by the Wami river basin Authority. Outgrowers for this company solely rely on rainfall for growing their cane crop and more details of their farming system is described in the section on rainfed agriculture. Some do irrigate the rice crop and have a similar use of resources as the farmers who live in the first area of irrigation.

Impact of irrigation

In the area up north within the forest reserve, the Mtibwa sugar company has overexploited an area around the river resulting in land degradation. During the wet season, this river often floods the surrounding area. In the floodplain a drainage channel constructed by the company has changed the direction of the Diwale river, as mentioned above, improving the situation in some areas but also making other areas more prone to flooding. In the latter areas farmers are considering changing from sugarcane production to paddy rice production.

Harvest of paddy rice

In the irrigated areas, farmers harvest paddy twice a year. The farmers who live in the first irrigation area are better organized and have a better canal infrastructure resulting in a higher production level in comparison to the second, more informal, irrigation area. The average yield is 30 bags per acre whereas farmers in the second area harvest 10 to 15 bags per acre. According to the farmers in this area they harvest 15-25 bags per acre at least twice a year.

Markets

Paddy rice is a cash crop and is sold at a reasonable market price although farmers say they sell rice that still needs threshing and winnowing for a low price at their houses. Some wait till the prices have gone up before they sell their harvest. Buyers from cities, including Dar es Salaam, come to the fields of farmers and buy up the harvest at the beginning of the growing season. They agree on a price and pay half before the harvest and half after the harvest. One year farmers had low quality rice but because they sold it based on the number of bags they did not lose money.

Markets are in Turiani and the prices have increased in recent years from 450 to 700 shillings per kilogram. The price of rice in larger cities is higher but the difference in price is because of the extra transport needed. For farmers this extra income is not worth it because of the additional costs of transport.

There are some main roads that have improved access to and within the watershed but some areas have very bad quality roads. The second area of irrigation has no roads at all making the transport of produce difficult. Also Dakawa, despite being closer to the main Dodoma-Morogoro-Dar es Salaam highway, one needs a tractor to transport the harvest to the market.

Communication

Telecommunication, especially mobile phones, has improved significantly in the area making it possible for more farmers to know the prices of their produce in other markets in the country.

Other inputs

Most of the farmers in the first irrigation area around Mkindo use high yielding variety seeds and fertilizers. Herbicides are used to control diseases. In the other areas with informal irrigation systems farmers do not use fertilizer.

Figure 3: Map of the other resources used in the irrigation narrative

Training

An education centre, the Mkindo Farmers Training Centre, is situated in Mkindo village. Here farmers can receive training on new farming techniques. Farmers in the Mkindo area have received training from the local education centre and learned about new and more efficient techniques for rice production. For some this has increased their production, for others there is still more to learn.

The government has extension officers to disseminate knowledge and advice throughout the rural areas. However the extension officers lack the means of travelling through the area. This makes it difficult for farmers to get the advice they need when they need it. There are many extension officers but the lack of transport facilities means extension is not carried out to its full potential.

There is also a feeling that farmers have not organized themselves enough and with the facilities available they should be able to get the support they need and produce more.

Financial services

There are financial service organizations active in the area. One is SACCOS, which provides large loans but the process of application is long. Another organisation is CARE which provides small loans to 'village saving and loan groups' made up from local community groups especially women. It takes one year to provide a return on the sums of money each person puts into the common fund. The interest rate is decided on by the people themselves. At the moment 110 groups are involved. In general people lack the knowledge of what institutions there are and how to apply for funds. It would be ideal if they would learn this but that is probably not realistic.

Setting up a new irrigation scheme is very costly and cannot be done through these two financial bodies. The district office has funds for irrigation scheme development from the national government and they are improving four systems.

Other resources

Other sources of income include selling of maize, livestock, chickens, fruits, small businesses and forest products. The areas where these are grown or accessed are shown in Figure 3. Food crops are groundnuts, beans, cocoyam, cassava and maize and also fruit from fruit trees is consumed. All these are produced in the wetland areas along the rivers. Other resources used by farmers who utilise official irrigation schemes are livestock, vegetable gardens and in some cases fish farming. Farmers have 2 to 3 animals per household and do minimal or zero grazing. Goats graze along the roads close to the villages. Dairy cattle are kept next to the house. Farmers use the forest for medicinal plants, vegetables and spices. The vegetable plots are very small, around 1 to half an acre in size, and are situated in the wetlands along the rivers. Along the road to Hembeti tomatoes are grown. Maize is the staple food crop. Bananas are grown within the forest reserve and are irrigated. They are sold at the market in Turiani.

Social context

The Wami Basin river authority is in control of all water use in the watershed. They distribute water rights that aim to prevent rivers from drying up and finding a balance between production and water use. Their capacity to follow up on these water rights is limited so no up-to-date knowledge exists about the over or under use of water.

Health related issues

Throughout the watershed there is a high incidence of mosquitoes and malaria. Water for domestic use is of poor quality but can be improved by boiling it. People know this but don't do it which results in people getting typhoid. Because there is no chlorinated tap water people also use the water from

the river for drinking. Even if this water is boiled it is still of such poor quality that it is unsuitable and they should not be drinking it. The main reasons for the poor quality are that animals drink from it and people use it for dumping garbage. During the rainy season bacteria develop in water sources resulting in more people becoming ill. Labour productivity however is not impacted because not everyone gets ill at the same time.

In some areas the drinking water has been affected by the farming in the upstream areas. Also pit latrines have been built upstream of one shallow well making this water very bad for the health of those who drink it. Malaria, bilharzias and typhoid occur frequently and health facilities are far away in Turiani and Dakawa towns.

3.2 Those dependent on rainfed agriculture with supplementary irrigation

Rainfed agriculture

The participants of the workshop defined rainfed agriculture as a type of agriculture in which farmers do not have the physical structures of an irrigation scheme and mainly depend on rainfed agriculture. This takes place close to rivers or in the lower lying areas where water gathers, as can be seen in Figure 4.

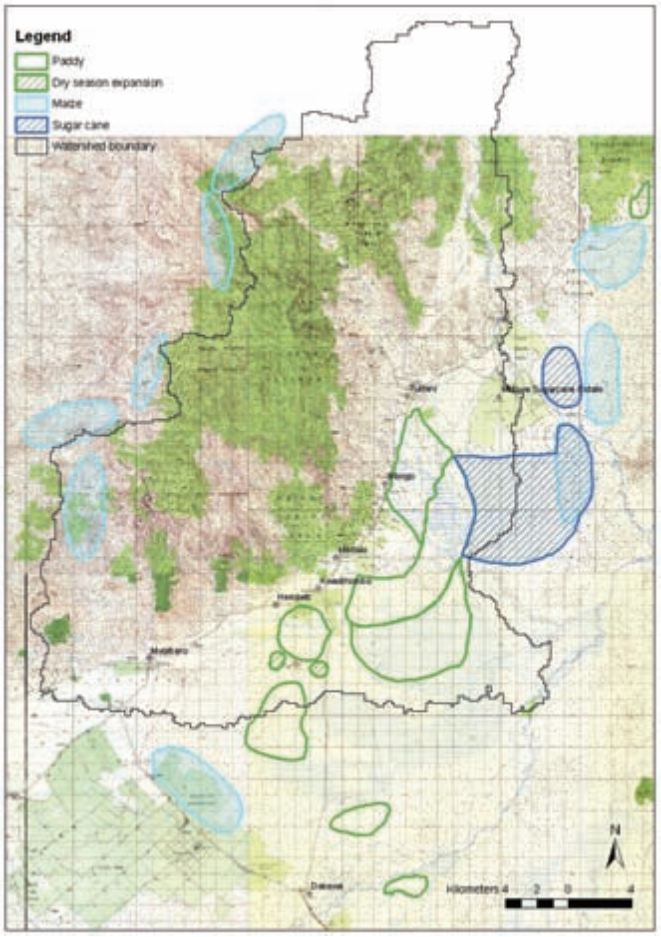

Figure 4: Map of the crop production areas in the rainfed narrative

People tend to make use of the floods. Those close to the river sometimes use buckets, hosepipes or diesel pumps when the farms are of a large size. This however tends to happen only to avoid the loss of the crop in the dry season when the short rains have not come or it has rained too little. Rainwater harvesting is done with bunds to store water in the field and decrease runoff. In the areas where rice is produced farmers create the bunds before the rains to let the field get filled up by rainwater.

Some people farm in the forested areas that are not inside the forest reserve. It is illegal to farm within the forest reserve. The people who hold large numbers of livestock are also included in this livelihood analysis. Over time livestock keepers have changed their ways of living to include more rainfed agriculture and diversify their sources of income and decrease their risk. Therefore they are also considered to be rainfed farmers.

Crops grown under rainfed agriculture include rice, maize, and sugarcane as in Figure 4. Other crops include fruit trees, bananas, avocados, mangos,root crops and vegetables. When there is enough rain the area of rainfed rice is extended. These are the dry season expansion areas in Figure 4. On the other side of the mountain range and therefore outside the watershed the villages also depend on rainfed agriculture. Farmers in that area grow mainly maize and beans.

Livestock keeping

Part of the livelihood strategy of rainfed farmers is livestock keeping. All of them keep a small number of animals. The animals graze along the roads and on the fringes of the forest. During the dry season they sometimes come into the forest for fodder despite this being illegal. Illegal grazing also happens at the Mtibwa Sugarcane plantation. Another source of income for rainfed farmers is the leasing of land to those mainly dependent on keeping livestock. The land is let for 3 to 4 months during the dry season and will again be used for crops during the wet season. Although this helps to feed the animals the difficulty facing the livestock keepers is the lack of water points. Often they are forced to go to another area entirely because of the lack of water. During the rainy season water is collected in ponds for watering animals and for domestic use.

In the floodplain where most of the cattle graze, shrubs and acacia trees are the predominant vegetation. Goats and sheep get fodder from these trees. In the past the area used to be woodland with plenty of shrubs. However, due to overgrazing only isolated trees are left without grass or undergrowth. The most valuable trees have gone. The area is drying up resulting in especially dry grasses growing there. The rains used to be more frequent and longer. Nowadays it rains for a month only. Also due to overgrazing this area has rapidly deteriorated. Different tribes of livestock keepers have come to the area over the years. They include the Masaai, the Mang'ati and Pare. By now they have intermarried and although there are conflicts over the scare resources available there are no tribal based conflicts. Also people from other towns come to the borders of the villages of the livestock keepers increasing the pressure on the land.

Other resources used by the rainfed farmers are similar to those used by those having access to irrigation. They have vegetable plots along the rivers, gardens near the houses, fruit trees scattered around the villages, and some small scale harvesting of forest products. The resulting products are often sold along the road and are another source of income for the farmers.

About 80% of the people who are involved in rainfed agriculture have no access to official irrigation facilities. This includes the livestock keepers who also depend on agriculture.

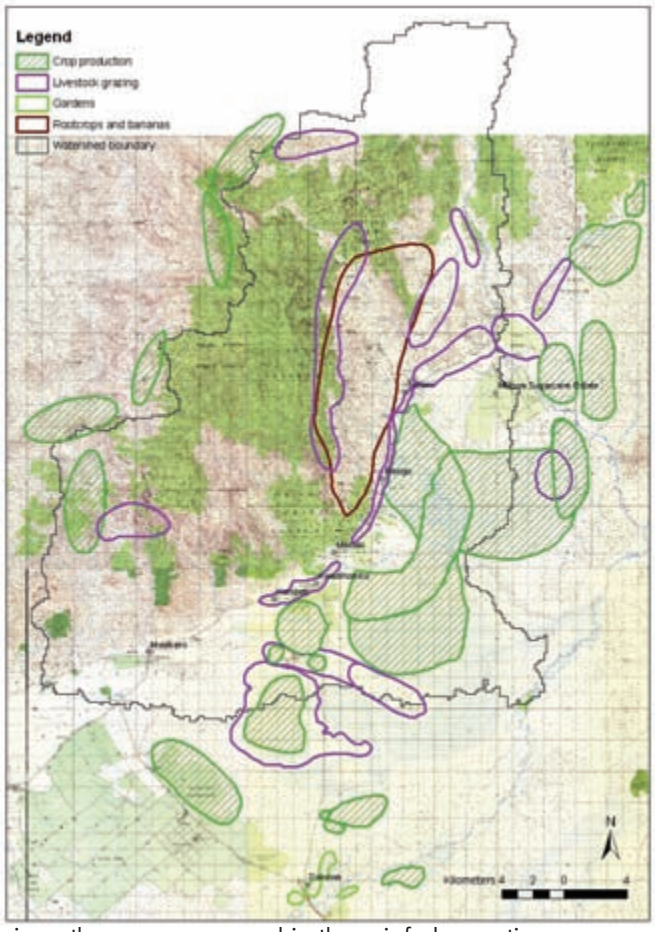

Figure 5: Map showing other resources used in the rainfed narrative

Maize and paddy rice

The farmers tend to harvest maize and rice once a year although this depends on the rainy season. Some are able to make use of the short rains and harvest another maize crop. A second rice harvest is not feasible because more work is needed to harvest rice when compared to maize. The amount of crop that is harvested depends on the different techniques farmers use. Those who have had training at the Mkindo Agricultural Centre have increased their water use efficiency. As such, water scarcity is not the problem, because the area is a wetland the water table is high, however drainage is the problem. Farmers harvest about 7 to 9 bags of maize per acre. The production area in the South of the watershed harvests much less: 4 to 7 bags of maize per acre.

The rains in 2008 were very bad and rice was not harvested by the farmers. Further away from the river and the river banks, agriculture is much more rainfall dependent. When the rainfall is not enough for the crop there is no harvest possible. Because of topographic differences, which create different crop suitability in the watershed, most farmers have some rice fields in the lower lying areas and some fields for maize in the higher lying areas. This is a risk mitigating strategy. When there is too much rain in one period and little drainage, rice will be affected negatively because the water level will be too high but the maize crop on the higher lying land will do better. When it is too dry the water accumulates in the lower lying areas making a harvest of rice possible, but making maize harvest lower. In the area where farmers grow rainfed sugarcane more water accumulates due to the changes of the river and drainage channels. Farmers mentioned that this made them consider changing from sugarcane to rice, because it needs less water.

Sugar cane

Where farmers are outgrowers who sell their cane to Mtibwa Sugar Estate, bureaucracy makes it difficult for some to sell and easy for others. When a farmer is well connected to the Mtibwa Outgrowers Association he/she can sell quickly and in time following a harvest schedule. Others however sometimes have to wait longer than two years to harvest which results in a low sugar content which is what the price the farmer gets is based on. Also the chances are that when the farmer has burnt the field in preparation for harvest he has to wait for the other members to sell theirs first. This may take longer than the two days in which the sugar has to be processed for a high level of sugar . Another risk he/she takes is that during this time rains can come again which will ruin the crop completely. Generally the outgrowers harvest about 15 to 25 tons per hectare in comparison to the sprinkler irrigated harvest of 60 to 65 tons per hectare. As Mtibwa is the only buyer of sugar cane in the area they have a monopoly which makes it difficult for the rainfed farmers to improve their situation.

Fertilizer

In some areas of the watershed people have been farming for years, especially in the area around Mkindo and Dihombo villages. Farmers in these villages must use fertilizers in order to realise good yields. There, people use fertilizers to get a similar harvest as before. In general, however, water is the restricting factor. The soils are alluvial and therefore naturally fertile. People from outside the watershed know the suitability of the land for farming and are interested in getting land in the area.

Market accessibility

Rainfed farmers tend to be far away from the main road network and it is often more difficult to get the crop to market. Poorer farmers often do not have storage facilities and as a result they have to sell everything at once. As with the farmers with irrigation access, there are buyers who come into the farms and buy the crop there. Farmers depending on rainfed agriculture are completely dependent on the buyers who therefore can give a lower price for the crop.

Water quality

The river water is of poor quality and therefore not recommended for domestic use.

Resource conflict

The conflict between rainfed farmers and livestock keepers has increased over the past few years. People even have lost their lives. The struggle is often about animals coming into the cropping area. Livestock keepers are not allowed to live in certain areas. However, people have come in pretending to be rainfed farmers and then slowly introduced more animals into the area.

The problems underlying the conflict are both about land and water, but mainly water. There is enough water to have farming and livestock keeping in the watershed but water is not efficiently used. There is a lack of education and environmental protection is not yet addressed. In the South of the watershed farmers have not yet organized themselves enough to talk about water use efficiency and proper distribution.

Animal diseases

Medication to treat, especially, poultry disease is expensive and as a consequence a high number of poultry die each year. Veterinary services are available and a project was set up to train extension officers so that they can train people how to best keep animals and how to give medication.

Resilience

The strategy of having a field for maize and a field for rice, keeping some livestock and running small businesses means rainfed farmers are able to cope throughout the year. If the crops fail, the

farmer will sell some animals for food, or livestock is moved to another area or sold to save money and buy new animals in the future. But if there is a drought then not only the crop fails, but also the animals suffer and possibly die. The small businesses need some inputs during the dry season, either money to buy in whatever they sell, or food produced at the farm. If there is no food and no money then a small business cannot run. Some people rely on family members in towns to cover the input for their businesses, but crop failure will have a devastating effect on other sources of income.

Having diversified from only being a farmer or only being a livestock keeper the rainfed farmer can cope with the negative effect of changes in climate. He or she has spread the risk by doing a little of everything (hunting, labourer on the larger commercial farms, petty trader, selling some wood from the forest, etc.). They see opportunities when water resources for the farm fail or market access is difficult. The result of this, on the other hand, is that the farming component will not be their main investment as that would be too risky.

3.3 Livelihood narrative of those dependent on livestock keeping

Those people within the watershed whose main sources of income are from livestock live and work with the animals in specific areas indicated in Figure 6. However their animals do go throughout the watershed for grazing. There are different tribes that can be called livestock keepers although many of them combine livestock keeping with agricultural farming. These are: Mang'ati, Masaai, Pare and the Sukuma people. About 10 to 15% of the people in the watershed are livestock keepers.

The livestock they keep are cows, sheep, goats and poultry. Milk and leather products are also sold but only contribute a little to their income. The milk is for children and women. Some milk is sold to the milk processing plant in Kambala.

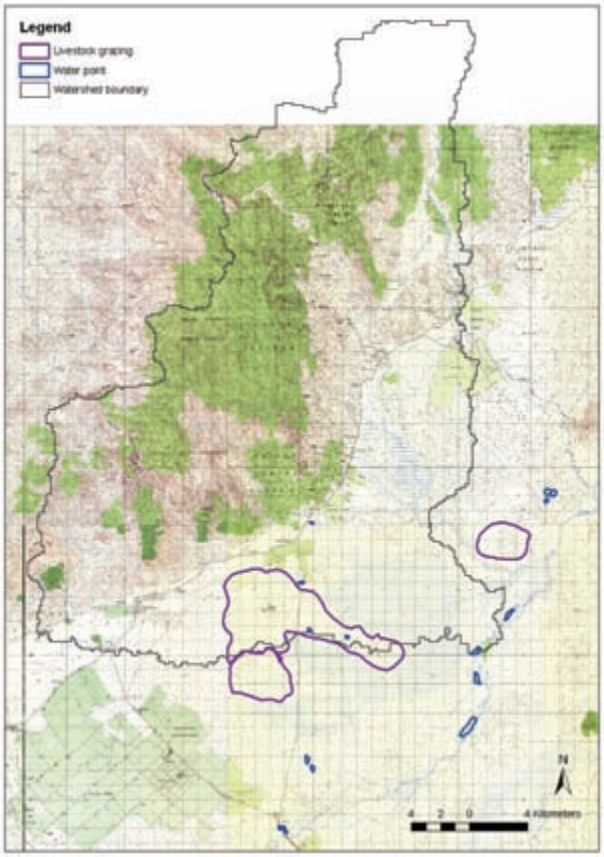

Figure 6: Map of the area used by livestock keepers

The number of cattle a man keeps is part of his esteem and gives him opportunities to marry a desirable woman because dowry has to be paid and depends on the number of animals or money equivalent a woman is worth. A woman with a lighter complexion is valued higher and will need a larger dowry. A man without cattle is not respected. Most livestock keepers aim to keep a good number of cattle but by doing so the people do not take into account the amount of land available. There is a problem of overstocking and land degradation due to overgrazing.

Another problem is water availability. Government has not invested enough in water structures for cattle such as charco dams, consequently livestock keepers have to live close to areas with farming as there will be water and consequently pasture availability.

A challenge is the land shortage which on the one hand means too little food, but also means that in future the area for agriculture will likely expand and the area for livestock will keep diminishing. The livestock keepers cannot migrate forever and in every area they migrate to there are other tribes or people who keep livestock who already use that land intensively. The Masaai used to migrate to the highlands during the dry season from Arusha and let the low land rejuvenate - the transhumance system of keeping animals. But expansion of commercial plantations and small-holder agriculture in the highlands forced them to change their way of life and they started to migrate to other areas. Not all land is suitable: animals can only be brought to areas where the Tsetse fly is not present and the land is not waterlogged. Wet areas give rise to foot rot.

A possible solution to the shortage of land and fodder is to confine animals in a ranch or in a concentrated area. This has already happened in two places within the Mkindo watershed. In this system, fodder is produced in the surrounding area and brought to the cattle. This way, people can keep a number of animals and provide them with good food throughout the year including concentrates and sugar molasses from the Mtibwa sugarcane plantation. The animals do not degrade the pasture around and will fetch a higher price at the market because they have had enough food and did not have to walk a lot. The turnaround of investment is also high: it takes only about 2 to 3 months to fatten an animal. The downside of this system is that several people would have to keep their herd of animals together. At the moment they like seeing their livestock every morning and a different system will make it difficult for the women to keep records. It would require a change of mind-set.

Another option is to give people ownership of a piece of land so that they keep the number of animals appropriate to the carrying capacity of that piece of land. The Masaai have actually been given land but they still use it as communal land for the village as a whole. Fencing a piece of land to keep your animals in and others out is not how these livestock keepers keep their animals.

Farming

The livestock keepers produce some rain fed rice and maize for subsistence but the 2-5 bags of maize per acre and 6-7 bags per acre of rice are not sufficient for the community. They buy the rest of the food they need at the market in Dakawa or from farmers in the area. Their crops get water from the catchment of the floodplain and only hand hoes are used to prepare the fields.

Water related problems

The second main problem the livestock keepers face is lack of water, and difficult access to water. To water their livestock villagers are forced to cross agricultural fields. When too little rain has fallen all livestock is moved even further away from the village. In the Mkindo watershed there are different points where livestock keepers come to water their animals in the dry and rainy season. These are along the rivers, near bridges or in ponds and charco dams in the area. Especially along the river and

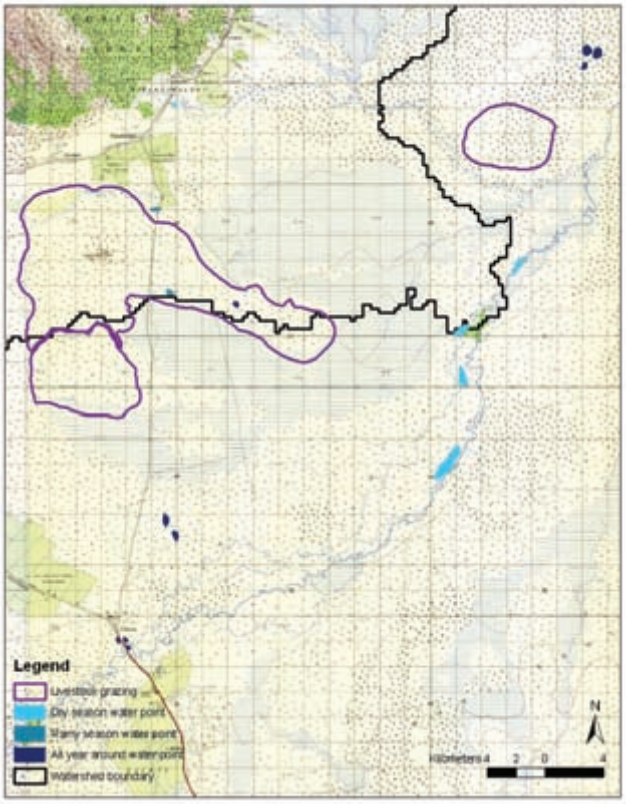

Figure 7: Map of the seasonal water points used by livestock keepers

near bridges the large number of animals has destroyed part of the infrastructure. The majority of the water points are far away from where livestock keepers live and those water sources nearby are often not reliable. Only during the rainy season does water collect in ponds.

During the dry season they move towards the Wami river as can be seen in Figure 7. Some livestock remains in the village during that time. They go to ponds next to rivers and leaking irrigation canals for water but due to lack of water the majority of the livestock migrates to Mkindo village. The livestock keepers lease land from farmers and water the livestock from the local rivers. To get to the river however means that the livestock keepers have to go through agricultural land. This is against the bylaws and if they are caught in that area they have to pay a large fine. There have been talks of creating a livestock corridor for animals to cross through farm land to get to the river but farmers protested. It is a continuing source of conflict.

In one place there is bore hole which provides water for both livestock and domestic use. The water is pumped with a petrol pump into a trough from which animals can drink. Water for domestic use is taken from one shallow well which dries up after the rainy season. The pump is old and often breaks down. During the dry season people from the village get water from Dakawa using bicycles.

Other resources

They get their fuel wood from the area where they live. They collect the dry wood in the woodland around their village. They do not cut down trees as the Acacia trees, especially, produce new leaves and shed pods during the dry season and in this way provide the animals with fodder.

Although the area where livestock keepers live has trees and they protect them from being cut down, the area just beyond their village is used by people from outside for making charcoal. The open fields that have resulted from this are considered bad land management.

Livestock keepers do not have fish ponds because in general there is a lack of water but also because they consider fish to be like snakes. Some of them fish in the rivers during the rainy season.

Labour

The men own the animals but the daily management is done by children and women. Children take the cattle to the fields; women milk the cows and are responsible for keeping a record of the numbers of cattle and of the amount of milk that is going to the processing plant. Men only verify the size of their herd and see what they can sell. They are the ones who go to the markets. Another responsibility of the men is to keep the animals healthy and if needed bring medicine for them.

Men deal with money, on the market and at the processing plant for milk. If something is commercial it's the men who are involved. Women take care of the household and feeding the family.

The livestock keepers keep cattle in different areas and need a lot of labour. This is provided by the children at the expense of their education.

Health

The tsetse fly is a large problem for the livestock keepers. The fly can be found in shrubs which is why these are burned. When the government proposed to move all livestock keepers to the South of Tanzania the people were very much against this because of the tsetse fly infestation in that area.

Malaria, typhoid and tuberculosis and other water related diseases occur frequently and health facilities are far away in Dakawa.

Resilience

The livestock keepers have different parts of their herds in different places. This is a strategy to decrease the risk of disease outbreaks. They are able to do so because there are enough children to take the cattle to these different areas.

The livelihood strategy of the livestock keepers is more resilient than those of the farmers because they can move their cattle to other areas, and even to different parts of the country. It was acknowledged, though, that in these other places the livestock keepers will find the same problems of shortage of land and water because in those areas other livestock keepers live.

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