



Effects of Artisanal Small-Scale Gold Mining on Fisheries Management of Lake Victoria, Kenya

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Abstract

Artisanal Small-scale Gold Mining (ASGM) has direct and indirect impacts on fisheries management. These impacts are mainly about the quality of the water where fish lives, ownership of the surrounding waters, land and human health. This study was carried out in two landing sites of Wagusu and Riskis Kogwari in Central- Sakwa Location of Siaya County in Kenya in which Kibere and Kajohn gold mining areas are located. The findings indicate that identifying the sources of conflicts (land, water, gold, fish, fishing and mining equipment, and vegetation) between artisanal fishers and small-scale gold miners is a stage in improving fisheries management, as it gives the root cause of the problem. Other findings indicate that challenges to fisheries management resulting from ASGM activities include (inadequate funds and mining skills; political interference, illegality of some sectors of the ASGM sector; corruption, and failure to represent ASGM in the Beach Management Unit (BMU) committees). In order to address these challenges, we propose that the illegal sectors of ASGM should be legalized. In addition, efforts should be taken to combat corruption, and reward and punish BMU working with the ASGM sector. Furthermore, we recommend for the improvement of the landing sites infrastructure, and the ASGM stakeholders need to be represented in the BMU committees as means of enhancing co-management in fisheries management.

Keywords: Artisanal Small-scale Gold Mining, Beach Management Unit, Fisheries Management, Lake Victoria.

Introduction

Lake Victoria is the world's largest tropical lake covering 68,800 km², which is shared by the bordering states of Kenya (6%), Uganda (43%) and Tanzania (51%), (LVBC, 2011). It has a mean depth of 40 m, a shoreline of approximately 3500 km and a catchment of 193,000 km² extending to Burundi and

Rwanda. The lake is an important source of food, employment and earnings for the riparian communities. The Lake Victoria gold fields located on the catchment area covering almost 200,000 km² is estimated to employ nearly 300,000 people (UNIDO, 2002).

Artisanal Small-scale Gold Mining (ASGM) is a globally-significant industry, providing rural employment directly to at least 15 million people and indirectly to over 100 million in more than 70 countries (WHO, 2013). ASGM in this study refers to the mining of gold by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal (illegal) sector of the market. Many ASGM operations occur near streams, rivers and lakes for easy access to alluvial ores, but also to supply water used in processing and as a receiving environment for mine waters. Although ASGM contributes to rural economies, it often results into degraded environment, safety and social conditions due to the rudimentary mining and processing techniques used (Telmer and Veiga, 2009). In Lake Victoria, industrial, agricultural and domestic waste discharges have increased the levels of heavy metals in the lake (Muli, 1996). Gold mining is expanding along the Lake Victoria region and it may have a considerable impact on the lake environment causing a threat to its management.

A study conducted by NEMC (1994) on heavy metal pollution in open pits in gold mining areas in the lake zone revealed that mercury levels were significantly higher than the permissible level of $1\mu\text{g l}^{-1}$ in drinking water. Kahatano et al. (1995) also found high levels of Pb, Cu, Cr, Zn and Hg in water, sediments and soil of some streams and rivers in goldfield. These metals possibly end up in the lake through practices like ASGM.

Beach Management Unit (BMU) is defined as an organization of fisher folk at the beach (boat crew/baharia, boat owners, managers, charterers, fish processors, fish mongers, local gear makers or repairers and fishing equipment dealers) within a fishing community (LVFO, 2007). On the other hand according to FAO (1997), fisheries management is the “integrated process of information gathering, analyzing, planning,

consultation, decision making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives.”

Up until the late 1990s, the governments of the three Partner States (Kenya, Uganda and Tanzania) sought to manage Lake Victoria’s fishery resources using methods of ‘direct command and control’. A combination of high catch rates from the Nile Perch stocks and high prices from international markets have contributed to increased fishing effort (legal and illegal) making thus the existing management approaches uncontrollable. It was realized by Lake Victoria Fisheries Organization (LVFO) that Tanzania had initiated the involvement of all stakeholders in the management of fisheries resources on their side of the lake and that the results had often been positive. This being a shared resource, LVFO then appealed to the other Partner States to embrace BMUs as the common foundation for a co-management approach to the management of Lake Victoria’s fisheries (LVFO, 2007).

Considering the composition of the BMU Committee which has between 9 and 15 members democratically elected by the BMU Assembly, constituting the Chairperson, Vice Chairperson, Secretary, and Treasurer, plus any other post defined by National Guidelines or by the BMU Assembly, it may not be easy to manage fisheries as the representation of the BMU committee has the following distributions: 30% boat owners; 30% crew (fishing laborers’/baharias- who do not own boats); 30% other stakeholder groups (including fish processors, boat makers, local gear makers or repairers, fishing equipment dealers and managers); and 10% fish mongers/traders (LVFO, 2007)

which leaves out other stakeholders like those in ASGM who may have a greater effect on the shared resources by those in fishing industry. This may not be a direct problem from ASGM but it acts as a source of threat in fisheries management due to the regulation on the composition of the BMUs, which excludes those in ASGM.

Conflicts emerge between those in ASGM and those in fisheries management, as those in ASGM have a feeling that they have a right to use water at the shore of the lake without any interference. At the same time, those in fisheries feel that their right is being interfered with by those in ASGM who are washing their ore around the landing site where they should be placing their boats and other fishing equipment. This conflict of interest is not easy to manage, as most of the people that are involved either in fishing or ASGM derive their livelihoods from these activities. Strict enforcing of management rules and regulations, may lead some families to have extreme poverty and hunger. It is because of such conflicts of interest that this study's aim was to examine the relationship between artisanal small-scale gold mining and fisheries management.

Methodology

This study was carried out in Central- Sakwa Location of Siaya County in Kenya. Most of the residents in the location have shelters which are semi-permanent. Factors influencing types of shelter in Central-Sakwa Location include cultural beliefs, affordability of building materials, climatic conditions and technology. Main economic activity in Central- Sakwa Location is crop farming which contributes highly to the household incomes. Other income activities include fishing and mineral exploitation. However, over-fishing in breeding grounds along the lakeshore and use of illegal fishing methods has negatively impacted on sustainable exploitation in the industry. This

is driven by increasing demand from the increasing population, among other factors (such as export demand, weak governance of the sector, lack of alternative livelihoods etc.). Mining and quarrying generate income in a number of households. The mining sites are located next to water bodies because they need water to wash the ore. This venture is however unregulated and in most cases leads to land degradation (NEMA, 2007). Two landing sites from the location namely, Wagusu and Riskis Kogwari were sampled because of close access to the mining sites of Kibere and Kajohn respectively as shown in Figure 1.

Data Collection Methods and Tools

This study adopted a descriptive survey design methodology which allowed the researchers to generate reliable information concerning the study. This study identified the effect of ASGM on fisheries management with special references to establishing sources of conflict between ASGM and fisheries management, challenges to fisheries management as a result of ASGM activities and solutions on better fisheries management with ASGM activities present at the beach.

Household survey and observations were used as data collection methods. Questionnaires and observation checklist were used to collect data. The questionnaire was self-administered to the respondents by the two researchers and the research assistants.

Sample, Sample Size and Sampling Technique

According to the Kenya National Census (2009), Central-Sakwa Location has a population of approximately 27,353 people. However, records from the BMUs of the two landing sites Wagusu and Riskis Kogwari indicate that about 1,548 and 1,263 people are residing along the two beaches respectively. In this study the target

populations comprised of house hold heads living along the landing sites and are involved in either fishing or ASGM activities. The two landing sites Wagusu and Riskis Kogwari have approximately 298 households and 243 households respectively.

The study used probability sampling method to get the sample size of respondents for the household survey. Proportionate random sampling technique was used to get the household heads for the household survey. The desired sample sizes of respondents for the household survey by the researchers was 100 household heads living within the two landing sites and were involved in either fishing or ASGM activities.

The desired sample size was determined with reference to what Munyoki and Mulwa (2012) and Emory (1985) respectively gives as explanation on sample size. They argue that “there has been no agreement as how large a sample one should choose, since sample size is just an indicator of representativeness. Many researchers have relied on what others have done before to justify the size of the sample. It is often claimed that the sample chosen should bear some proportional relationship to the size of the population from which it is drawn. How large a sample should be is a function of the variation in the population parameters under study, and the estimating precision needed by the researcher.”

To ensure beach representation in the sample, proportionate numbers were selected from the two landing sites. In order to get the size of respondents from each stratum a calculation was used making the number of household needed for the two landing sites as Wagusu 55 and Riskis Kogwari 45. Simple random sampling was used to pick the household heads. A list for the households was obtained from the BMU office as they have records of those residing along the landing site.

Two research assistants who had a form four certificate and knowledge on gold mining and fishing activities were hired. Four days training was conducted for the research assistants. The training covered the following areas; background and the objectives of the study; field study ethics, methods of interaction, team spirit, selection of respondents, understanding sections of the questionnaire, and data collection techniques. These were done in three days and on the fourth day the research assistants carried out a pre-testing of data collection tools. A total of 10 household heads were sampled (5 from each landing site).

The 10 household heads interviewed in the pre-testing study were drawn from the study population but were not part of the sample size used in the study. This was done to avoid inclusion of pre-test sample in the main study. Pretesting of the study tools ensured that content validity and reliability of the study was reached.

Data Analysis

In this study data analysis started from editing and checking of gathered raw data for accuracy, usefulness and completeness. Coding then followed and it involved corroborating findings from the questionnaires and observations. Data from field were fed into the excel work sheets and analyzed by the use of descriptive statistics (involves the describing, exploring and summarizing of data to establish patterns in the data using summary measures that help to compress the data and make it easier to understand). The analyzed data was presented by the use of narrative reports, tables and bar charts.

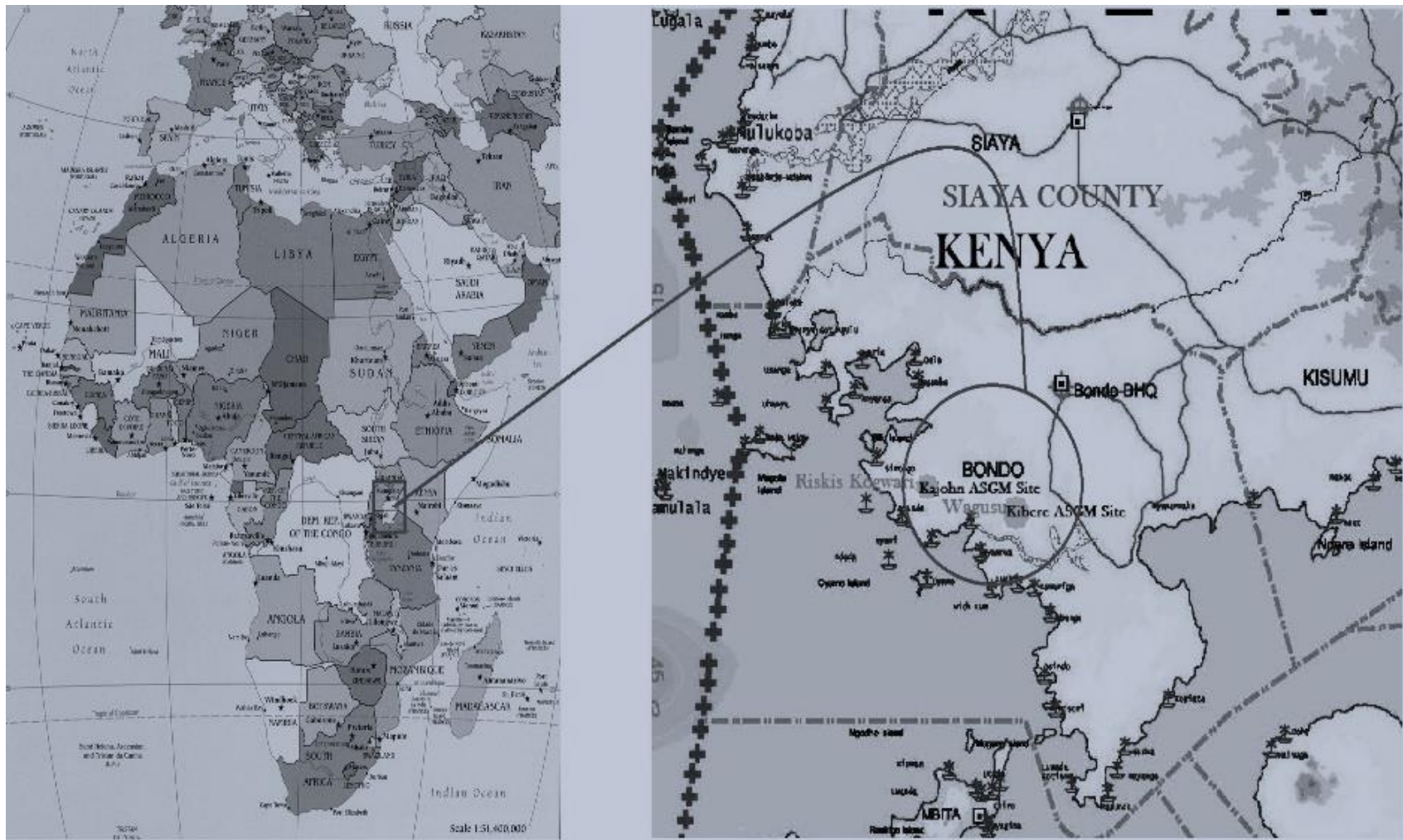


Figure 1: Map of Kenya showing study Area

Results and Discussions

Demographic information collected were about the sex of respondents, highest level of education of respondents, main occupation of the respondents, sources of conflict between ASGM and fishery industry, challenges of fisheries management as a result of ASGM activities and better fisheries management with ASGM activities present within the landing site.

Table 1: Percentage responses by activities and sex of respondents

	Wagusu		Riskis Kogwari	
	Male	Female	Male	Female
Fishing	20	19	20	11
Gold Mining	11	5	8	6
Total	31	24	28	17

Table 1, indicate that males dominate in both fishing and gold mining. Generally, there were 59% males and 41% females an indication that the two activities are both dominated by males (fishing - 40% and gold mining 19%) with females complementing the systems. In Wagusu, 20% of males were involved in fishing compared to 19% of females. In addition, 39% of the respondent were involved in fishing activities while those in gold mining were 16%. In Riskis Kogwari 31% were in fishing while 14% were in gold mining.

In ASGM, it is the men that go down the shafts to mine, as women are barred from doing so making them to be washing what is given to them or what has been even washed by the men. The men dominate the fishing as women dominate the post-harvest activities. This is an indication that the two activities are gender based. The male in most of the communities are the decision makers as they are the ones that are mostly appointed for leadership positions within the BMU committee. This may be a source of conflict

as women in both activities are not properly represented and most of their views may not be taken into consideration more so when they are in conflict with those of the men's interest. In relation to fisheries management, leaving women out of the decision making process may make them reject some of the rules and regulations that would have made it easy to manage the fishery industry.

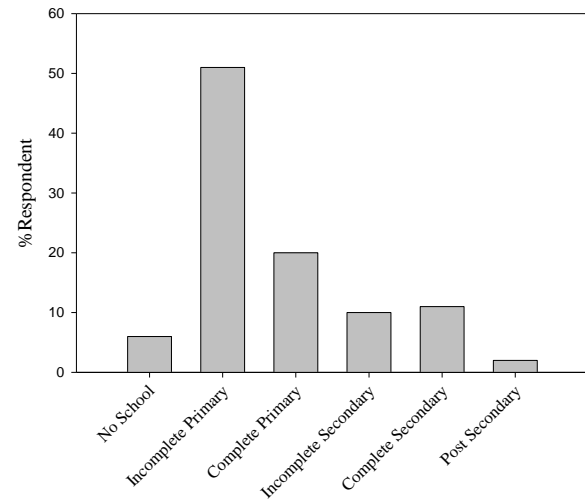


Figure 2: Highest level of education of the Respondents

Most of the respondents have not completed primary education (51%), followed by (20%) who have completed primary education. Only (6%) indicated to have no schooling. At the same time, (10%) have not completed incomplete secondary (Figure 2).

These result indicate that academic qualification is not a major requirement for ASGM activities. Both activities have led to high rate of school dropout in different ways. For example, due to so much time taken in mining and fishing, people involved fail to educate their dependants as money earned from the sectors may not be enough to pay fees as they do not have more time to do other activities for extra income. The level of education has an influence on how people involved in ASGM and fishing industry get their livelihoods; take safety and health

measures and how they spend income earned from the activities especially on improving or developing landing site infrastructures.

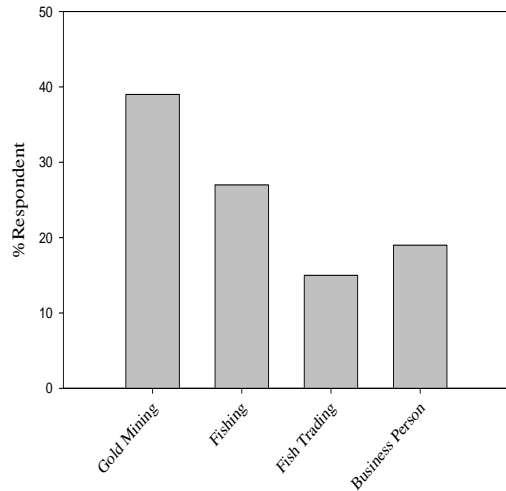


Figure 3: Main Occupation of the Respondents

From the study, 39% of the respondents had gold mining as their main occupation, 19% were business persons, 27 % were from fishing, and 15% were in fish trading (Figure 3). All the activities that takes place within the beach depends on the lake as the main source of their livelihoods, meaning that failure to conserve or manage sustainably the Lake Victoria then many of them including those in fishing loose their sources of income. Conflict do arise on the accessibility of the resource. For example, those in fishing depends on the water for fish, those in gold mining need water to wash the ore, those in business need the water to provide transportation hence causing them to fight for points of accessibility.

There were other activities like vegetable and crop farming, chicken and cattle rearing that were practiced by the respondents to supplement income from their main activities. This they say was because income from their main activity was not enough to meet their household needs.

Table 2: Sources of Conflict between ASGM and fishery industry

Source of conflict	Percentage (%)
Land (along the shore)	60
Fish	20
Gold	15
Water	74
Vegetation	35
Fishing Equipment	40
Mining Equipment	50

Water has been identified to be a source of conflict because users in ASGM, fishing industry and other sectors did not know how best to share its accessibility. Land along the shore brings conflict as those in ASGM wish to place their washing racks at the shore and those in fishing would want to place their boats at the same area, with each group claiming to have more rights than the other. This is in conjunction with the concept of tragedy of the commons where tragedy is a dilemma arising from the situation in which individuals, driven independently by the power of their own self-interests, ultimately deplete a shared limited resource without considering future sustainability of the same resource (Dietz *et al.*, 2003). In fact, they even forget that their livelihood depends on the sustainability of the resources in question and this fuels more tragedy.

Gold and fish are not that problematic as both of them are sources of income for those in ASGM and fishery industry. Vegetation is a source of conflict because as those in ASGM want to mine their gold, they first have to clear the vegetation and with loss of vegetation there is probability of reduction in amount of fish resulting in decline in fishing-based livelihoods and revenue collection. Fishing and mining equipment are sources of conflict between ASGM and fishing industry because when the two groups come together there is a possibility of equipment getting lost

and destroyed due to conflicting interest by each group.

Mining equipment has become a challenge as the grinding machines which are based less than 50 Meters from the shore of the lake makes a lot of noise and has soil particles emission which may lead to deafness and breathing problems. With limited health facilities at the beach, the cost of treatment for such health conditions may become high or even impossible due to the distance to be covered in order for one to be treated as well as the cost involved in monetary terms.

As gold miners wash ore to get gold at Riskis Kogwari beach of the Lake Victoria (Plate 1), there is an increase in water pollution at the shores of the lake and people come to collect water from nearby which means that they are collecting contaminated water as the miners are using mercury in this process.

Table 3: Perception of the respondents on problems in fisheries management resulting from ASGM activities

Problems of fisheries management	Percentage (%)
Inadequate Funds	80
Inadequate mining skills	40
Political interference	65
Illegality of activities in the ASGM sector	33
Corruption	76
Failure to represent ASGM on the BMU committee	47

Most respondents (80) % stated inadequate funds as a problem in fisheries management (Table, 3). Due to inadequate funds to build the ASGM sector to required standards, it becomes difficult to earn income that can be channeled for development purposes. This happens because income from the sector is not reliable (not earned with timed seasons)

hence cannot be used to fund infrastructure development (roads, schools and health center) development at the beach. Some respondents (40%) stated inadequate mining skills to be the problem (Table 3). With inadequate mining skills, those in ASGM may have problems on how best to have safety measures for themselves and those within their surrounding leading to a series of accidents and health problems. ASGM having gold as its main resource, has political interference as government and local leaders may wish to have control on who is to do the mining, those to be licensed and how best income from gold is to be shared to them rather than used for development purposes. This gives a restriction on using money attained from mining on fisheries management (maintenance and keeping of order along the beach).

Illegal activities within the ASGM sector has made it to be a threat to fisheries management, as it gives room for corruption especially by those polluting the water as they release soil particles and mercury from washing gold ore. They end up having substances like explosives and mercury that are not approved for use by the health and mining sectors. Corruption is a problem to those in fisheries management as those polluting the water body from ASGM when caught, bribe their way out. Failure to have ASGM represented in the BMU committee in beaches with ASGM, becomes a problem as those in ASGM at times take advantage of them not being included in the planning, decision making, implementation, monitoring and evaluation of the rules and regulations used in running the daily activities within the beach as they know making them accountable for breaking them will not be easy.

Plate 2 shows a woman with a child washing gold as she explains that she had no one to leave the child with at home due to inadequacy of the income earned from Gold

mining. The woman has fetched water from the lake and is using basins as she acknowledge that washing the ore inside the lake is a health hazard. The woman is not using any protection as she touches mercury. This is dangerous as the child is still being breastfed and the mother touches her breast with the hands that has touched mercury. This may lead to transmission of mercury into their body systems.

Table 4: Ensuring fisheries management with presence of ASGM activities at the beach

Solutions	Percentage (%)
Legality of illegal sectors of A SGM and fishing industry	60
Fighting Corruption	44
Having rewards and punishment of BMU committees with A SGM practiced at their beaches	32
Improving beach infrastructure	81
Having stakeholders represented in BMU committees	57
Embracing co-management of the fishery industry	78

When the activities in ASGM and fishing industry that are considered illegal are formalized and made known to the authorities, it becomes easy to manage the fisheries because some problems of management emerge from illegality of some activities within them. When corruption is fought in its totality, then rules and regulations benefiting management will be easy to implement. Having rewards and punishment for the BMU committees that are working hand in hand with ASGM sector, will either motivate or discourage them towards coexistence between ASGM and fishery industry. This is because those in the committees will work hard so that they can be rewarded and avoid doing wrong things as failure to work will lead to punishment.

Infrastructure such as roads, health facilities and schools should be improved at

the landing site as it will be easy to transport goods and services in and out of the beach, respond to emergencies and acquire knowledge and skills which may lead to earning better individual income hence improved living standards. Having other stakeholders represented in the BMU committees, will ensure the diversity and availability of improved knowledge on how best to manage fisheries. Embracing co-management of the fishery industry will improve fisheries management as indigenous and improved knowledge will be made available to both those within the community and those responsible for fisheries management.

Local people need education, finance, planning and management tools suitable to their local situation (Jentoft *et al.*, 2010). The involvement of these end-users is expected to increase their sense of responsibility and ownership, thus facilitating the self-enforcement of the management system and in principle the ‘sustainability’ and equity of the system (Béné *et al.*, 2009).

From plate 3 it is clear that the color of water has changed due to washing of gold at the landing site. There is also possibility of gold miners and fishers coexisting at the landing site side by side with each group having clearly demarcated areas where they can conduct their activities.

Conclusions

The causes of conflicts identified in this study are; land (along the shore), fish, gold, water, vegetation, fishing equipment, mining equipment. These pose challenges to fisheries management. In this study, these challenges are attributed to inadequate funds, inadequate mining skills, political interference, and illegality of activities in the ASGM sector, corruption and failure to represent ASGM on the BMU committee. These challenges may be addressed by formalizing the informal sectors of ASGM

and fishing industry, fighting corruption, having rewards and punishment for BMU officials' /committee members, improving beach infrastructure, having ASGM stakeholders represented in BMU committees and embracing co-management of the fishery industry. In order to ensure fisheries management, it is necessary to regulate the actions of people by understanding the human factors such as the reactions of fishermen, those in ASGM, business and trading of goods and services along the landing sites as that will help in identifying vulnerability exposure and capability of all stakeholders in fisheries management.

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Plate 1: Miners as they wash soil to get gold at the shores of Lake Victoria



Plate 2: A woman washing gold at the shore of Lake Victoria



Plate 3: Change of water color at the beach