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Conflict potential over water resources and effects of the water management at the Bathi River

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Introduction

The area of Kimende, situated at the edge of the Aberdare Ranges in central Kenya, is prone to changes in the water household in the future. This is due to omnipresent effects like population growth, land use change, climate change and improper water management, leading to over-abstraction and pollution of water resources (UNEP, 2009). In the scope of a fieldcourse at the University of Copenhagen a two week field campaign was conducted that investigated different aspects: The chemo-physical state of the Bathi River at the end of the dry season, the local knowledge of farmers affected by the river and interviewed representatives of the government, NGOs and community based associations with respect to their plans of proper water resource management and governance.

Study area

The fieldwork was carried out in Kenya in the equatorial part of Eastern Africa. High altitude, forested areas in the western and central part of the country generate fresh water due to high precipitation, these areas are called the 'water towers' and supply freshwater to large parts of Kenya. This study took place in the southern part of the Aberdare Range, where a section of the the Bathi River, that flows over the course of 42 km towards the the Athi-Galana River, until it reaches the Indian Ocean, was investigated.
The study site is located near the Kikuyu Escarpment Forest, the survey involving the local farmers was conducted in the nearby towns of Kimende and Kagwe in the Kiambu County. The land use in the Kimende area is mostly substantial farming, with the main crops being potatoes, maize and beans, the Kagwe area is characterized by cash crops, mainly in the form of tea. The Aberdare Range is located 60 km north of Nairobi and is crucial for the water supply of the highly populated adjacent lowlands.

Methods

To get insight on the situation of the water household in the area, along with the complex water management that involves several stakeholders, a holistic approach was chosen, that employs a multidisciplinary approach, situated in the overlapping of natural, social and political science. A three stage approach was developed:
(I) The chemo-physical state of the Bathi River was investigated along a section of the river stretching from the upstream area located near Kimende, to the downstream area located just

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south of the Kagwe township. All data points were localized and recorded with a Garmin GPS eTrex® 10. The concentration of fertilizers (nitrate/nitrite, ammonium and phosphate) in the water was evaluated by using on-site tests (Macherey-Nagel, QUANTOFIX®), additionally selected parameters such as temperature, pH and electric conductivity, were measured. Discharge measurements were obtained at the same sites by measuring the stream profile and the average water velocity.

(II) The local farmers' knowledge of management of the river and perception on quality/quantity changes of the river was investigated through the use of standardized questionnaires, ensuring that all respondents were asked the same questions and that the answers for each question could be quantified and interpreted through statistical analysis. Only respondents who owned plots with access to the river and who were able to extract the water for irrigation purposes were included in the survey.

Key informants were identified to conduct semi-structured interviews, with the aim of achieving more detailed knowledge about local governance and customs. Interview guides were prepared in advance to ensure proper coverage of the topic investigated, open-ended questions were allowed to answer questions in a more flexible manner.

(III) In the same manner authorities and representatives of the government were interviewed. Respondents included the ministry of agriculture (MoA), the village chief of Kimende, the local water service board, the NGO Kenvo, involved with the protection of the local forest and the chairman of the local water resource users association (WRUA). Additionally the juridical framework was studied in a literature review.

Results

I State of the river

The quantitative measurements show constant rate of discharge over the course of the stream, recharge, though water abstractions exist. The many tributaries joining the Bathi river provide stable recharge. In the Kimende area the discharge is about 12 l/s, while further down towards Kagwe the discharge increases to an average of 150 l/s after a forested, uncultivated area of high recharge and no abstraction. The discharge shows a increasing trend further downstream.

Concentrations of fertilizers vary throughout the course of the stream, whereby WHO threshold concentrations are not exceeded, the lower threshold concentrations given by the Kenyan government are exceeded for nitrate throughout the river and for ammonium at one location, pH remains within the upper and lower limits given by WHO. With regard to the tested compounds the water is clean enough for drinking, irrigation and further purposes according to the WHO standards, a pollution by fertilizers is not apparent. The more strict governmental guidelines render the water not drinkable due to too high nitrate concentrations. Organic contamination was not tested in the scope of the field campaign, but may be expected due to e.g. open sewage systems.

II Quantity change and affection (Fig. 1)

When asked about changes in the amount of available water, a clear trend was shown, that most people (96%) did notice decreased amount of water. The subjective timeframe ranged from 2 years to 20 years. When asked, if this affects the respondents agricultural practices, 48% replied positive. Farmers, who claimed not to be affected by decreasing amount of river discharge had access to alternative water sources like personal wells or individual constructed tap systems.

III Education (Fig. 2)

The collected data pointed to a connection between obtained education and the evaluation of the individual impact: Asked if a personal impact on the water quality or quantity exists, farmers who attended secondary schools replied with 'yes' in 45% (n=20) as opposed to farmers who had no or only primary school with 3% (n=30). Therefore it can be concluded, that the understanding of environmental impact is enhanced by proper education.

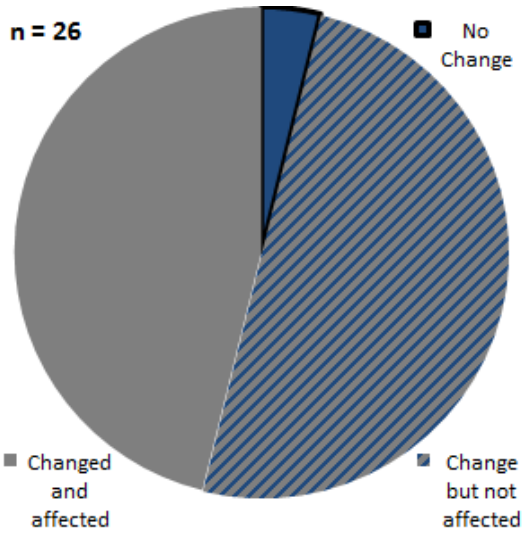

Figure 1: Response of farmers if asked for changes in the changing quantity in the river

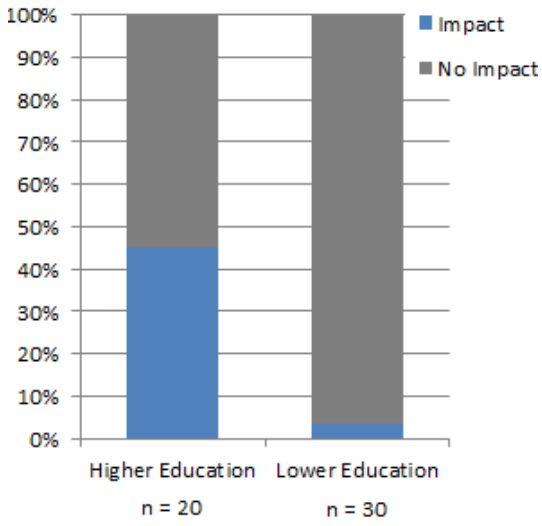

Figure 2: Subjective opinion of farmers on personal environmental impact, grouped after education

IV Legislation/Regulations (Fig. 3)

The legal base for water use and management in Kenya is the "Water act 2014" published by the Kenyan government, it distributes the responsibility between different authorities. On regional level official and voluntary organizations developed own guidelines and regulations, partly contradicting each other.

Everybody is granted the right to freely access water resources for domestic use, but permits are needed for economic water abstraction (irrigation, installation of drainage systems and dams).

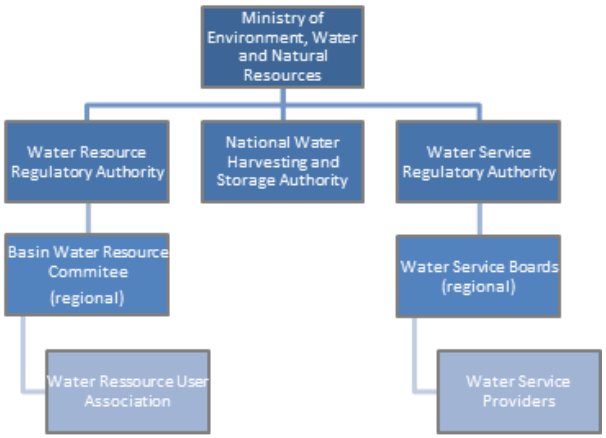

Figure 3: Stakeholders involved in the water management in Kenya

A specific law regarding the use of agrochemicals does not exist, but "The Environmental Management and Co-Ordination (Water Quality) Regulations, 2006" (MENR, 2006) list limiting values for the discharge of various compounds into the environment. These can be used as a benchmark. The authorities additionally advise the farmers to (1) use the product prescription as measure for the amount and (2) base their use of agrochemicals on soil samples analysis.

Challenges

Several key challenges can be identified, that can reach the area in the future: An increase in water demand is likely due to population growth, increased frequency in draughts and floods or by the upgrading of local farmers, either by the extensivation of farmland or the wish to change to more water consuming plants, like e.g. tea. Many local farmers expressed the demand for technique that increases the amount of water that can be abstracted and used for irrigation, as pumps or the construction of dams. The idea to conserve water, as e.g. by the employment of more efficient irrigation techniques is not yet an issue in the area, as water demand did not yet exceed water supply. For future development the MoA favours rainwater harvesting as one of the key techniques to conquer changed precipitation patterns, but yet lacks specific plans to encourage the local community to do so.

The collaboration between different stakeholders, as there is e.g. the government and NGOs and the local community needs to be enhanced as it still has difficulties. Mutual approach of all stakeholders is required to get the full benefit. Today the collaboration is shaped by mistrust and ignorance. Expectations of approach to each other hamper the collaboration. Authorities claim to advertise and provide information which is ignored by local farmers, local communities on the other side have no confidence in the authorities and expect impediments by the authorities; experiences in the past and in the present, as corruption and bribing, shape these attitudes.
Though the juridical frame is in position, the implementation often lacks seriousness. Not only exists a pluralism of law and information, that makes it difficult to identify the correct situation for each case, additionally is the law enforcement poor to nonexistent. Though authorities claim to patrol the area in regular intervals, farmer rarely report the occurrence of executive power. Infringements as the farming in the riverine zone or the rinsing of agricultural products in the river have been observed during the fieldwork. Information and responsibilities are often split between different frameworks and institutions, making it difficult to understand the applying judicature in specific cases.

Conclusion

At the present state, the area of Kimende is not directly under threat by water shortage. Its privileged position on high altitude and forested areas in the direct proximity influence the water availability to the positive and farmers can sustain to irrigate the substantial small scale farming practices in the area. However, there exists the danger, that due to improper management of the water resources, water may become a hindering factor for economic growth. A potentially higher demand on resources, due to land use change and changing agricultural practices, may thereby inflict conflicts, which are at present prevented by social interaction between adjacent farmers. Under increasing competition for water resources in the future the social interaction may decrease or even cease to exist.
To prevent a deterioration of the situation the already existing structures, like legislation and community internal organizations as e.g. water user resource associations (WRUA) must be empowered and strengthened. Raised education of affected people may facilitate the endeavours, as environmental relation can be understood and realized. It is hereby crucial that action is taken before serious water shortage or disputes are rising.

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