



Agricultural Water Management Scenarios in the Mkindo Watershed Wami Basin, Tanzania

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Report for Agricultural Water Management (AWM) Solutions Project

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1 INTRODUCTION

This report describes the results of different Agricultural Water Management (AWM) scenarios 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 Mkindo watershed was done during November and December 2009 in cooperation with Soil Water Management Research Group of Sokoine University of Agriculture, Morogoro, Tanzania.

Previous to the scenario analysis a baseline assessment of the current resource-based livelihood strategies was done. 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.

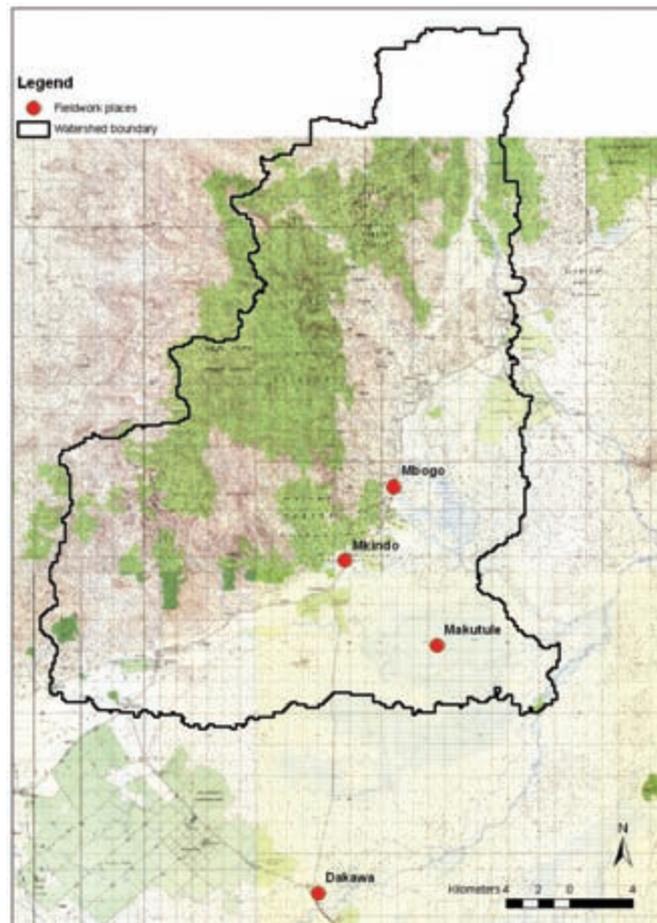


Figure 1: Villages where community fieldwork has taken place

These detailed studies at the community level were then up-scaled to the watershed level during an expert meeting with a small group of local experts. Participants at the expert meeting mapped and discussed the current situation of water management, livelihoods and resilience of different livelihood

Table 1: Participants of Community fieldwork

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

groups within the Mkindo watershed. The participants worked in a part or throughout the watershed, some of whom worked for the Wami Basin Authority, lecturers at the university in fisheries and livestock keeping, and one participant who worked for Care International in forestry management. The map that resulted from that first day can be seen in Figure 2. It depicts the three main livelihoods in the area: those farmers with access to irrigation, those dependent on rainfed farming and livestock keepers.

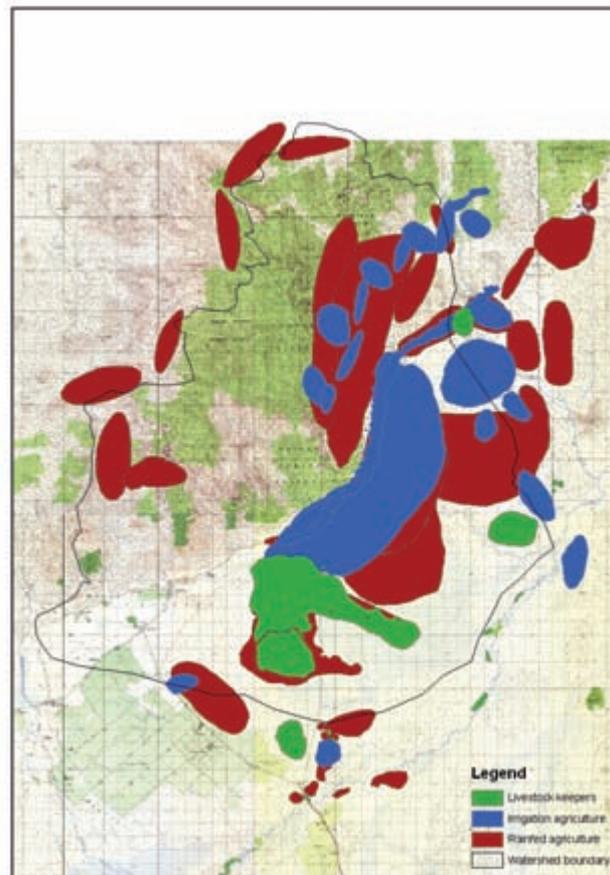


Figure 2: Map showing the different livelihoods of farmers and livestock keepers in the Mkindo watershed based on the first day of the expert meeting

Scenarios are defined as ‘Plausible futures, each an example of what might happen under particular assumptions’.¹ Participants were asked to develop believable stories of possible future outcomes with a time horizon of 10 years. The particular assumptions were called starting points. Each was developed by the project team and was based on suggestions made during a state level consultation event hosted by IWMI (AgWater Solutions Stakeholders Consultation Workshop organised in 2010 in Dar es Salaam). The starting points reflect a range of possible future changes that would affect different stakeholders in specific parts of the watershed. They describe the context and the resulting agricultural water management changes that would occur. A map showed the areas where these changes were to happen. In the Mkindo watershed the starting points were ‘Expanding irrigation schemes and small scale storage for livestock’, ‘Pumps for agriculture and drainage channel for livestock’ and ‘Large irrigation scheme for cash crop production’.

The participants discussed which stakeholder groups in the watershed would be potential beneficiaries and for what reasons, who would be unaffected, and which groups would have their livelihoods negatively impacted or would dis-benefit as a result of the suggested changes. The location and extent of each of these types of stakeholder groups were then indicated on a map. Participants then went on to discuss any factors that would need to be in place to maximise the benefits of the AWM interventions or mitigate the foreseen negative effects for dis-beneficiaries. They also discussed factors that could compromise the success of the changes.

Each of the three starting points is first described, including the illustrations that were used during the meeting, after which the results are presented in the same order as the discussions took place. The resulting map with changes in areas that would benefit and dis-benefit from the AWM intervention was analysed quantitatively. Results are presented with the map. Participants were also asked to write the full story of the scenario at the end of the meeting to answer the question: what will happen over a ten year time period if .. (starting point).. would occur? After this the ‘expanded scenario’ summarises all the results in a story.

1 Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-Being. Synthesis, Island, Washington, DC.

2 SCENARIO 1 - EXPANDING IRRIGATION SCHEMES AND SMALL SCALE STORAGE FOR LIVESTOCK

2.1 Starting point

- Driver of change: Intensify agriculture in mid-section of watershed and drainage for livestock watering
- Primary change: Expand small scale production along river network using pumps; diesel pumps near the river network and lower technology (treadle) groundwater pumps in the drier rainfed areas. Development of a drainage canal from Mkindo river to the lowland livestock area used for improved livestock production (Kambala region)

In the watershed irrigation infrastructure is increasingly provided by the government but in other areas farmers use unpaved waterways to transport the water or buckets from the river. The pictures in Figure 3 present some of the possible improvements that could take place. For livestock keepers the main constraint is the water availability in the area, which causes conflicts with farmers and in some cases death of livestock. Migration of cattle is a large aspect of their lives which is entirely to do with finding pastures and water.

In this starting point participants were asked to consider the impacts of expanding the existing irrigation scheme in the middle section of the watershed and newly constructed pits to harvest rainwater for livestock watering in the lowland area, as shown in Figure 4.



Figure 3: Three possible impacts of scenario 1: (f.l.t.r.) Expansion of existing irrigation scheme; livestock watering point; construction of watering point.

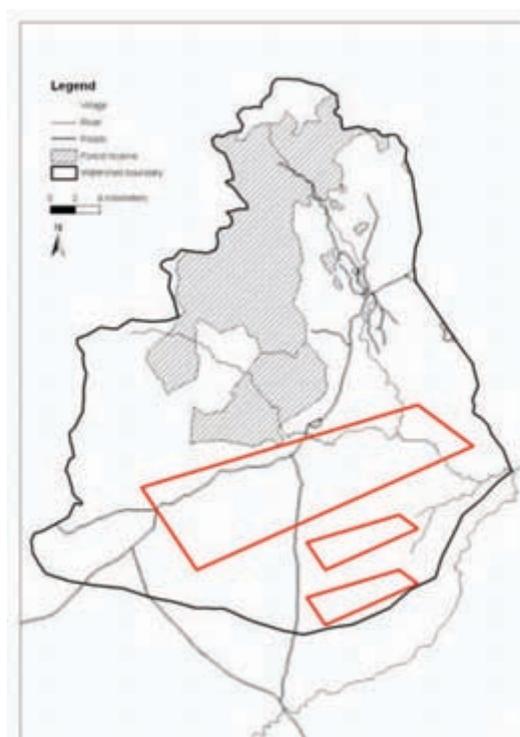


Figure 4: Map of the watershed where the participants were asked to consider the impacts of expanded irrigation in the middle section and watering points in the two smaller red squares.

2.2 Impacts on livelihoods

Those who will benefit from the effects of expanding irrigation in the middle section

| Stakeholder group | Direct impact on livelihoods |
|--|---|
| Small-scale farmers with land in the irrigation expansion area (including women farmers) | <ul style="list-style-type: none"> • The existing areas irrigated using traditional canal systems could have significant increases in yields with improved irrigation systems • Yields per harvest increase by 75% coupled with a doubling in the number of harvest per year (from one to two) • Improvement to water access for agriculture also improves domestic water access • Farming incomes improve from small plots by improvements in yields • Additional irrigation potential for high value cash crops such as vegetables, other crops and horticulture |
| Sugar cane out-growers | <ul style="list-style-type: none"> • Sugar cane out growers – would most likely change from producing sugar cane to growing rice • This would be dependent on the price for the two commodities – but it is most likely that the sugar cane area will decline if the potential for more than one rice harvest exists with the new scheme • The payment for rice sales is more straightforward with a guaranteed market (sugar cane sales can be erratic) • This shift stabilises the income of this group |
| Other residents | <ul style="list-style-type: none"> • Residents within the irrigation scheme area benefit from the availability of water for domestic uses – reducing their labour demands • Local food prices drop for residents across the watershed (and beyond) due to improved yields and harvests |

Those who will benefit from the small scale storage of rainwater for livestock watering

| Stakeholder group | Direct impact on livelihoods |
|--|--|
| Small-scale farmers with land in the irrigation expansion area (including women farmers); Existing irrigation scheme farmers; Sugar cane out-growers | <ul style="list-style-type: none"> • Improved watering points reduces livestock migration • This reduces crop losses and hence conflict between the crop producers and livestock keepers • Price of meat reduces due to improved production benefiting nutrition |
| Fruit and root growers; Other residents | <ul style="list-style-type: none"> • Price of meat reduces due to improved production benefiting nutrition |
| Dedicated livestock keepers | <ul style="list-style-type: none"> • Livestock keepers would stop migrating cattle if water points had reliable quantities of water • Less migration leads to reductions in the conflict between livestock keepers and crop growers • Water would need to be of good quality and depth to maintain reserves Improvement to water access for agriculture also improves domestic water access • The ponds provide the opportunity to diversify – e.g. into fish production in the livestock water ponds/dams • Increased influence in the district governance structures with improving incomes income improves |

Those unaffected by the effects of expanding irrigation in the middle section

| Stakeholder group | Direct impact on livelihoods |
|------------------------------------|--|
| Existing irrigation scheme farmers | <ul style="list-style-type: none"> • These farmers could benefit from the expansion of the irrigated land area as they acquire a greater area of irrigated fields • The reduction in the availability of cheap labour – through increased availability of irrigated land for other farmers – results in the current irrigated farmers having to return to actively working their fields themselves • The expansion of the scheme results in an erosion of their influence and authority – as they are now one of many – rather than a few • The overall increase in production lowers market prices meaning that incomes for per hectare drop – this is offset for farmers who more obtain irrigated land within the expanded scheme |

Those unaffected by the small scale storage of rainwater for livestock watering

No one is unaffected by the small scale storage of rainwater for livestock watering

Those negatively affected by the effects of expanding irrigation in the middle section

| Stakeholder group | Direct impact on livelihoods |
|-----------------------------|---|
| Fruit and root growers | <ul style="list-style-type: none"> • Price for these crops drops locally • The producers (who are outside the irrigation scheme) need to sell their further produce away at new markets • This increases their costs of production which needs to be passed onto consumers • The lower local prices of rice and maize resulting from increased local production mean this groups costs of living is also reduced – offsetting the potential reduction in their income |
| Dedicated livestock keepers | <ul style="list-style-type: none"> • Current grazing areas are utilised for permanent cultivation reducing the area for grazing • Local food prices drop reducing the cost of living – but also reducing the market prices for meat and dairy produce |
| Petty traders | <ul style="list-style-type: none"> • The drop in crop prices reduces traders profits • This is offset to an extent by a drop in the local cost of living via cheaper food prices |

Those negatively affected by the small scale storage of rainwater for livestock watering

| Stakeholder group | Direct impact on livelihoods |
|-------------------|---|
| Petty traders | The drop in meat prices reduces traders profits |

Quantitative analysis of change in areas in crops

Figure 5 shows the map of areas where benefits and dis-benefits would occur. The differences in area of benefits and dis-benefits can be quantitatively assessed. Table 2 shows the differences in percentage of area.

Table 2: Quantitative analysis of change in areas in crops from baseline to scenario 1

| | Change in area |
|--|----------------|
| Overall Change in Crop Yields | 72% |
| Vegetables | -100% |
| Maize and Rice | 118% |
| Root and fruits | 55% |
| Sugar | -21% |
| Overall Change in Livestock Grazing | 105% |

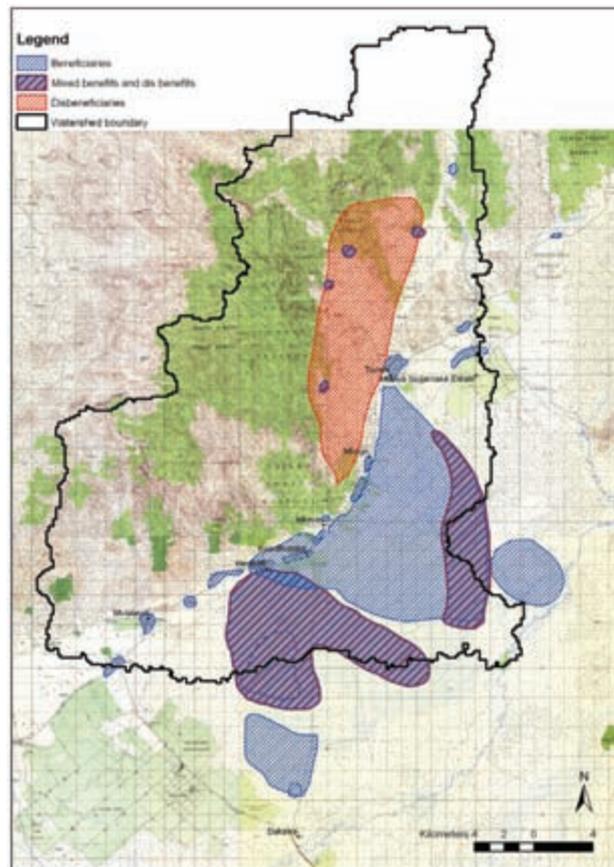


Figure 5: Map showing where in the watershed beneficiaries and dis-beneficiaries are when irrigation would be expanded and watering points for livestock would be constructed

2.3 Factors

Factors that can maximise benefits of expanding irrigation in the middle section

- Establishment of user associations/groups to maintain the irrigation structures
 - Generates feelings of ownership of the irrigation scheme amongst users
 - This contributes to long term maintenance of the irrigation scheme structures
 - Members contribute either through labour or fees to maintaining and extending the AWM technology – e.g. building more canals etc.
- Farm roads improved
 - Allows for improved efficiency of harvesting
- Farmer education
 - Training on how to level fields to ensure efficient water use
 - Water and health impacts – farmers need to be educated in the need to keep separate their domestic water supplies from that used for livestock watering
- Access to capital to level fields and build farm roads(From funder or government)
- Improved local research to identify factors that would provide the greatest agricultural benefits – this would help with prioritizing investments etc.

- Land use planning
 - Identification of one use/areas to avoid conflict between dedicated livestock keepers and crop producers
 - Arrived at in participatory way
 - Needs to be a structured introduction of the new activities and schemes to ensure the effective uptake
- Governance structures to mitigate livestock/agricultural conflict
- Water user associations
 - Water management plan
 - Village by laws approved by the District
 - These agreements need to be independent of changes in government/local councils etc.
 - to ensure their longevity
- Joint forest management agreements (JFMA) instigated between the community and government (independent of status change of park)
 - These need to be implemented to ensure the forest is not degraded effecting the 'sponge' effect of the forest in the watershed
 - Agreements would be between the government and the local communities
- A key requirement is the development of practices that remove farming within 60m of the rivers

Factors that can maximise benefits of the small scale storage of rainwater for livestock watering

- The pond/reservoir technology would be required to keep water throughout the year for livestock
 - Large underground storage of rain water would ensure supplies throughout the year
- With improvements in livestock water and pasture – Maasai may slowly change their traditional livestock management practices
- The creation of fodder banks
 - Zero/minimum grazing - harvest grass and store it to feed to the livestock
 - This change would offsets the need for extensive pasture and livestock migration
 - During the wet season a lot of grass is available – if this could be stored effectively for the dry season it would reduce the requirement for livestock movement
 - This would complement the benefits of having increased water available for livestock from the introduction of the ponds
 - Fodder could be irrigated with water from the ponds/reservoirs if supplies were sufficient to ensure a good supply
- Improvements in the breeds of cattle kept in the area
 - New breeds could be introduced to match the new conditions – maximising the benefits
 - These new breeds would improve the yields of meat
- Improved education system for livestock keepers – develop farmer's field schools to improve the knowledge and skills of the livestock keepers.
- The benefits of the new fodder banks and water supplies would need to be effectively communicated to the livestock keepers

- Show positive effects of small number of cattle
- Take up of cattle genetic information to increase productivity
- Development of user associations/groups to govern and maintain the pond/reservoir structures
 - Generates feelings of ownership of the water points amongst users
 - This contributes to long term maintenance of the irrigation scheme structures
 - Members contribute either through labour or fees to maintaining and extending the AWM technology – e.g. building more canals etc.
- Improvements to the veterinary services
 - These need to be developed to ensure the maximum success of livestock improvements

Factors that can mitigate dis-benefits of expanding irrigation in the middle section

- Open up access to new markets for root and fruit producers
 - These farmers could receive higher prices for these crops further away from the watershed if their local price drops
 - This could be mitigated by selling these crops further away
 - This would be dependent on physical access to the markets
- The tarring of the main road to Morogoro and Dakawa road will allow easier access to markets for all residents
- The strengthening of governance structures for conflict mitigation and management e.g. village committees
 - Improved governance structures could offset the potential tension caused by reductions in the extent of grazing land through the expansion of irrigated crop land

Factors that can mitigate dis-benefits of the small scale storage of rainwater for livestock watering

There are no factors compromising benefits of the small scale storage of rainwater for livestock watering

Factors that can compromise the benefits of expanding irrigation in the middle section

- Land use planning needs to be done by users
 - To ensure success the land use planning for the area needs to be participatory – and include all the various stakeholders
- Livestock keepers may be resistant to changes in migration habits – necessitated with the extension of the irrigated crop area.
 - Less migration required to make the schemes work
 - Livestock migration routes need to be in plans
- Sungaji – giant grass
 - Invasive grass difficult to remove – and effects area for crop production
 - Needs to be removed from the irrigated crop areas
- Education need to be in place for farmers (Lower priority)
- Improvements in crop production resulting from irrigation need to be balanced with the need to maintain the sponge effects of the forest in the upstream area of the watershed (Lower priority)

- Road improvements to open up the area to markets:
- Will lead to increases the illegal logging and mining
- Logging may compromise the water flows needed for crop production

Factors that can compromise the benefits of the small scale storage of rainwater for livestock watering

- Land use planning needs to be done by users
 - To ensure success the land use planning for the area needs to be participatory – and include all the various stakeholders
- Livestock keepers would probably not be willing to pay for the maintenance of ponds
- Livestock keepers would need to reduce their stocking density – to maximise benefits
- “New” livestock keepers may migrate into the area
- Maasai society may be slow to change their cultural habits - for example:
 - Move to fodder production
 - Move to lower stocking rates
 - Move to new species
 - However there is some evidence of recent moves towards new species amongst some Maasai - for example introduction of Boran cattle from Kenya by certain Maasai farmers
- Information for planning not given to livestock keepers
 - Unless information is effectively disseminated – the schemes will not be as successful as possible

2.4 Scenarios

Scenario of the participants

- Secured employment and job security
- Ensures good supply of grains, root crops and fruits
- Improved livestock products
- Maintains harmony between farmers and pastoralists
- Sustainable ‘natural’ resource management
- Implemented “Kilimo Kwanza”
- Reached the goal of making Morogoro especially Mvomero district “a national food store”

Expanded scenario

In 2012 investment in two complementary agricultural water management schemes is made in the Mkindo watershed. This coincides with the completion of the tarring of the main road to Dakawa significantly opening up market access to the small-holder farmers in the watershed. After consultations with the existing village management groups across the watershed, the Wami river basin authority, district office personnel and Sokoine University researchers, a participatory land use management plan is developed. This designates areas for crop land development and those for livestock grazing. Based on the land use plan new concrete irrigation channels are built significantly increasing the size of the irrigated crop field area. At the same time deep ponds are dug and small reservoirs are constructed in the drier livestock growing area to provide water points for cattle.

In the first season after completion of the canals, the new scheme leads to a large increase in the production of rice and maize for farmers with land in the new irrigated area. The rise in production leads on an increase in the number of buyers for rice and maize coming to Mkindo. This increased production and market interest stabilises the price of rice and maize at a lower level than current 2010 prices. This price stability encourages sugar cane out growers who neighbour the irrigation extension to switch production to rice as they can get a more reliable income stream than they achieve from sugar. The rise in production and crop price drop leads to a reduction in the price food commodities across the watershed and local district. This benefits all residents, especially those in urban centres, as people's cost of living improves. The incomes for small holder famers with land in the scheme are still improved as their yields are significantly higher and the reliability of their harvests improved. This greater availability of rice and maize along with commodity price-drops initially damages the income for root and fruit growers. To compensate they initially switch to their other livelihood income such as small businesses and labouring for other farmers to supplement their income. After a few years, with assistance from the district officers and greater market options linked to the improved road network and influx of buyers from outside the watershed, the root crop producers begin selling their produce further afield. Their income improves meaning the development of irrigation only results in a temporary dip in their agriculture based livelihoods.

After initial problems with livestock keepers continuing to move animals through the new irrigation scheme leading to conflict with the crop farmers the local governance structures enforce the new migration routes that were included in the participatory land use plans. To promote the uptake of less livestock migration additional training is organised by the village committees and provided to pastoralists to highlight the benefits of the new management techniques. Training in zero-grazing practices from farm extension services leads to reductions in the need to move animals and the farmers slowly adjust to more sedentary practices. Some farmers build fodder storage facilities harvesting grass in the wet season for use as food in the dry season. The use of these fodder banks allows children to begin attending school more regularly as they are not required to be cow herds.

Crop farmers invest their improved incomes in more use of fertilisers and pesticides. This leads to problems for downstream users in terms of water quality issues. The overall rise in incomes allows crop farmers in the irrigated land to take out loans to invest in improved farm roads and pay for the mechanised levelling of their field's. This further increases income as the crops are in better condition for the buyers and receive a better price. The skills necessary to maximise the benefits of these improvements are provided by the improved extension officers paid for via a levy on use of the irrigation schemes charged by the village committees. Farmers also begin to experiment diversifying into higher value crops such as vegetables and horticulture. This increases their income still further and provides a more diverse income base which is appealing to the risk adverse small-scale farmers.

The availability of water for domestic purposes and improved nutrition lead to better health levels for all residents in the vicinity of the scheme. This has benefits for the farmers as fewer days are lost through illness.

The improved road network means that Mkindo is more accessible. Whilst this provides large benefits it also results in problems with increased logging in the forest reserve. The strengthened village committees enforce the joint forest management agreement and prevent this becoming a serious issue. Villagers across the watershed help in reporting any incidents of logging quickly as they realise deforestation jeopardises the water flows into the irrigation scheme.

After nearly a decade the irrigation schemes begin to suffer from lack of maintenance threatening the improvement in yields and incomes, however, the village committees organise farmers into user associations with responsibility and 'ownership' of sections of the irrigation canals and small reservoirs. Some farmers pay for the maintenance in cash but most contribute labour between harvests to ensure that the irrigation systems are maintained.

The livestock keepers begin to diversify. Some farmers build fodder storage facilities harvesting grass in the wet season for use as food in the dry season. Others begin growing fodder bank crops to provide supplementary nutrition for their animals in the dry season. They use supplemental irrigation from the ponds and reservoirs to maintain these fodder crops. The improvements in livestock management reduce the labour requirement of livestock keeping. Some livestock keepers also invest in aquaculture growing fish in the ponds for local sale. The livestock keepers increased incomes allow them to invest in new cattle breeds to maximise the benefits of these management changes. These new breeds return greater yields from less head of livestock. Despite these improvements most farmers retain big herds due to their cultural values. However after ten years some farmers begin to see the benefits of greater secure income outweighing the status they enjoy from having large herds. Being rich in shillings starts to count for as much as being rich in cattle.

After ten years the watershed is transformed. Small holder farming is now a more viable activity across the watershed with better yields for rice and maize. Farmers are better trained in the best techniques and have invested in farm infrastructure to further improve their yields. Pastoral practices have also evolved into a new approach with fodder banks and low grazing techniques aligned with new cattle breeds and increasingly smaller herds improving farmers' incomes whilst also reducing their labour demands. Other sources of income are developing through fish production, vegetable growing and horticulture. Community cohesion has been increased with strengthened village councils who manage the irrigation schemes. Overall there is good job security, a reliable supply of grain, root crops and fruit and improved livestock products of meat and dairy. The tensions between the pastoralists and crop growers have diminished with changing practices. The new farm systems hold the promise of a sustainable use of natural resources helping the local district reach the national goal of being part of 'a national food store' - "Kilimo Kwanza".

3 SCENARIO 2 - PUMPS FOR AGRICULTURE AND DRAINAGE CHANNEL FOR LIVESTOCK

3.1 Starting point

- Driver of change: Intensify agriculture in mid-section of watershed and Drainage channel for livestock watering
- Primary change: Expand small scale production along river network using pumps; diesel pumps near the river network and lower technology (treadle) groundwater pumps in the drier rainfed areas; Development of a drainage canal from Mkindo river to the lowland livestock area used for improved livestock production (Kambala region)

The pictures in Figure 6 present an image of what the watershed might look like.



Figure 6: Changes that could happen in the area (f.l.t.r.) with farmers using diesel pumps; and a channel for livestock watering in the downstream area.

Similarly to scenario 1 this considers a solution for the water accessibility difficulties of the livestock keepers in the lower section of the watershed. It takes a more technological perspective to the solutions in agriculture and livestock keeping and will use the river water more intensively than in the first starting point.

In this starting point participants were asked to consider the impacts of the drainage channel for livestock to reach all throughout the lower part of the watershed and the effects of the diesel pumps along the rivers in the middle section, as shown in Figure 7.

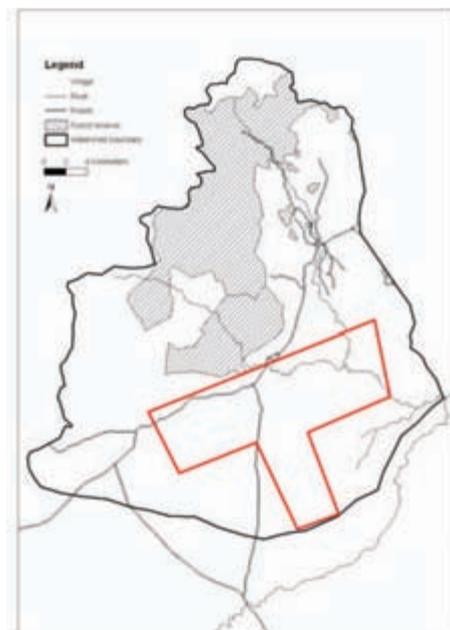


Figure 7: Map of the watershed where the participants were asked to consider the impacts of more use of diesel pumps as well as a drainage channel for livestock

3.2 Impacts on livelihoods

Those who will benefit from intensified agriculture in the middle section

| Livelihood strategy | Direct impact on livelihood strategy |
|--|---|
| Small-scale farmers with land in the irrigation expansion area (including women farmers) | <ul style="list-style-type: none"> • Initially improved livelihoods from yield increases of paddy rice and maize – leads to temporary drop in food prices for people in the watershed • The pumps would also prove very useful for vegetable growers – increasing production – tomatoes, eggplants. This could particularly benefit the women’s income • The use of pumps close to the river would allow improved yields for maize – which is currently rainfed improving incomes for farmers. • Maintenance and operation costs increase for those farmers who adopt the pumps • The technical difficulties and costs of maintaining pumps will mean that in the longer term a large percentage will fail and be abandoned • The benefits of the technology will therefore be dissipated over time as fewer of the pumps remain operational • Expansion of irrigation leads to the increase in the incidence of water borne diseases including malaria, bilharzia and typhoid. This reduces farmers ability to work reducing their income and livelihoods |
| Existing irrigation scheme farmers including those using traditional canals | <ul style="list-style-type: none"> • These farmers could benefit from the expansion of the irrigated land area as they acquire a greater area of irrigated fields by utilising pumps beyond the extent of the lined gravity canals and traditional canal irrigation schemes • An initial reduction in the availability of cheap labour with small-holder farmers using pumps – results in the current irrigated farmers having to return to actively working their fields themselves • This situation reverses over time as the pumps drop out of usage • The overall increase in production lowers market prices meaning that incomes for per hectare drop – this is offset for farmers who obtained more irrigated land within the expanded scheme • The prices rise again with the drop in production associated with the abandonment of pumps • Expansion of irrigation leads to the increase in the incidence of water borne diseases including malaria, bilharzia and typhoid. This reduces farmers ability to work reducing their income and livelihoods |
| Sugar cane out-growers | <ul style="list-style-type: none"> • No change in their livelihood strategies – with concentration on the production of sugar supplemented by maize production • Sugar-cane out-grower’s could benefit from improved maize yields through the use of pumps • Their higher income – from the production of sugar – may allow them to invest in the maintenance of the pumps making this change sustainable |

Those who will benefit from a drainage channel for livestock watering

| Livelihood strategy | Direct impact on livelihood strategy |
|--|--|
| Small-scale farmers with land in the irrigation expansion area (including women farmers) | Improved availability of water for animals reduces livestock migration This reduces crop losses and hence conflict between the crop producers and livestock keepers Price of meat reduces due to improved production benefiting nutrition and income losses are offset by the rise in production |
| Existing irrigation scheme farmers | Improved availability of water for animals reduces livestock migration This reduces crop losses and hence conflict between the crop producers and livestock keepers Price of meat reduces due to improved production benefiting nutrition |
| Sugar cane out-growers | Improved availability of water for animals reduces livestock migration This reduces crop losses and hence conflict between the crop producers and livestock keepers Price of meat reduces due to improved production benefiting nutrition |
| Fruit and root growers | Price of meat reduces due to improved production benefiting nutrition |
| Dedicated livestock keepers | Different to concentration of livestock Livestock keepers stop migrating cattle as the canal provides reliable quantities of water Less migration leads to reductions in the conflict between livestock keepers and crop growers The development of the canal leads to increased concentrations of livestock in this area – leading to overgrazing issues of the pasture along the canal The adoption of different grazing regimes reduces this negative impact Water would need to be of good quality and be available throughout the year. With the increase in pumping and pollution of water courses this may be a problematic – leading to conflict with the small holder farmers Improvement to water access for agriculture also improves domestic water access Increased influence in the district governance structures with improving incomes income improves |
| Other residents | Price of meat reduces due to improved production benefiting nutrition |

Those unaffected by intensified agriculture in the middle section

| Livelihood strategy | Direct impact on livelihood strategy |
|------------------------|---|
| Fruit and root growers | <ul style="list-style-type: none"> • Price for these crops drops locally whilst the pumps are in operation putting these communities under pressure • The producers (who are outside the area suitable for pumps) need to sell their produce further away at new markets. This increases their costs of production which needs to be passed onto consumers • The lower local prices of rice and maize resulting from increased local production mean this groups costs of living is also reduced – offsetting the potential reduction in their income • Over time the current situation is restored with local commodity prices rising as production drops with the abandonment of the pumps • The root growers market base has increased geographically making their livelihood more resilient to local price changes |

Those negatively affected by intensified agriculture in the middle section

| Livelihood strategy | Direct impact on livelihood strategy |
|-----------------------------|--|
| Dedicated livestock keepers | <ul style="list-style-type: none"> • Current grazing areas are utilised for permanent cultivation by small holder farmers reducing the area for grazing • Local food prices drop during the initial stages of the pump use reduces the cost of living – but also reduces the market prices for meat and dairy produce • This reverses when the use of small pump technology goes into decline • The excessive use of pumped water by small-holder farmers leads to increases in resource conflict with the livestock keepers demanding their share of the water resource. This conflict declines as the use of pumps diminishes |
| Other residents | <ul style="list-style-type: none"> • The use of pumps upstream in the watershed results in pollution of the drainage streams used by the livestock keepers. This pollution has negative consequences on human and animal welfare. This problem declines as the use of pumps diminishes • Local entrepreneurs develop businesses to service and maintain the pumps. This livelihood adaptation is successful whilst the number of farmers utilizing the pumps remains high – but may become unsustainable if farmers abandon the technology • Downstream communities have less water available due to increased extraction through pumping and poorer water quality through fuel spillage contamination • This change in the availability and quality of water leads to conflicts between the downstream communities and the small holder farmers utilising pumps |
| Petty traders | <ul style="list-style-type: none"> • The drop in crop prices reduces food traders profits • This is offset to an extent by a drop in the local cost of living via cheaper food prices |

Those negatively affected by a drainage channel for livestock watering

| Livelihood strategy | Direct impact on livelihood strategy |
|---------------------|---|
| Petty traders | The drop in meat prices reduces traders profits |

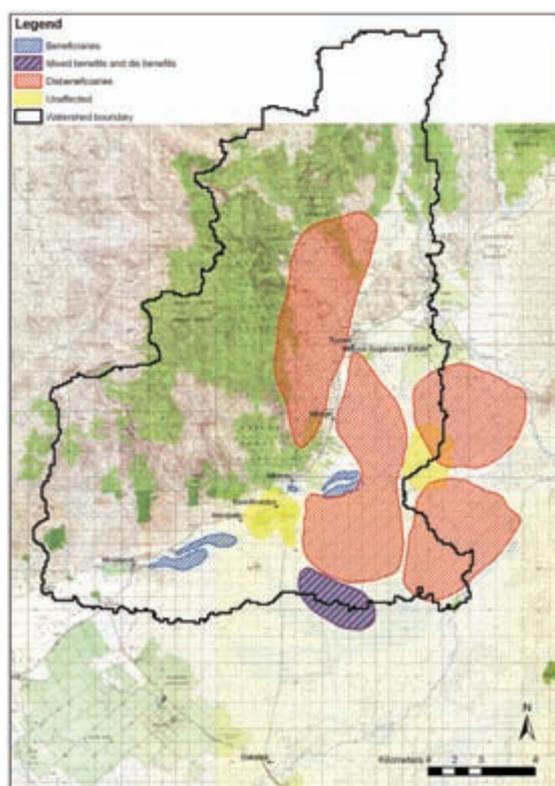


Figure 8: Map showing where in the watershed beneficiaries and dis-beneficiaries are when agriculture intensifies in the middle section and a drainage channel would be put in place for the livestock watering.

Quantitative analysis of change in areas in crops

Figure 8 shows the map of areas where benefits and dis-benefits would occur. The differences in area of benefits and dis-benefits can be quantitatively assessed. This table shows the differences in percentage of area.

Table 3: Quantitative analysis of change in areas in crops from baseline to scenario 2

| | Change in area |
|--|----------------|
| Overall Change in Crop Yields | 18% |
| • Vegetables | 465% |
| • Maize and Rice | 18% |
| • Root and fruits | 42% |
| • Sugar | -43% |
| Overall Change in Livestock Grazing | 6% |

3.3 Factors

Factors that can maximise benefits of intensifying agriculture in the middle section

- Improved governance of water resources by government agencies
 - Need to balance roles and responsibilities of government agencies and water users
- Agreements on water rights and water use need to be developed. This should occur before any irrigation scheme is implemented to ensure that the management plan is in place before water usage is increased
- The Wami basin authority is tasked with maintaining the quality and quantity of water throughout the basin. This requires knowledge of the amount of water available – understanding the water balance (Wami database). This would require more gauging stations to ensure sustainable use of supplies. The authorities would need to know the quantity of supply before water can be managed sustainably
- For the pump users this would involve a cost for usage of water. Farmers would be charged based on the area of land they were irrigating – assuming a certain amount of water required per acre but would need to be accompanied by assured supplies for users. Paying for water would result in farmers investing in more efficient use of water
- For example – increased use of drip irrigation technology
- 1.5l required for each paddy plant to create a good yield
- Improve the record keeping skills of farmers
 - Need to know costs of production changes from introducing pumps – and profit increases resulting from increased yields
 - Monitor and record - input costs, yields, crop value, cost of water (if there is a price associated e.g. pumping costs (diesel), pump maintenance costs, pipe costs etc.)
 - This improvement may prove to farmers the financial benefits of pump irrigation – meaning that they invest in making the system sustainable
 - Better records could also be useful for accessing business loans for farmers as they demonstrate the financial basis of making the loan
- Some farmers will be early adopters and innovators of the pump technology
 - Increased yields using pumps offset the costs of the pump maintenance
 - Other farmers will copy these developments if they are seen to be successful
- Establishment of user associations/groups to maintain the irrigation structures

Factors that can maximise benefits of a drainage channel

- Need to control the flow of water down the canal – to maintain supplies for entire year
 - If this is unsuccessful – livestock keepers will continue to move cattle to natural water points
 - This would result in continued or increasing conflict with small holder

Factors that can mitigate the dis-benefits of intensifying agriculture in the middle section

- Open up access to new markets for root and fruit producers
 - These farmers could receive higher prices for these crops further away from the watershed if their local price drops
 - This could be mitigated by selling these crops further away
 - This would be dependent on physical access to the markets
- Need to develop a participatory land use plan
 - Include carrying capacity of the grazing areas to identify sustainable numbers of livestock
 - Then limit the number of livestock in the area
- Create a sense of ownership over introduced technologies
 - Develop projects so that any donated technology is seen as being 'owned' by the farmer
 - E.g. not like shallow wells in other area – these were seen as project property not farmers property
 - This problem led to a lack of maintenance and eventual abandonment of the scheme
- Responsibility for water office to maintain water quality and water flow
 - To maintain user access to water
 - Needs improved monitoring of flows

Factors that can mitigate the dis-benefits of a drainage channel

- Canal for livestock keepers needs to be at the junction between the Mkindo and the Dalume rivers to be successful
 - Accessing water here from this relatively wide deep channel would minimise the problems for downstream users
 - Solar powered or wind powered pumps would be required to keep water flowing in the livestock keepers canal
- Number of livestock needs to decrease to make the scheme sustainable

Factors that can compromise the benefits of intensifying agriculture in the middle section

- Farmers would not invest beyond the project in the pumps – they do not undertake or understand cost-benefit analysis and would not invest in pumps even if they had resulted in greater yields
- Farmers would be resistant to the introduction of pumps – unless other infrastructure to maintain the pumps using local technology was also introduced
- Increased costs to farmers to maintain the pumps
- Environmental pollution
 - Diesel spillage
 - Increased agriculture inputs e.g. fertilisers
 - Pollute water courses
 - Leads to downstream pollution of water courses effecting livestock keepers and other users having worse quality water
 - Negative health impacts

- Increased conflict between upstream and downstream users
 - Due to increased water scarcity – through over exploitation of water by the crop growers
- Control of water conditions and flows leads to increases in the cost of water to farmers
 - This relies on management systems maintaining the quantity and quality of supplies
 - This is what the Wami river basin authority is tasked with achieving
- Technical difficulties in building the drainage canal for the livestock keepers
 - Drying up of channel for livestock
 - This could be overcome by pumping groundwater to supplement the supply
 - These solar powered groundwater pumps are expensive
- Not enough pasture is the limiting factor for expanding livestock
- Livestock become concentrated along the canal
 - This leads to negative impacts along the channel: soil erosion and over grazing

Factors that can compromise the benefits of a drainage channel

- Land use planning needs to be done by users
 - To ensure success the land use planning for the area needs to be participatory – and include all the various stakeholders

3.4 Scenarios

Scenario of the participants

- Conflicts Increase
 - Between farmers and livestock keepers
 - With communities upstream and downstream
- Polluted water courses
- Increased water use which may lead to the drying up of Mkindo and Diwale river
- Increased incidence of disease such as malaria, bilharzia and typhoid

Expanded scenario

In 2012 investment in two complementary agricultural water management schemes is made in the Mkindo watershed. This coincides with the completion of the tarring of the main road to Dakawa significantly opening up market access to the small-holder farmers in the watershed. After consultations with the existing village management groups across the watershed, the Wami river basin authority, district office personnel and Sokoine University researchers, a participatory land use and water management plan is developed. This designates areas for crop land development and those for livestock grazing. The water management plan also introduces charging for water extraction based on the area of land being irrigated by farmers. This charging is linked to an investor scheme introducing and promoting the use of diesel pumps and treadle pumps to small holder farmers to improve the extent and reliability of irrigation across the crop producing areas. The Wami basin authority is tasked with ensuring these payments are met by farmers – and also with maintaining water supplies for all other users across the watershed.

Initially the availability and promotion of new technologies by the investor leads to a rapid take up of the diesel pumps by some innovative small holder farmers. For some farmers the pumps are donated by a project to encourage the take up of the technology for others loans are arranged to finance the purchase. The diesel pumps prove the most popular technology due to their low labour demands. The early adopter small holder farmers begin to irrigate a much greater extent of the watershed from the drainage network that was previously reliant on rainfall. The irrigated fields are used for maize and paddy rice together with an expansion in the extent of vegetable cash crops. In the first year the increased irrigation through diesel pumps leads to a sharp rise in yields and allows at least two harvests for areas that previously only supported one for these early adopter farmers. This improves the income for those farmers with pumps significantly.

The improvement in yields achieved by the early adopter small holder farmers encourages other farmers to adopt the new technology increasing the extent and use of pumps still further. Local entrepreneurs recognise a gap in the market and begin to offer servicing, supply and maintenance of diesel pumps improving their livelihoods. The yields for Mkindo continue to increase as more farmers begin to utilise the pumps. The early adopters whose incomes have improved also begin to use more farm inputs, such as fertilisers and pesticides, to increase their yields still further.

The increasingly widespread use of pumping begins to cause negative environmental and socio-economic consequences. The farmers did not receive sufficient training in the use of the pumps leading to diesel spillages into the water courses. Also the increase in pesticide and fertiliser usage together with irrigation run-off adds to the pollution of the rivers and streams. This begins to affect the downstream communities' water quality causing health problems for these residents. These problems cause the build up of tension between the upstream and downstream users. The rapid changes in water usage in the Mkindo watershed initially overwhelms the Wami River Basin Authorities ability to keep up in terms of implementing the management agreements developed alongside the participatory land use plan.

A lined concrete gravity fed canal system is completed taking water from the upper reaches of the Mkindo watershed down to the livestock grazing area around Kambala. The canal allows the livestock keepers to maintain animals in this area all year reducing the need for migration to other water points. This reduces conflict between the livestock keepers and the small holder farmers over the use of land for grazing which had increased with the expansion of the irrigated fields. Overall the extent of land available for grazing has been reduced with the expansion of irrigated crop production.

The diesel pump usage continues to expand as the investor donates more pumps to crop farmers across the watershed. The increase in pumping leads to the over extraction of water resulting in shortages for downstream users. The Wami River Basin Authority income has risen through the improved collection of water payments. This income allows the authority to invest in improved monitoring of water flows and extraction rates. This information allows them to assess the flow reduction in the Mkindo and Diwale for downstream users caused by crop irrigation. The level of conflict between the upstream and downstream users of the water continues to escalate with increasing levels of pollution through diesel contamination, pesticide and fertiliser run-off together with increasingly compromised surface water flows.

The livestock keeper's canal has brought many benefits for the communities around Kambala whose farmers bring their cattle and goats for water. The livestock keeper's income has improved as the quality of meat has increased. The canal also improves the domestic supply of water bringing human health benefits across the villages. However, the concentration of livestock numbers along the canal leads to increased grazing pressure on the pasture resulting in soil erosion problems. The farmers begin to

investigate alternative grazing regimes including the development of fodder bank crops irrigated with water from the canal and zero fodder grazing regimes.

The investor withdraws from the Mkindo area leaving the small holders farmers to maintain and utilise the pumps. The yields and number of harvests in the irrigated crop land of maize and paddy rice have increased substantially. This rise in production decreases the market value of these crops but this is offset for the farmers by the rise in the volume of their crop. The drop in commodity prices benefits the residents across Mkindo who can purchase food more cheaply. However, farmers who have not increased their irrigation, including the root and fruit producers in the north of the watershed, see their incomes drop significantly as they are either not producing enough crop to offset the decline in rice and maize prices they receive or the demand for their produce of traditional staples falls dramatically. These non-irrigation farmers increasingly fall back on other livelihood strategies to ensure sufficient income including labouring for other farmers. The fruit producers also begin to sell their produce away from the Mkindo area where demand is higher. This increases their costs of production putting their livelihoods under pressure.

For some early pump technology adopters the improvements in incomes allow them invest in drip irrigation technology reducing their water usage. The early adopters and entrepreneurial farmers recognise that whilst the diesel pumps and increased use of agricultural crop inputs have raised the costs of production these are offset by the rise in income from improved yields. This is particularly the case for vegetable cash crop production mainly undertaken by women farmers who have begun to grow large amounts of tomato and egg plant for export outside the region. For other farmers (the majority) who do not maintain adequate records the additional costs appear to be a large burden which they do not see as justifiable. These farmers begin to abandon the pumps after the withdrawal of the investor.

Despite this abandonment by some farmers the increased in pumping continues to cause problems. The expansion of irrigation has led to a rise in waterborne diseases including malaria, bilharzia and typhoid affecting the health of residents across the watershed. The pollution and over extraction also continues to affect the downstream water users. In order to address the problems of the downstream users the Wami Basin Authority reduces the amount of water that small holder farmers can extract to ensure the supply of water to all users and increase the charges for water.

The initial pumps introduced by the investor begin to age requiring increased maintenance. The entrepreneurial farmers with accurate record keeping recognise that the improvements in yields and income justify maintaining the pumps. They also continue to invest in irrigation technology such as drip irrigation to reduce their water usage keeping costs down by ensuring efficient irrigation. For other farmers (the majority) these benefits are not so obvious. They see the additional costs of production through the use of fertiliser and diesel as being an unnecessary burden. Some abandon the pumps when they fail as they perceive their repair as being the responsibility of the departed investor. Others are unwilling to pay for the maintenance costs. With increasing pump failure rates and return to conventional traditional supplementary irrigation farming methods the over extraction of water declines.

For the livestock keepers, changes in management regimes reduce the overgrazing and erosion issues along the canal. However, new problems emerge for these farmers. Firstly, the quantity of water in the canal is unreliable in the dry season requiring stock to be moved away to existing water points – reducing the benefits it introduced. Secondly, the quality of water in the canal continues to be affected by upstream pollution through diesel spillages leading to tension between the communities. Thirdly, the canal has begun to crack in places requiring maintenance. The communities using the canal set up a water users association to help address these problems. They levy a fee on the users of the canal to raise income to repair the cracks. They also lobby the Wami Basin Authority over the pollution issues

and water flow problems. The association and Basin Authority install a solar powered pumping system at the source of the canal to supplement the gravity flow in the dry season ensuring sufficient water flows all year. The Basin Authority begins to monitor the water quality in the canal.

The number of pumps in operation is restricted to a relatively small number of early adopter and entrepreneur farmers (including women) who concentrate on growing high value crops having invested in sustainable use of drip irrigation technology, pesticides and fertiliser. Their incomes are substantially higher than before the pumps were introduced. A small number of traders have also benefitted from providing pumps for sale and maintaining the existing pumps.

The majority of pumps are abandoned when they require maintenance and the small farmers revert back to traditional supplementary irrigation along the river channels and rainfed production inland. The reduction in water demand resolves the conflict over water quantity with downstream communities and the remaining pump users manage their resources more effectively making the system sustainable with less pollution. The price for commodities locally reverts to those before the introduction of pumps increasing residents' costs of living. However, for those beyond the irrigated area including the root and fruit growers this return to pre-intervention prices boosts their livelihoods from agriculture. The livestock keepers have developed a sustainable grazing system and management association for the canal. Their livelihoods have improved significantly and with a rise in income their influence and status in the watershed decision making structures has been enhanced.

Overall the outcomes of the interventions are very mixed. The use of diesel pumps whilst initially popular was not properly adopted by many farmers and poor water and farm input management led to pollution and supply problems for downstream users. The increase in irrigation also led to problems with disease for most farmers and residents. However, for the relatively small number of farmers that manage the technology well there are significant improvements in yields and incomes. These include women who concentrate on cash crop vegetable production. For the majority of farmers the diesel pumps are not perceived as 'belonging to them' or sustainable with the increased associated costs. Despite improved yields and incomes a large number of farmers abandon the 'investors' pumps and return to traditional rainfed approaches. For the livestock keepers the canal is largely successful once the initial construction and maintenance problems are overcome. The sustainable use of the canal does, however, require a large change in livestock management systems. Monitoring and maintaining both systems has required a large increase in the workload of the Wami Basin Authority to determine sustainable water use levels effectively, assess pollution, collect water use payments from irrigation farmers and implement water management agreements to ensure the supply of water downstream.

4 SCENARIO 3 - LARGE EXTENSION OF IRRIGATION SCHEME INTO DRYLAND AREA

4.1 Starting point

- Driver of change: Large extension of irrigation scheme into dryland area
- Primary change: Development of extensive diversion of surface (river) water to lowland area; large expansion in crop production area (Dakawa, Kambala region); Concentrated on higher value cash crops.



Figure 9: Three possible impacts of scenario 3: (f.l.t.r.) Expansion of agricultural production in the lowland area; large irrigation scheme; Large scale production of the same crop

In the watershed the lowland area is suitable for agricultural production if the water availability is improved. A large enterprise could come into the area and take up the land to produce a cash crop. In other areas in Tanzania this has happened. Figure 9 presents some pictures of what the impacts could be like of such a change to the watershed.

In this starting point participants were asked to consider the impact of a large scale extension of the irrigation scheme into dryland areas, as shown in Figure 10.

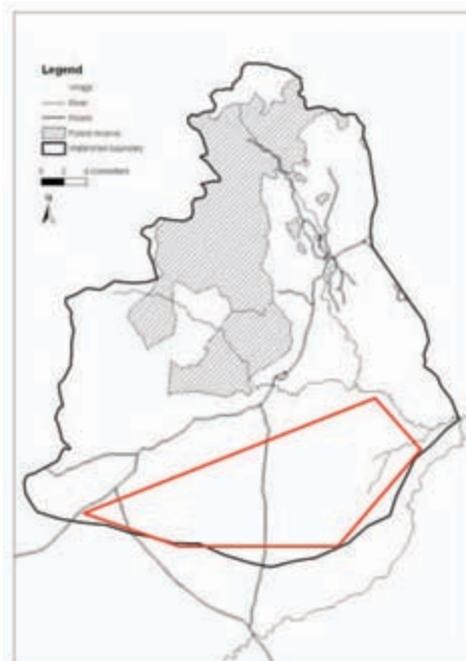


Figure 10: Map of the watershed where the participants were asked to consider the impacts of starting point 3, the lowland area of the watershed.

The participants identified two possible pathways for elite farmers who are private investors (including civil servants) from outside the watershed or large scale producers from outside the watershed to get access to land. They would have to either:

1: buy up land from small scale farmers

2: lease land from small holder farmers.

Small scale farmers in the Mkindo area not ready (financially or psychologically) to make the leap to be producers of cash crops. Instead they will mainly become labourers for elite farmers leaving behind their cultural history of being farmers which is a loss of identity. In this context it also matters that with land you are someone, without land you lose that status.

4.2 Impacts on livelihoods

4.2.1 Those who will benefit from expanding irrigation in the lowland area

| Stakeholder group | Direct impact on livelihoods |
|---|---|
| Small-scale farmers who sell or lease land to the elite farmers | <ul style="list-style-type: none"> • They raise money through the sale of land – allowing them to invest in new land elsewhere • Small holders make money from the land they lease • Make commission from hiring labourers • Small holders also work as labourers on the leased land • They are assured of constant cash income for labour to cash crop farms |
| Remaining small scale farmers | <ul style="list-style-type: none"> • Remaining small scale farmers – producing rice and maize (north of watershed) • With production of local staple crops reduced demand for and the price of remaining maize and rice increases • Increased incomes for these farmers |
| Fruit and root growers | <ul style="list-style-type: none"> • Less maize and rice produced with switch to cash crops resulting in increased demand for 'traditional staples' such as cassava, yams, banana etc. • This increase in demand would improve the income from these crops |
| Dedicated livestock keepers | <ul style="list-style-type: none"> • May benefit if crop production expands into their area through selling land • Lease/sell land to the elite farmers for crop production • This would entail livestock keepers changing the livelihood or migrating to a new area for grazing • Restrictions in the land for grazing could also lead to more conflicts between the cash crop farms and livestock keepers over trespassing issues • May benefit from infrastructure improvements in terms of roads and electricity supply. This would allow them to diversify into higher value dairy products such as milk production that require more mechanisation |

4.2.2 Those unaffected by expanding irrigation in the lowland area

| Stakeholder group | Direct impact on livelihoods |
|------------------------------------|--|
| Existing irrigation scheme farmers | <ul style="list-style-type: none"> The existing irrigation scheme area may be subsumed within the expanded cash crop production farms Alternatively, these producers may carry on as they do now producing irrigated paddy rice |
| Sugar cane out-growers | <ul style="list-style-type: none"> Remain producing sugar cane – which is already a high value cash crop |
| Other residents | <ul style="list-style-type: none"> Negative impacts of rising local food prices due to declining local production Large change in area (>80% of population effected) – therefore the scenario effects everyone Some would generate an income from working on irrigated cash crop farms seasonally Moving back to their own farms/land during rainy season |

4.2.3 Those negatively affected by expanding irrigation in the lowland area

| Stakeholder group | Direct impact on livelihoods |
|------------------------------|---|
| Farmers who become labourers | <ul style="list-style-type: none"> Lose identity and status through the loss of land. |
| Dedicated livestock keepers | <ul style="list-style-type: none"> Restrictions in the land for grazing could also lead to more conflicts between the cash crop farms and livestock keepers over trespassing issues |
| Other residents | <ul style="list-style-type: none"> Most residents not working/connected to farm – including those beyond the watershed would have negative impacts from local commodity price increases The environmental impacts from cash crop production may be large with pollution from inputs, excessive water use leading to a shortage of supply for other residents of the watershed |
| Beyond the watershed | <ul style="list-style-type: none"> The concentration on cash crops means that food production for local consumption is no longer a priority. This will put pressure to increase local food production elsewhere in the watershed or district. This will increase the pressure on the remaining cropland and other ecosystem services. |

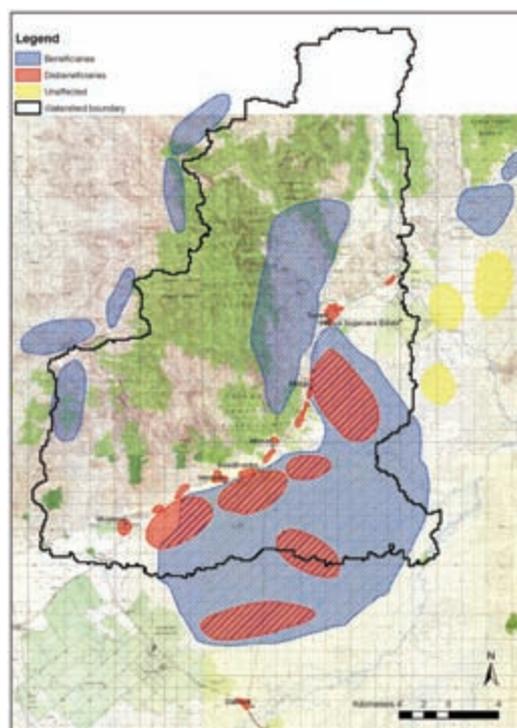


Figure 11: Map showing where in the watershed beneficiaries and dis-beneficiaries are when expanding irrigation in the lowland area would happen.

Quantitative analysis of change in areas in crops

Figure 11 shows the map of areas where benefits and dis-benefits would occur. The differences in area of benefits and dis-benefits can be quantitatively assessed. This table shows the differences in percentage of area.

Table 4: Quantitative analysis of change in areas in crops from baseline to scenario 3

| | Change in area |
|--|----------------|
| Overall Change in Crop Yields | 164% |
| • Vegetables | -1% |
| • Maize and Rice | -50% |
| • Root and fruits | -15% |
| • Sugar | -3% |
| • Cash crops | 100% |
| Overall Change in Livestock Grazing | -33% |

4.3 Factors

Factors that can maximise benefits

- Environmental impact assessment undertaken
 - This would identify potential risks of the cash crop scheme
 - Management plans could mitigate the potential environmental impacts
- Investors take into account corporate social responsibility – leading to spreading benefits to other groups such as the livestock keepers who would otherwise be negatively effected
- Improved infrastructure
 - Elite farmers will want to make sure that crops are exported easily and quickly outside the area
 - Better roads will open possibilities for other producers in the watershed to also export their produce more easily e.g. the livestock keepers dairy produce
 - Could lead to Kambala being connected with the energy grid – opportunity for better production of dairy products e.g. milk
- Availability of energy and infrastructure could lead to the development of more processing facilities in the watershed
 - This allows value added products to be exported rather than raw crops, e.g. If rice processing facilities increase – farmers export milled rice – not raw paddy rice, and farmers could get better prices for their crops
- Coordinating management structures
 - Environment/planning/training/marketing etc.
 - These need to be in place to ensure that the investment in cash crops does not have excessive negative consequences
 - This could also improve the marketing of crops for small farmers – leading to better prices etc.
- Improved support for extension officers
 - Better transport and facilities
 - Maximise the benefits of the change to cash crops
- Minimise the use of mechanised farming
- Maximise the use of labourers to ensure that the majority of people get some benefit through employment as labourers

Factors mitigating dis-benefits

- Existing farmers sell land to elite farmers
 - cash sales
 - possibility to migrate – farm elsewhere
- Opportunity to work for elite farmers
- Root growers incomes improved
- Pasture irrigation scheme

- Construction of industrial processing for livestock – benefit livestock keepers
- Minimise the use of mechanisation – use labour force

Factors compromising benefits

- Existing small scale farmers become labourers
 - Loss of freedom if not farming own land
- May be large environmental impacts
 - Pollution (from inputs)
 - Excessive water use
- Increased conflict between livestock keepers and large scale farms
- Effects on large number of people
- Effects two main farming groups
 - With expansion of cash crops – less ‘room’ for all existing residents – so existing farmers move away
 - Unlikely to move to North West of watershed - as considered too remote
 - More likely to move beyond the watershed – to buy land in new areas
- Shift in crop
 - In other areas elite farmers have switched production from food crops to biofuels production
- Cost of living increases for all people
 - Commodity prices increase
 - Effects farmers and all residents buying local food
- Local farmers resilience not high
- Liquidity in the local economy may dry up – without local farming activities

4.4 Scenarios

Scenario of the participants

- Fundamental shift in communities way of life from subsistence food crop production to cash crops
- Area becomes net importer of food
- Negative environmental impacts due to changing river courses
- An increase in poverty gap from land owners to labourers

Expanded scenario

In 2012 large scale investors target the Mkindo watershed as ripe for development to meet the national policy of ‘a national food store’ - “Kilimo Kwanza”. They buy up land from existing small scale farmers around Mkindo and from livestock keepers around Kambala. They begin planning major infrastructure changes including diverting the drainage system to irrigate the dryland areas around

Kambala for crop production. The Wami River Basin Authority requires all the schemes to undertake strategic environmental assessments (SEA) to ensure that they are sustainable.

The schemes get the go-ahead and the construction begins of a number of canals to divert water into the existing rainfed crop production and livestock grazing areas. They continue to buy up land but increasingly also lease fields on a long term basis from the small holder farmers. The construction of the canals leads to large infrastructure improvements across the watershed with better roads and electricity supplies for a number of communities especially in the livestock keeping areas around Kambala.

The irrigation and infrastructure schemes are completed and begin irrigating large areas for the production of cash crops. The farmers who sold their land have largely used the money to move out of the watershed and farm elsewhere. Those who remain or have leased their land begin working as labourers on the cash-crop farms. The reduction in rice and maize production increases the costs of living for all residents as commodity prices rise. Food demand exceeds supply meaning that food has to be imported into the Mkindo area for local consumption. This increase in food prices improves the income for farmers beyond the extent of the cash crop scheme and those producing traditional root and fruit crops. Other food stocks such as wild fruits are depleted as residents increase their use of these resources.

The livestock keepers suffer from a reduction in the extent of grazing land due to the expansion of irrigated agriculture. They come into conflict with the elite farmers but are forced off the cash-crop farms. A number of livestock keepers move out of the watershed due to the significant reduction in the availability in grazing and restrictions on accessing traditional water points. In order to placate this problem the elite farmers agree to invest in improved infrastructure for the remaining livestock keepers. They allow some water from the irrigation schemes to be used to water livestock and supply electricity to the villages around Kambala. They also give loans to the livestock keepers at preferential rates to allow them to develop a processing plant to produce refrigerated milk which improves their incomes.

The small-scale farmers who retained land in the original irrigation scheme around Mkindo benefit from improvements in the crop processing plants associated with the cash-crop farms. These facilities allow the farmers to produce milled rice rather than raw paddy rice improving their incomes considerably. All the remaining small scale farmers also benefit from improved marketing opportunities and infrastructure associated with the cash-crop farms. However, the numbers of small holder farming residents is now relatively low.

The use of water for irrigating cash crops reduces the supply of water for downstream communities affecting human health and welfare. However, as a large number of people in these communities now work for the elite farmers they do not feel able to complain. These problems lead to more people leaving the area.

With the depopulation resulting from livestock keepers and many small farmers migrating away other small businesses suffer. A number shut as demand diminishes resulting in more people leaving the watershed.

The watershed is a net exporter of high value cash crops. The existing sugar cane has been supplemented by the cash-crops produced on the irrigated farms controlled by the elite farmers. A large number of the former small holder farmers who had land in the new irrigated area and many other small business people have emigrated away after selling their land to the elite farmers. Similarly

a number of livestock keepers have left due to significant reductions the extent of grazing. The majority remaining residents earn a living from leasing land to the elite investors and working as labourers producing cash crops. Their social standing has diminished, as they no longer own land, even though they now earn a higher regular income. The only local beneficiaries are the remaining small scale farmers and the small number of livestock keepers who now produce high value dairy produce.

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