

**COMMUNITY PERCEPTION ON RESOURCE DEGRADATION: THE  
CASE OF TREES AND WATER SOURCES IN BAGA WATERSHED  
LUSHOTO DISTRICT.**



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Cover Photo: Well-protected water source. Courtesy of Hussein Mansoor.

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## **Background to the Problem**

Degradation of natural resources in the highlands of Usambara has been extensively covered. A report by Pfeifer (1990) informs us that past farmers in the Usambara's were actually practicing effective soil conservation and soil fertility preserving methods like multi-storey agroforestry, mixed cropping and green manuring. Yet according to Johansson (2001) this system and knowledge began crumbling when German colonialism and cash economy set in these highlands which are home to the Wasambaa. It is the German settlers, who, lured by belief that the soils on these highlands were extremely fertile opened up huge plantations of cash crops, started exporting timber, hired local labour and in so doing also introduced the Wasambaa to the cash related agricultural activities. In doing so, the natural resources on these highlands began degrading.

Among the earliest efforts in addressing resource degradation on the Usambaras was through the introduction of the Mlalo Basin Rehabilitation scheme in 1930, during British rule (Johnson (2001)). The scheme emphasised on soil conservation and intensification of agriculture. The local chiefs were directed to implement it through strict by-laws. This scheme actually failed because of what the local people perceived as veiled attempts of resettling them on the lowlands and stealing their cattle through compulsory destocking programmes. Johansson (2001) reports other smaller schemes. These include the Usambara Scheme during the 1960s and a host of similar efforts some of which were locally motivated. One of the largest attempts in this area was a German project called SECAP (Soil Erosion Control and Afforestation Project). SECAP tried to conserve the Usambara highlands almost 30 years after the Usambara Scheme. As Johansson (2001) argues, though SECAP is reported as being successful, the major part of the Usambara is without conservation structures and degradation of natural resources goes on unabated. It can be said that to date Lushoto has had many such projects including LIDEP (1972 – 1979) TIRDEP(1972 -1979), LDP (1979 – 1984) etc. with similar focus, but achievements have been minimal. All these efforts had one thing in common; they relied heavily on by laws and were not participatory in their implementation. Among the recent attempts in this regard is the introduction of the African Highlands Initiative (AHI). In 1998 the AHI introduced soil conservation project in Lushoto in a village called Kwalei (Lyamchai *et al.* 1998). Here the approach was participatory. The AHI has been involving farmers to see the advantage of conserving through a combined, individual and collective approach to resource conservation. Despite its short period, Mowo *et al* (2003) report some remarkable successes. In Kwalei village the adopting farmers now serve as trainers of trainers. This is an improvement from past approaches. By 2002 this initiative was being considered for scaling out into another 5 villages. These villages; Mbelei, Kwekitui, Kwehangala, Dule, Kwadoe and Kwalei form the Baga watershed. These villages have a common drainage. Kwalei the pilot AHI village is the reference point and a learning center for the introduced technologies. During one of the field excursions to these villages attention was brought to us on the high level of degradation of trees, water sources and soils. In almost all the six, water scarcity and degradation of the water sources were reported as being their number one problem.

In view of the above this study was initiated in order to collect adequate information which would provide guidance into the necessary course of action for mitigating resource degradation so as to contribute towards livelihood improvement in these five villages. This study therefore had the following specific objectives:

1. Assess communities perception on effect of selected tree species on water sources

2. Investigate communities' practices which contribute to current resource conditions and how they are currently addressed
3. Develop with communities a possible course of action which will mitigate degradation of such resources

## MATERIALS AND METHODS

### *The Baga watershed*

Meliyo *et al* (2004) locates the Baga watershed between Latitude 435114.25E, 9459812.53N (South); 437824.23E, and 9470004.90N (North) south of the Equator, and between longitude 441477.08E, 9467825.03N (East) and 430813.39E, 9465939.74N (West) East of Great Meridian. The water shed is largely in Mamba ward, Soni division, in Lushoto district. Most of the watershed is within an area Pfeifer (1990) "humid-warm" agro-ecological zone ranging with altitude from 800 to 1500 m a.s.l. This zone receives an annual rainfall that ranges between 800 and 1700 mm. The major cash crops grown in the zone include coffee, tea and vegetables while for food crops maize, banana, potatoes, cassava and beans predominate. Earlier work by Meliyo et al (2000) in Kwalei village had indicated that most of the soils in the area are highly weathered, humic and ferralitic. Most soils classified into *Acrisols*, *Lixisols*, and rarely *Luvisols*, on the upper slopes while *Gleysols* and *Fluvisols* were mostly observed in the valleys. The six villages making up the Baga Watershed have a total area of 6006 ha; Kwalei (1098 ha), Mbelei (838 ha), Kwedoe (1217 ha) and Kwekitui (877 ha) Kwehangala (2277 ha) and Dule (301 ha). Meliyo et al (2004) reports the total population in the Baga Watershed at 13183 (6763 males and 7375 females). Individually the picture across each village is as indicated in Table 1.

**Table 1: Population in the study villages in the Baga watershed**

<b>Village</b>	<b>Male</b>	<b>Female</b>
Kwekitui	1414	1178
Mbelei	1111	1214
Kwadoe	1117	1377
Kwalei	1293	1434
Kwehangala	1169	1434
Dule	659	738
<b>Total</b>	<b>6763</b>	<b>7375</b>

Source: Meliyo et al (2004)

### **(B) Methodology**

The intention of the team was to meet resourceful farmers who are knowledgeable in matters of interest to the team and who could represent the various interest groups across the villages. We therefore conducted this study through the following steps;

1. The team prepared a Kiswahili based questionnaire (Appendix 1) from a checklist of issues for which data was considered necessary. A field officer pre-tested the questionnaire with a sample of six farmers (one in each village) and fed back the team on the necessary adjustments
2. The Team consulted literature from earlier work on Watershed communities' engage by the AHI in the same villages and selected names of farmers who had participated in water related committees. Twelve farmers were selected from each village (Appendix 2). The team then sent messages to the respective village leaderships

requesting appropriate meeting times. Names of the pre-selected farmers were passed on to the leadership so that the selected farmers could be informed of the impending meeting before hand. In the event the farmers were not around, the leaders were given a free hand to fill in those farmers they trusted could discuss the issues in question.

3. The team met two days before the meetings with farmers for briefing in the AHI office. These briefings were for the division of roles in the forthcoming meetings with farmers. During these sessions the team consulted literature from each village which was collected from previous surveys and studies.
4. The team met farmers in pre-arranged places and times. During meetings the team was introduced to farmers and role of each team member was described. Farmers also introduced themselves detailing where they come from in their villages.



Plate 1. Open session meeting with farmers

5. The team leader facilitated the discussion keeping close to the checklist of issues to be discussed and already prepared during briefings. The discussions were recorded on a flip chart. Farmers had dialogue on matters which they disagreed at first until when consensus was reached.
6. After 2 hours of discussions the team introduced short breaks in which refreshments and bites were provided. After these discussions the team and farmers left for the field to visit water sources, and crop fields. While in the field the team discussed the real situation as observed and potential solutions.



Plate 2. Inspecting fields and water sources after meetings

7. The team on its own deliberated on the next steps and proper course of action.

## RESULTS AND DISCUSSIONS

### (a) *Communities perception on harmful trees*

Across the six villages there is a uniform concern by farmers on the harmful role of certain tree species to water sources and even soil fertility. Most farmers seemed to classify such trees into three categories. All villages ranked highest the exotic trees introduced as being hostile to the water resources. Eucalyptus trees were ranked first across the six villages as the worst offender of water resources while a local tree Mshai “wawa” was categorised as the worst offender of soil fertility. In Mbelei village for example, Mshai wawa “albizia” was reported to have infested the entire village while the Eucalyptus spp. A mostly found in Kiguha hill (Nywelo), Sakharani Mission, Kishewa, Handei and Mtindili hamlets in that order. The second group of “bad” trees was that of Cypress (*Cupressus lusitanica*) *Casuriana*, spp (Mvinge) and *Aerocarpus fraxinifolius* which were blamed for suppressing crops and their leaves do not decompose easily. In Mbelei (Table 2) these trees are mostly concentrated in Sakharani Mission and Mbelei roadside. Farmers whose fields’ border these trees are affected. The last group was composed of Muwati – the wattle tree (*Acacia mearnsii*), *Croton megalocarpus* and *Senna spectabilis* which farmers reported to have a smaller effect compared to other two groups. In Kwekitui and Mbelei villages for example the local people report that historically the exotic trees, especially the eucalyptus were planted by Mr. Sakharani in the 1930s who was the owner of the current facility at Sakharani Mission. More trees were added during the 1960s. When Lushoto district introduced the German sponsored project SECAP, still more eucalyptus were planted both along the roads and in some private fields. Today, most of the eucalyptus or exotic trees being planted are through individual farmer’s initiatives. Most of the trees are planted for the purposes of firewood, building poles, and timber, most farmers’ lack of knowledge on the side effects of the trees.

Table 2. Occurrence, distribution and community perception of harmful trees their ranked effect on water sources in Mbelei village

Local names	Botanical names	Where found	History	Rank
Mshai Wawa	Albizia schemperiana	Mbelei	Indigenous	2
Mkaratusi	Eucalyptus spp	Kiguha, Kishawa, Mtindili Mbelei, Handei	Exotic	1
Muwati	Acacia mearnsii	Nywelo, Kishewa, Mamba	Exotic	5
Acrocarpus	Acrocarpus fraxinifolius	Sakharani	Exotic	7
Cypress	Curpessus lusitanical	Sakharani	Exotic	9
Croton	e. megaloc	Mbelei	Exotic	4
Mvinje - Casuarina spp		Sakharani	Exotic	8
<i>Senna spectabilis</i>	mjohoro	Mbelei	Exotic	3

Source: Mbelei Farmers (2004)

NB: 1 = most negative effect  
10 = least negative effect

This trend in perception of the harmful trees was observed to be the same across the six villages. Mshai wawa (*Albizia spp*) was the only local tree, which the locals mentioned as having negative effects on soils, undergrowth and water sources. In fact this observation correlates with what Wickama and Shangali (2000) had earlier reported while studying tree parasitic plants in the village of Kwalei. Across the villages, Eucalyptus trees (Plate 1) are reported as being the most destructive on water sources. In Kwadoe village, farmers complained that since the eucalyptus have been planted on the high grounds, there has been a gradual decrease of water discharge in the water sources located in the valley bottoms. Similar concerns were recorded in Kwehangala, Kwalei and Dule. But probably the most hit are the villages of Mbelei and Kwekitui. In these villages farmers complain that fields bordering the eucalyptus tree lines owned by the Sakharani mission get very little crops compared to those around the villages elsewhere.



Plate 3. Eucalyptus woodlots are often blamed for drying of water sources in the Baga watershed

Similar effect was reported of fields bordering private eucalyptus wood lots in Kwekitui and Kwehangala. The contradiction around eucalyptus is two folds. First, nearly 40% of the women interviewed across the six villages actually preferred it against other trees in view of its ease in fire wood provision. Secondly 30% of the men interviewed while pointing out to its disastrous effects to the water sources still would prefer planting it in their fields because of its ease in the provision of building poles for both domestic and commercial use. However, 20% of the men interviewed were skeptical about its alleged destructive role. This group argues of knowing water sources still in use, which have eucalyptuses around them. In fact in Kwalei village one farmer (Mr. Thomas Nyundo) who has a two-acre wood lot of eucalyptus

is both selling poles and extracting eucalyptus oil, which he sells to traders who deliver it to pharmaceutical companies in Dar-es-Salaam. This farmer reports an income of around Tshs. 400,000 (USD 400) per year from eucalyptus for sale of the mentioned items.

**(ii) Beneficial trees**

For beneficial purpose some 20 trees were mentioned (Table 3). We observed a very similar perception to these trees across the six villages. This could be attributed to the relatively homogenous ethnicity across the six villages such that over the years all the communities have more or less same level of experience on the trees studied/mentioned. We have therefore pulled the ranking across them. Highest ranking (9-10) were Mkuyu (Plate 4), Mvumo, Muombeombe, Mshai, Mweeti, Mzumbasha and Mmandai. These were described as being beneficial to soil fertility and water sources conservation. They are scattered throughout the six villages. The second group (rank 7-8) was that of Ng'weng'we, Muuwi, Muungu, Mnula, Mwefu, Mshwi, Mluati and Mhafa. The majority of these trees are beneficial for either timber, medicinal or firewood. Only a few had soil fertility benefits.



Plate 4. Ficus- Vallis chaudae (Mkuyu) is the most preferred tree for water sources in Baga

The third group (rank below 7) represents those trees, which have occasional importance to water sources, soils, or commercial importance like in the making of charcoal and specialised medicinal characteristics. In this third group there was a variation among farmers as to the ranking which such trees deserve. It will be noted that in this group there are hardly any exotic trees. Generally exotic trees were not mentioned as being useful for water sources or improving soil fertility. This underscores the fact that most of the studied farmers have a knowledge gap as what exotic trees could have similar properties. The AHI can address this gap in the coming phase of activities through the innovative partnerships that it has built in Lushoto and elsewhere.



Plate 5. Women though acknowledge its negative effect on water sources, still prefer eucalyptus trees because of ease of firewood

Table 3. Selected trees in Baga Watershed and farmers' perception on their usefulness for soils and water resources

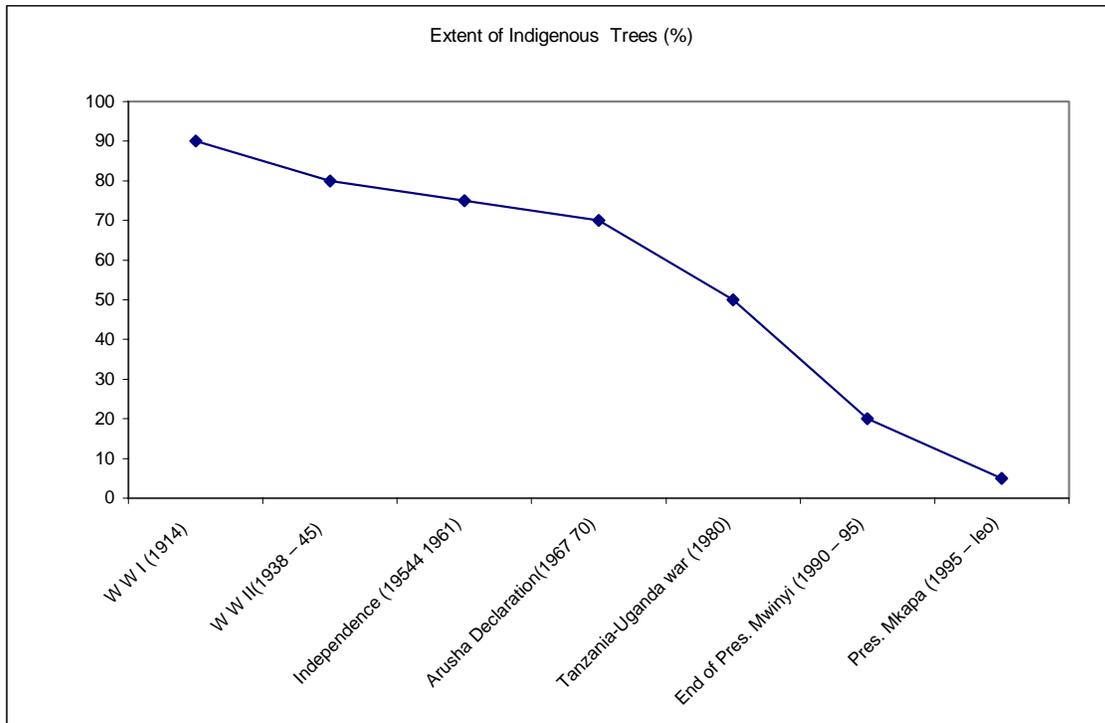
Local name	Botanical names	Where found	Benefits	Rank
Mkuyu	<i>Ficus- Vallis chaudae</i>	All villages	Soil fertility, Water friendly, firewood, medicinal for bad teeth	10
Mvumo	<i>Ficus thonningui</i>	All Villages	Soil fertility, Water friendly, Heart problems, Milk production for cows	9
Mshihwi	<i>Syzygium s. guineense</i>	All Villages	firewood, timber	5
Muombeombe	<i>Hallea rubrastepulata</i>	Valley bottoms and water sources	Water and medicinal (teeth)	9.5
Mshai	<i>Albizia gummifera</i>	All Villages	Soil fertility, firewood, timber, medicinal (teeth)	10
Mtiindi	<i>Cusonia holstii</i>	All Villages	Soil fertility,	8
Miungu	<i>Enythrina abyssinica</i>	All Villages	Soil fertility, medicinal (stomach ache)	6
Mmongko	<i>Barsama abyasina</i>	Forest	Soil fertility, firewood	8
Muula	<i>Parinari excelsa</i>	Mbelei - Kwadoe	Timber, medicinal, edible fruits	6
Mweeti (Msesewe)	<i>Rauwolfia caffra</i>	All Villages	De-worming cattle and people	9
Ng'weng'we	<i>Dracaena usambarausis</i>	All Villages & around water sources	Ropes, forages, water friendly	7
Mweefu /mlifu	<i>Warburgia salutaris</i>	All Villages	Soil fertility improvement, tooth problems	5
Mkulo (camphor)	<i>Ocotea usambareusis</i>	Forest	Timber, Firewood	8
Mhafa	<i>Milletia dura</i>	All Villages	Timber, Firewood	5
Mringaringa/Mfu fu	<i>Cordia abyssinica</i>	Forest	Soil fertility, firewood	8
Mluwati	<i>Dombeya shupangae</i>	Tongoi	Firewood, Anti skin rashes, indicator of onset of cultivating season	5
Mshegeshe	<i>Myrica salicifolia</i>	Forest	Treats coughs	8
Muuwi	<i>Synadenium glaucescens</i>	All Villages	Medicinal, toxic, treating, water friendly, poultry diseases	7
Mzumbasha	<i>Ocimum suave</i>	All Villages	Soil fertility, firewood, medicinal for malaria, masala for tea, treats coughs	10
Mmandai	<i>Agauriasalcifolia</i>	All villages	Charcoal making, Firewood, medicinal for sprains, toxic if eaten	10

1 Least beneficial

10 Most beneficial

### (iii) Perception on resource degradation

All farmers reported that there has been massive reduction of the indigenous trees across the six villages. They attribute the reduction to four major factors (a) indiscriminate felling of trees for expansion of agricultural land (b) population increase which adds pressure on the demand for land (c) increase in area allocated for human dwellings which has necessitated clearing of more land from the initial forests for that purpose (d) haphazard burning of fires in the forests. During the discussions with the groups we came up with this trend which shows a gradual decline in the forest cover with time.



Source: Field data (2004)

Figure 1. Trend in the decrease of indigenous trees in Baga Watershed in various periods

It will be noted that though there has generally been a steady decline in the presence of indigenous trees in the villages, the period “Arusha declaration” onward has a steeper decline. This could partly be attributed to the implementation of socialist policies in the form of villagization schemes. In these schemes, people were moved and resettled in newer areas where they established “Ujamaa (socialist) villages. To settle in these places required space for agricultural land and materials with which to build the villages. Many farmers attribute this period to significant clearing of natural forests after the initial clearance, which was done shortly after independence.

### (iv) Perception on water availability and water sources’ condition

Detailed work has been done by Meliyo *et al* (2004) on the delineation of several water resources in the Baga watershed. It is correct to say that the Watershed is blessed with a big number of water sources. However owing to the abuse of the natural resources, including the water sources, a significant number have dried or become seasonal. During this study, the

majority of farmers ranked inadequate availability of water as their problem number one. Farmers attribute the inadequacy of water to four major factors; *reduced amount of water from current sources, increased water demand, excessive wastage of water from poor water use practices and poor distribution of irrigation*. These factors are in-turn caused by several underlying causes (Fig. 1). Historically, farmers report that inadequacy of water in the watershed was unnoticed before the 1960s. The elderly farmers in Mbelei and Dule villages reported that prior to the 1960s water was in ample supply and “you could not then see the river bottom due to thick forests at the time” Changes became noticeable after huge tracts of forested land was cleared and allocated to the local people for cultivation in the mid 1960s. Presently, the watershed is observing decreased numbers and discharges of springs. Consequently a number of streams and rivers have become seasonal though were once permanent. Irrigated agriculture has now fallen and people degrade the fragile water sources though there are by laws which bar them from such practice.

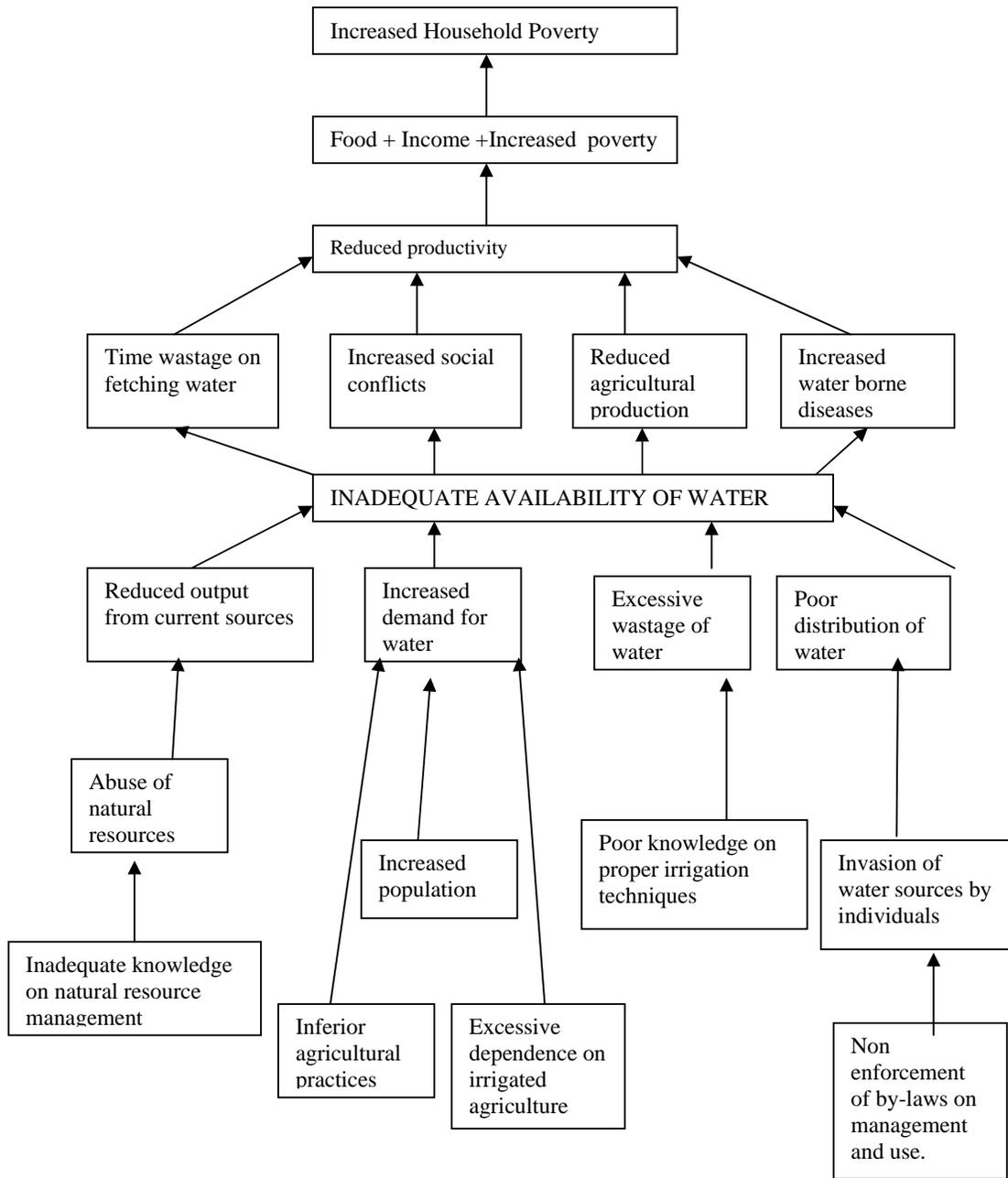


Figure 2. Synthesis of the relationship between water availability and poverty in Baga watershed

Across the Baga watershed, water related diseases have increased Dysentery, Diarrhoea; cholera, hookworm's farmers use the now dear and polluted waters from the few sources that still discharge water. Unlike any other period in the past, now the village' governments and elders handle water related conflicts than before. Women are exceptionally affected by this problem. In off-rain season they have to walk long distances to fetch water. In one village, Kwekitui, it was reported that during dry season they spend between six to seven hours to get one bucket of water. Perhaps to illustrate the magnitude of this problem, here is the example from Mbelei village. In Mbelei alone farmers mentioned 19 water sources. However the number of water sources which now reliably provide water across the year are only 10 (50%) – Table 4. Hence whenever the rain season ends in these villages, their governments brace themselves for the handling of water related conflicts.

Table 4. Water sources, their degradation status and water discharge levels in Mbelei village

S/N	Name of source	Where located	Status of degradation, discharge	Household served	Owner
1	Kwenzuka/Kwemvumo	Tongoi	Small, permanent	50	Communal
2	Kibwiyo ***	Tongoi	High, Drying	50	Communal
3	Lutindi	Lutindi	Small, permanent	74	Communal
4	Kwebua	Kwebua	Small, declining	30	Communal
5	Kishewa	Kishewa	Small, good discharge	10	Communal
6	Koughogho***	Nywelo	Average, fair discharge	10	Communal
7	Mabovu (a)***	Nywelo	Small, good discharge	10	Communal
8	Kwemkitindi**	Nywelo	High, dried	15	Communal
9	Mabovu (b)***	Mabovu	Small, permanent	All village 500	Communal
10	Mamba	Mamba Kaya	Small, permanent	75 - 80	Communal
11	Mtindili a ****	Mtindili, Mpakani, Mamba	High, drying	20	Communal
12	Mtindili b ****	Mtindili	High, dries during day	20	Communal
13	Mtindili C ***	Kwebati	Small, permanent	15	Communal
14	Kwemihula (a) ****	Chulwa Mzee Galu	High, dried	10	Communal
15	Kwemihula (b)	Tanga Mission	Small, permanent	1	Tanga Mission (Sakharani)
16	Kwemuhula c **** - ****	Mzee Mohamed Abdalla	High, dried	5	Tanga Mission (Sakharani)
17	Mbelei (a)	Mbelei	Small, discharging	200	Communal
18	Mbelei (b)	Kwekijava	Small, permanent	200	Communal
19	Kwesing	Shule P/S	Small, permanent	30	Communal

NB: \*- Affected by bad trees

\* - Affected by cultivation to source

#### **(v) Perception on problems and corrective action necessary**

A case by case treat of some of the water sources assessed is in Appendix 3. Across the villages, one pattern kept repeating itself. In many villages, the water sources have been seriously abused. In fact in those villages where water availability is most inadequate (like Kwekitui) human induced degradation of the water sources was also highest. One other pattern was that in villages where leaders have come forward to enforce by laws that protect water sources (like Mbelei), there is an increase in the water discharge from the reclaimed sources. We also observed that where communities have respected sanctity of the natural water sources and refrained from polluting them (like Kwadoe), the sources have remained productive. Hereunder are examples of a case by case assessment of selected samples of water sources from some of the studied villages. However, in view of strong similarity of the problems across the six villages we have identified the following limitations with regard to water sources;

- 1 Most indigenous trees perceived as being water friendly are hardly found around the water sources, they have been cut.
- 2 Grazing of livestock around the water sources contributes to the degradation of the water sources by accelerating soil erosion and siltation.
- 3 Cultivation up to the water sources, though restricted by village by laws is going on especially in Kwekitui, Kwehangala and Mbelei. This practice is the most serious abuse of these sources.
- 4 There is inadequate construction around the water sources earmarked to supply villagers with tapped water. Consequently water is lost at source instead of being piped.
- 5 Connectivity of the pipes which deliver water from the sources has not been done properly to ensure build up of adequate pressure to deliver the water to distant points across the villages.
- 6 Farmers also complain that the huge Eucalyptus trees on high ground planted near to the water sources affect the water discharge. This needs to be verified.
- 7 Farmers practice in irrigation are generally high water demanding. Farmers are unaware of efficient irrigation practices which require less amount of water for similar effect.
- 8 Agricultural practices in most of the villages are resource inefficient. This makes farmers opt for putting more land under irrigation to get what they would have otherwise got through using intensification techniques with a quarter of the land.
- 9 Most farmers are not aware of other enterprises which could be undertaken that could bring in good income without depending on irrigated agriculture.
- 10 Enforcement of by laws that protect water sources is generally weak in most of the villages.

#### **Action needed**

Despite the variation of the intervention needed at each source, the following are general measures which apply to nearly all the villages we studied. It is obvious that addressing inadequate water in these villages will require contribution of different actors. We recorded these suggestions from farmers across the six villages;

1. Install efficient water collection structures at sources earmarked for provision of tapped water to ensure adequate collection and pressure of the water delivered.
2. Replant water friendly trees like Mikuyu, Milombeombe, Msesewe in all water sources which lost them to indiscriminate felling of trees.
3. Enforce the ban on cultivating or grazing close to the water sources.
4. Separate drinking places for people and livestock as well as ban washing of clothes and utensils at source.

5. Reduce the high stand of Eucalyptus and wattle around water sources.
6. Installation of anti erosion grass lines around sources.
7. Promote collective action for cleaning the sources from the silt.
8. Reclaim cultivated land near the sources.
9. Expose farmers to efficient agricultural, irrigation, and alternative enterprises which are less dependent on irrigation.
10. Reduce pressure on current sources by encouraging rain water harvesting from roof tops for domestic use.

## **CONCLUSIONS AND RECOMMENDATIONS**

In view of the above we conclude that;

- (1) There is significant resource degradation in the Baga Watershed. The most visible forms are reduced cover from indigenous trees that are friendly to water sources, soil erosion, siltation of water dams and springs. The other forms of degradation are declining water sources and soil fertility in agricultural lands. Kwekitui village is the most degraded in terms of water and tree resources while Kwadoe is the healthiest in same parameters.
- (2) Farmers perceive most exotic trees as unfriendly to water sources and soil fertility. Eucalyptus species and Wattle trees are the most disliked trees. Women prefer the Eucalyptus owing to its ease in generating firewood. Among the indigenous trees, farmers report Mshai wawa as being unfriendly to both soil fertility and water sources. Mkuyu and Mlombelombe are the most preferred among the local trees because farmers perceive them as being beneficial to both soil fertility and water sources.
- (3) Availability of water for both domestic and agricultural purposes is now a priority problem in the Watershed. Women are the most affected as they have to spend many hours now fetching water from sources that are progressively drying.
- (4) Resource protection by law is not adequately enforced in the study villages. This has given rise to serious resource abuse in those areas without enforcement and poses a grave danger to new efforts geared towards natural resource management in the Watershed. Mbelei and Kwadoe villages are the most observant in the enforcement of these by laws while Kwekitui is the most negligent in enforcing them.
- (5) Most farmers practice inefficient agricultural and irrigation techniques. This has led many of them expanding areas under cultivation and irrigation and thus put pressure on the water sources.
- (6) Most farmers are totally dependent on irrigated farming hence unaware of any other potential enterprises which could otherwise be undertaken without need of irrigated enterprises. This has added to the demand for irrigation water.
- (7) For most villages the population has more than doubled in the last 15 years. As the majority of these take on inefficient resource utilization and agriculture, pressure has built on the current water sources to the extent that human induced resource degradation has virtually increased.

## **Recommendations**

We therefore recommend the following measures;

- (1) Promote enforcement of resource protection by laws across the six villages. For this there is need of soliciting political and executive support from the local district council in Lushoto and establishment of an inter-village forum for following up on trans-boundary matters that relate to resources under investigation
- (2) Since inadequate knowledge on proper irrigation techniques contributes to wastage of irrigation water, we advocate for a capacity building program in which farmers will be exposed to superior and resource efficient agricultural and irrigation practices so as to bring around judicious utilization of natural resources in this Watershed
- (3) The majority of farmers have inadequate exposure to potential alternative to irrigated enterprises. We therefore propose that farmers be exposed to potential enterprises which less or no irrigated water and their respective market linkages (poultry, honey harvesting, mushroom farming, dairying etc). The more people adopt non irrigative enterprises the better for resource degradation and utilization in the Watershed
- (4) There is need of building capacity of farmers across the six villages in proper management of natural resources and then promote adoption of integrated natural resource management technologies. Training farmers in such matters will sustain the efforts and ensure that other farmers elsewhere will be trained by their fellow farmers.
- (5) The six villages receive a bimodal rain to the magnitude of 1200mm/year. We therefore recommend introduction of rainwater harvesting programs. If water from roof tops could be harvested, it would reduce workload on women and reduce pressure from current sources for supply of water for domestic use.

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Miti ya Kigeni		

2b) Ni nani wafaidikaji wakubwa wa manufaa haya hapa Kijijini walipo, na ni kwa vipi?

3) Ni miti ipi yenye athari mbaya kwa vyanzo vya maji (Visima, chemchem)

Aina ya Miti	Ilipo Kijijini	Aina ya Athari
Asilia		
Kigeni		

3b) Nani waathirikaji wakubwa hapa kijijini, mahali walipo, na ni kwa vipi?

4) Ni miti ipi yenye manufaa kwa vyanzo vya maji

Aina ya Miti	Ilipo Kijijini	Aina ya Athari
Asili		




4) Linganisha idadi ya miti husika kadri miaka ilivyopita (miaka 30 – 40) na taja sababu za mwelekeo huo. Ikiwezekana taja lini hasa mwelekeo mkubwa ulianza

5) Ni nani wanafaidi zaidi kuwepo kwa miti hii na kwa vipi?

**E TATHIMINI YA ATHARI**

1) Orodhesha miti yenye athari mbaya shambani kwa umuhimu wao (1 – 10 )

1 = Kidogo 5= wastani 10= mbaya kabisa

Aina ya miti	Umuhimu kwa Athari	Nafasi
Asilia		
Migeni		

1) Orodhesha miti mibaya kwa vyanzo vya maji kwa umuhimu wao

1 = Kidogo Kabisa

5 = Wastani

10 = Mbaya Kabisa

Asilia	Umuhimu wa Athari	Nafasi

Migeni		

3 Ili kupunguza athari ya miti hiyo mashambani unatumia mbinu zipi?

**F. VYANZO VYA MAJI.**

- 1) Kuna chemchem na visima vingapi hapa Kijijini?  
Taja viliko, vinahudumia kaya ngapi? Nani mmiliki?

Jina la chemchem/Kisima	Kilipo	Watumuaji	Mmiliki wake

- 2) Taja aina ya umiliki wa vyanzo vya maji

Jina la Mmiliki	Aina ya umiliki (Kurithi, Kununua, Kuchimba)

**G. KIWANGO CHA ATHARI YA MITI KWA MAZAO NA VYANZO VYA MAJI**

1). Katika mazao yanayolimwa Kijijini ni yapi yenye kuathirika vibaya zaidi, orodhesha kisha panga kwa umuhimu

1= Inaathirika kidogo kabisa

5= Wastani

10= Inaathirika vibaya kabisa

Zao	Uzito wa Athari	KUSHUKA UZALISHAJI %

2) Katika visima chemchem zilizotajwa hapo juu ni zipi zimeathirika sana na miti mibaya

1 = Imeathirika kidogo kabisa

5 = Wastani

10 = Imeathirika vibaya kabisa

Jina la chemchem/Kisima	Uzito waathari

3)Kwa chemchem/Visima hapo juu taja miezi ya upatikanaji maji

Jina la Chemchem/Kisima	Miezi yenye maji		
	Kwa wingi	Kidogo	Hamna



**I MIGOGORO YA MITI NA VYANZO VYA MAJI**

- 1) Ni migogoro/migongano ipi unaikumbuka kusababishwa na miti inayoathiri ardhi/mazao mashambani hapa kijijini

Mgogoro/Mgongano	Mwaka

2. Ni migogoro/migongano ipi unaikumbuka kusababishwa na kuharibika/kuzorota vyanzo vya maji (chemchem/Visima)hapa Kijijini.


3. Kwa kadri ya miaka 30 ni migogoro ipi (1 au 2) iliyobadilika kwa wingi na kwanini?

## Appendix 2. Names of interviewees

### **Kwehangala**

1. Mr. Kipingu
2. Mzee Lwambo
3. Mzee Kitoi
4. Mzee Nguzo
5. Samweli Kariuki
6. Mzee Shangali
7. Mzee Musa Sechonge
8. Francis Shengovi
9. Martin Sheshunda
10. Alfani Ramadhani
11. Andrea Ramadhani
12. Bunge (Manjo)

### **Kwadoe**

1. Pascal Mbwana
2. Erenesti Shembu
3. Ayubu Rashidi
4. Said Mdoe
5. Idi Shaban Ponda
6. Yasuf Rashid
7. Masaidi Omari
8. Fatuma Ramadhani
9. Mima Ramadhani
10. Mariam Ramadhani
11. Salimu Seng'eng'e
12. Mwanahawa Saidi

### **Kwekitui**

1. Idi Kiuzio
2. Anna S. Chahoa
3. Eliza Kiberiti
4. Raheli Hernesh
5. Maria Kimea
6. Ramadhani Ndege
7. Simon Chahoa
8. Zaina Musa
9. Awadhi Jasai
10. Musa Ndege
11. Athumani Omari
12. Ali Amiri

### **Mbelei**

1. Martin Msumai
2. Ramadhan Asuman
3. Tamilwai Mwambashi
4. Athuman Saidi
5. Hamadi Mbilu
6. Ms. Asha Mbilu
7. Ms. Beatrice Elias Msumari
8. Ms Maajabu Almas
9. Edward Sama
10. Ms Mama Zaini
11. Hasan Ramdhani
12. Batuli Sama

### **Dule**

1. Mr. Mohamed Rajabu
2. Mr. Ally Rupia
3. Ramadhani Wandu
4. Makulangwa Chambo
5. John Wandu
6. Elice Mpemba
7. Hussein Mussa
8. Saidi Kinyashi
9. Raheli Kika
10. Sara Mpemba
11. Maria Paulo
12. Zubeda Ayubu

### **Kwalei**

1. Mathias Nyundo
2. Martine Mtunguja
3. Abeid Mshahara
4. Bakari Mshahara
5. Rashidi Zuberi
6. Ramadhani Hamisi
7. Mohamedi Shekibula
8. Ezekieli Shekighenda
9. Mariamu Musa
10. Athumani Saidi
11. Mohamedi Abdalah
12. Marko Mchanja

### Appendix 3. Site specific assessment of selected water sources

#### A. Mbelei village

Water source	Villages /Hamlets supplied	Status	Common vegetation	Courses of degradation	Recommendation /Measures to be taken
1. Mabovu	Mbelei and Kwekitui	-Constructed 2001 with 3'outlet -pipe -Vegetation around, -Restricted from cultivation	Mteei, Jeeni ong'e Boho	- Leakage through the gate -Deforestation -High water divergence due small constructed reservoir. - Gold prospectors	Install new gate.  -Emphases to neighbours - restricted from cultivation -Construct big water reservoir - planting suitable tree around the source – mikuyu(Ficus),mweeti (Rauvolfia) and muombeombe (Hallea)
2.Nywelo	Nywelo in Kwadoe -Mabofu in Mbelei	Constructed in 2003 Better design than than Mabovu.	Mtei, boho, ong'e	-Grazing practiced -Trees harvested along. -Cultivation around the sources still there. Complains on planted Eucalyptus	-Planting water friendly trees.like mikuyu mlombombe and mweeti. - Enforce bylaws on cultivating and grazing around the water sources.
3. Kwemabanthi	Kishewa, Kwebua, magunga	Not well constructed - Constructed mainly for irrigation -Is covered by wire mesh. -Dangerous to human and livestock.	Exotic tree species like Wattle, Grevillea and Eucalyptus	-Stand of wattle trees -Grazing of livestock -Siltation due to cultivation	To separate water outlet for people and and livestock Reduce Eucalyptus and Wattle planted around the sources
4. Mambakaya	Mambakaya Hamlets	Permanent sources - Reservoir not construction. -Highly degraded, cultivated, and silted	Open area	Cultivated tomatoes cabbages andsweet papper right to the source	-Village government to enforce bylaws on cultivation grazing. -Collective action to remove silt.
5. Mtindii	Mtindii B Hamlet	Temporary with low water flow, muddy and silt. -Within a Big stone Neglected due to other souces.	Mishai, Ong'e and misumbasha	Not protected with runoff.	Installation of communal dam/ resevoir -Establish ant -erosion grass lines -Reclaim cultivated land near the sources

## B. Kwekitui village

This village has the most degraded and seasonal water sources.

Water source	Villages / Hamlets supplied	Status	Common vegetation	Courses of degradation	Recommendation /Measures to be taken
Mzizima	Kovedalu Kwekibaa	Communal owned -Cultivated up to the source with maize and coffe	Dracaena sp. Vernonia myrianthus	-Cultivation -Deforestation	Stop cultivate close the source
Kwegoroto	Kwemindo Kivimo & Kwekitui	-Constructed -Water reservoir 1976 -Water available only in the morning	-Zia (Cyperus sp.) -Caesalpinia sp. -Plectranthus	-Cultivation of maize near the source	Division Secretary has been demarcate the boundary -Stop cultivate to the source
Misalai	Most of Kwekitui people	-Facing high degradation from cultivation open area without construction	-Tomatoes	-Cultivation of maize,tomators	-Stop cultivation -Replanting the valley with indigenous trees -Construction of main reservoir needed
Kwemshiw	Kwekitui, Kwembago	-Is in valley bottom -Not protected washing done at the source		-No soil protection -Cultivation of maize and vegetables	-Stop cultivation -Stop washing and any other activities -Replant indigeneous trees -Construct/build a basin

## C. Kwadoe Village

Water source	Villages /Hamlets supplied	Status	Common vegetation	Courses of degradation	Recommendation /Measures to be taken
Kwemondo meo A	Shwangoi, Mabovu, Mbaramo	Temporary water flow -Not constructed hence high water loss	<i>Lantana camara</i> , <i>vernonia spp</i> , <i>Plectranthus laxiflorus</i> , <i>caeslpina decapitala</i> , and <i>Ferns</i>	Basins not constructed hence high water loss.	-Construct water basin/ reservoir -Suitable tree planting around the sources.
Kwemondo meo B	Shwangoi, Mabovu, Mbaramo	-Permanent source-- -Has more water. -Has water for drinking	Mishai, mivumo	Cultivation close to the sources	Construct water basin/ reservoir -Suitable tree planting around the sources
Kwekidevu spring.	Mbaramo West	-water for drinking Permanent	Ficus spp	-Washing around soapy pollute water	
Kwasafari	Mbaramo	-Protected 2000 -More water from then	Vegetation: Jem, Caesalpinia guaguzo	-Cultivation around the sources	-Build around to collect more water -Stop

					cultivation and washing around.
Shuleni	Primary School	-they said water has been decreased since 1983 after exotic tree planting -dries during dry period	Eucalyptus, ,Acrocarpus, Lantana and ferns, & mnywanywa		-Built the reservoir/ basin around the sources -Replace Eucalyptus and Acrocarpus with other species -Reduce Acrocarpus
Mbaramo	Mbaramo	-Permanent -Biggest source of water	Mkuyu, Mshai, Cyperus, Mvuti, Zarake, Tughutu, Nughutu	Some cultivation and washing near the source	-Action needed: -Replanting indigenous trees around the source -Build concrete basins around it -Stop cultivation around it

#### D. Kwehangala

Water source	Villages / Hamlets supplied	Status	Common vegetation	Courses of degradation	Recommendation /Measures
Kwakilua	Kwehangala	Temporary	Ntungutu Mishai, caesalpinia spp,, msasa	-cultivation around the sources	Need collective action to protect cultivation around the sources and enforcement of the by laws
Kwakitoe,Kwa Shunda, Kwetongo	Kianga	-Permanent, but being abused Permanent,		-cultivation around the sources	-Stop cultivation around the sources -Require construction of collection basins
Kwa Kiondo	Mpalai	Permanent			
Kwa Shekiveja,Kwa Mhunga	Kwebalazi			Permanent grazing done around it	-Stop cultivation and grazing.
Kwa-Mdoe, Kwa Karata, Kwafedewa	Kizehui	One source is seasonal (Kwafedewa)			Require construction of collection basins
Magamba Hemkonde	Magamba	All permanent		- degradation is going on around	Require construction of

Kwesimu, Kwesiga				the source.	collection basins
Kwa Shehoza	Migae	All permanent			
Kibanama(K wemasghoshi ,Kweshegum i,	Kwefi ngo	All permanent		Cultivation & vegetables	Require construction of collection basins
Kweshiu	Kwehangala	-permanent and constructed	Ficus spp, Coffee and banana Ntungutu ,Mishai	-Various crops Cultivation eg yams	
Helkulu	Helkulu	Sources originate in natural forest	Indigenous trees	Not degraded	Require construction of collection basins around the sources
Bwiko	Bwiko -About 100- 150 people depends on this source	- some was having high water discharge to 1995 -Very little flow is observed now		- cultivation around the sources exist	Planting indigenous trees like Mkuyu and Mvumo near the sources -Need collective action and enforcement of the by laws.

Appendix 4. common species around water sources

<b>Local Name</b>	<b>Botanical Name</b>
1. Ngage	<b><u>Cyperus exaltatus</u></b>
2. Jeni	<i>Plectranthus laxiflorus</i>
3. Ong'e	<i>Cythea maniana</i>
4. Tughutu	<i>Vernonia myrianthus</i>
5. Mikuyu	<i>Ficus valis choudae</i>
6. Mishai	<i>Albizia gumifera</i>
7. Boho	<i>Inula decipiens</i>
8. Mtei	<i>Maesa lanceolata</i>
9. Mwombeombe	<i>Hallea rubrastipulata</i>
10. Mueti	<i>Rauwolfia caffra</i>
11. Mivumo	<i>Ficus thinningii, F. natalensis</i>
12. Mzumbashi	<i>Ocimum suave</i>
13. Ng'weng'we	<i>Dracaena usambarensis</i>
14. Zia/Zila	<i>Cyperus alternifolius</i>
15. Mtarumbeta	<i>Datura arborea</i>
16. Msasa	<i>Ficus exasperata</i>
17. Mwiba	<i>Caesalpinia decapitala</i>
18. Ng'wiza	<i>Bridelia micrantha</i>
19. Mwinu	<i>Cassia floribunda</i>
20. Usau	<i>Polygonium spp.</i>
21. Mbombwe	<i>Commiphora eminii</i>
22. Kavungahombo	<i>Burseradae crassocephylum</i>
23. Mvuti	<i>Lantana camara</i>
24. Mtughutu	<i>Vernonia sublifera</i>