

# Will Community-based Water Management Solve Africa's Water Problems?

The performance of Water Resource User Associations in the Upper  
Ewaso Ng'iro river basin, Kenya.

Joost Aarts



Radboud Universiteit Nijmegen



# **Will Community-based Water Management Solve Africa's Water Problems?**

**The performance of Water Resource User Associations in the Upper  
Ewaso Ng'iro river basin, Kenya.**

Name: Joost Aarts  
studentnumber S0516112  
Supervisor: Marcel Rutten  
2<sup>nd</sup> Reader: Lothar Smith  
Radboud University Nijmegen

Nijmegen, august 2012

## **Acknowledgements**

The writing of this thesis proved to be a lengthy process, but the journey is finally finished. It started with an incredible experience, four months of field research in the Upper Ewaso Ng'iro basin in Kenya and finishes today, the day I hand in my thesis. During this process a lot was learned. I further developed my professional skills as a researcher but also had some wonderful personal experiences. Living in a different culture, buying my first motorcycle which gave me the freedom to experience the area in a wonderful way and living in the beautiful nature of the Mt. Kenya region. Nevertheless the process was not always easy and this thesis would not be possible without the help of many. First I would like to thank all my friends who helped and supported me in the writing process. Especially Lucas Noah Dun. Furthermore, my girlfriend Pien Bons who supported me through out all the process and Rick Teunissen and Helen Heuven for their valuable advices and help during my SPSS analyses. Secondly my supervisor Marcel Rutten for his motivating and inspiring supervision during the research process. Thirdly, all organizations that provided me with valuable research data: Rural Focus, CETRAD, Laikipia Wildlife forum, Africa wildlife foundation and SNV. Lastly, special thanks to the Cocoon research project which provided me with the necessary funds to carry out my fieldwork.

**Thank you all!**

**Joost Aarts**

## **Table of contents**

<b>Summary</b>	<b>VIII</b>
<b>List of figures</b>	<b>X</b>
<b>List of tables</b>	<b>XI</b>
<b>List of abbreviations</b>	<b>XIII</b>
<b>1. Introduction</b>	<b>1</b>
1.1 Background	1
1.2 Water and conflict	1
1.3 Water management	2
1.4 The Upper Ewaso Ng'iro river basin	4
1.5 Research questions and hypotheses	5
<b>2. Methodology</b>	<b>8</b>
<b>3. Theoretical framework</b>	<b>10</b>
<b>3.1 Water availability in the world</b>	<b>10</b>
<b>3.2 Scarcity</b>	<b>10</b>
3.2.1 The concept of scarcity	10
3.2.2. Measuring water scarcity	11
<b>3.3 Conflict</b>	<b>12</b>
<b>3.4 The environment and conflict nexus</b>	<b>14</b>
<b>3.5 Management of common pool resources</b>	<b>21</b>
<b>3.6 Community based water management</b>	<b>23</b>
<b>3.7 The Kenyan water sector</b>	<b>24</b>
3.7.1 The 2002 water act	24
3.7.2 The concept of WRUAs	26
3.7.3 Formation of a WRUA	27
3.7.4 The objectives and activities of WRUAs	28
3.7.5 Membership of WRUAs	28
3.7.6 Management of WRUAs	30
3.7.7 WRUA Finances	30
3.7.8 Interaction between WRUAs and WRMA	31

3.7.9 Resolving conflicts	32
<b>4. The Upper Ewaso Ng'iro basin</b>	<b>34</b>
4.1 Introduction	34
4.2 Physical geography	34
4.3 Land cover	35
4.4 Climate and agro climatological zones	36
4.5 Socio-economic settings	38
4.6 Population and immigration	38
4.7 Land use	40
4.8 Land use changes	42
<b>5. Available water resources</b>	<b>43</b>
5.1 Introduction	43
5.2 Water supply	43
5.3 Rainfall and evapotranspiration	44
5.4 Surface water	48
5.5 Ground water	52
5.6 Natural springs and infrastructure for blue water	52
5.7 Theory of Falkenmark	54
5.8 Perception of people about water availability	55
5.8.1 Water availability	55
5.8.2 Relationships	56
5.9 Trend	60
5.10 Main water problems	61
<b>6. Water demand</b>	<b>62</b>
6.1 Introduction	62
6.2 Main water users	62
6.3 Method of abstraction	64
6.4 Abstraction permits	65
6.5 Payment for water	67
6.6 Water sources used	68
6.7 Most important water sources	68
6.8 Trend demand	69

<b>7. Conflicts over water resources</b>	<b>71</b>
<b>7.1 Introduction</b>	<b>71</b>
<b>7.2 Water and conflict</b>	<b>71</b>
<b>7.3 Different forms of conflict</b>	<b>72</b>
<b>7.4 Factors that link with the experience of conflict</b>	<b>74</b>
7.4.1 Member of a WRUA	75
7.4.2 Water availability for household economic activities	75
7.4.3 Logistic regression model	76
<b>7.5 People's opinions about conflict</b>	<b>76</b>
7.5.1 Main occupation	77
7.5.2. Scarcity of water for household economic activities	77
7.5.3. Ethnic Group	78
7.5.4. Main location	78
7.5.5. Member of a WRUA	79
7.5.6 Test between subjects	79
<b>7.6 Trend in conflict</b>	<b>80</b>
<b>7.7 Actions most helpful to prevent conflict</b>	<b>82</b>
<b>7.8 Conclusion</b>	<b>83</b>
 <b>8. Organizational features of Water Resource User Associations.</b>	 <b>85</b>
<b>8.1 Introduction</b>	<b>85</b>
<b>8.2 Formation process of the WRUA</b>	<b>85</b>
8.2.1 Year of foundation	85
8.2.2 Who's idea was it to form a WRUA	85
8.2.3 Trigger events that led to the formation of the WRUA	86
8.2.4 Support in development phase	86
8.2.5 Initial objectives	87
<b>8.3 Organizational structure of the WRUA</b>	<b>88</b>
<b>8.4 Activities</b>	<b>91</b>
<b>8.5 Best achievements</b>	<b>91</b>
<b>8.6 Main potentials</b>	<b>92</b>
<b>8.7 Differences between the WRUAs</b>	<b>92</b>
<b>8.8 Opinion of the community</b>	<b>96</b>
8.8.1 Membership of the WRUAs	96
8.8.2 Reasons for people to join the WRUA	97

8.8.3 Water availability	98
8.8.4 Impact on cooperation	99
<b>8.9 Researchers and NGO employees on WRUA and effectiveness</b>	<b>100</b>
8.9.1 Introduction	100
8.9.2 Influence on the availability of water resource in the area	100
8.9.3 Influence on cooperation	101
8.9.4 Management structure	101
8.9.5 Power issues within the management of the WRUA	102
8.9.6 Legal bases	103
8.9.7 Finances	103
8.9.8 Corruption	104
<b>8.10 Conclusion</b>	<b>104</b>
<b>9. Role of WRUAs in conflict and cooperation</b>	<b>106</b>
9.1 Introduction	106
9.2 Conflict resolution	106
9.3 Impact on conflicts	108
9.4 New types of conflict	110
9.5 Interviews experts	110
9.6 Conclusion	112
<b>10. Discussion</b>	<b>114</b>
10.1 Introduction	114
10.2 Falkenmark's water stress indicator	114
10.3 Conflict and environment nexus	115
10.4 Community based water management	117
10.5 Central hypotheses	118
<b>11. References</b>	<b>120</b>



## Summary

In Sub-Saharan Africa insecure access to water for consumption and productive use is a major constraint for poverty reduction. For millions of smallholder farmers, fishermen and herders in SSA, water is one of the most important production assets. Therefore, securing access to and control and management of water is key to enhancing their livelihoods. Furthermore, in less developed countries environmental conflict is likely to happen because there is high population growth and high dependency on renewable resources such as water. To reduce these conflicts, water as a natural resource should be well managed. Various strategies for water management are introduced to overcome the lack of water and related conflicts. In 2002 the Kenyan government introduced a new Water Act to this end. In this act the Local community based Water Resource User Associations (WRUAs) are legally recognized. Community based management is considered to be the key solution to prevent outbreaks of violence over water resources.

The central hypothesis of the thesis is that 'Water Resource User Associations which are formed under the 2002 Water Act, positively affect cooperation over water resources and these organizations will help to avoid conflict between the different water users in the changing rural water situation in the Upper Ewaso Ng'iro River Basin in Kenya'.

The Upper Ewaso Ng'iro River Basin is located to the north of Mt Kenya and an important source of water for farmers, pastoralists and tourist enterprises. In the last decades, the basin is facing major changes in its socio-economic situation through rapid population growth, both natural and through immigration, and a subsequent land use transformation. These changes have resulted in a society where several stakeholders claim access to natural resources. Pastoralists, commercial livestock ranches, the tourist industry, small-scale and large-scale farmers are now competing over increasingly scarce land and water resources. Historical analyses of river flow data show declining trends. Although rainfall figures do not show a degrading pattern, the onset of the rains seems to become less predictable and extremes are becoming more pronounced. The most important problem is believed to be the large amount of river water abstractions due to the rise in agricultural activities. As the demand for water rises continuously while already stressed supplies remain the same, the possibility of water use conflicts increases.

Conflicts about water in the Upper Ewaso Ng'iro basin are very common within the catchment. 72.5% of the community believes the natural resource water is a common cause of conflicts. These conflicts about water exist in different forms.

1. Intra-group conflicts, i.e., conflicts within a single group of water users,



2. Inter-group conflicts, conflicts between different groups of water users,
3. conflicts between groups of water users and the government,
4. conflict between groups of water users and private businesses.
- 5.conflict between humans and wildlife

However, conflicts that are most severe are the conflicts between the government and the community.

WRUAs are community-based organizations set up to manage the natural water resources and to prevent and resolute conflict. A WRUA is described as ‘an association of water users, riparian land owners, or other stakeholders who have formally and voluntarily associated for the purposes of cooperatively sharing, managing and conserving a common water resource. They are set up because water resources are extremely difficult to control as they are considered ‘common property’ and available to all’ (GOK, 2006).

After studying the water situation in the catchment, the conflicts and the WRUAs, some conclusions can be drawn. The WRUAs are still in a development stage and are dealing with some severe problems. For example, issues concerning the management of the WRUAs and their financial situation. Furthermore, there are big differences between the WRUAs. Where some WRUAs function very well and are very professional, others are not able to accomplish almost anything. Nevertheless, a large part of the community believes that formation of the WRUAs has led to less conflict, more cooperation and less water scarcity in comparison to the situation ten years ago when the WRUAs did not exist. Also, resource experts state that WRUAs are doing a good job on the resolution and prevention of conflict. However, the community also states that there is now more conflict than 10 years ago, when WRUAs did not exist. This is at least remarkable. Yet, this can also mean that although there is now more conflict than 10 years ago, without the WRUAs there would even be more conflict. Therefore, WRUAs can still be seen as very helpful organization in the prevention and resolution of conflict.

## List of figures

Figure 3.1: Stages of conflict	13
Figure 3.2: The institutional set-up under the 2002 Water act	26
Figure 3.3: Formation stages of a WRUA	28
Map 4.1: The Upper Ewaso Ng'iro catchment	35
Map 4.2: Land cover in the Upper Ewaso Ng'iro basin	35
Map 4.3: Monthly aridity index	37
Map 4.4: Population and population growth in the Upper Ewaso Ng'iro catchment	39
Map 4.5: Land use in the Upper Ewaso Ng'iro catchment	41
Figure 5.1: The water balance in the Upper Ewaso Ng'iro catchment	44
Figure 5.2: Rainfall data of three gauging stations; Timau Marani, Jacobson & El Karama.	45
Map 5.1: Monthly rainfall	47
Figure 5.3: Discharge data of the Ewaso Ng'iro river and Ewaso Narok.	49
Figure 5.4: River flow data of the Timau and Naro Moru river.	49
Figure 5.5: River flow data of the Nanyuki and Ewaso Ng'iro river	49
Figure 5.6: Variation in monthly discharge of the Ewaso Ng'iro at Archer's Post 1960 -2010.	51
Figure 5.7: Influence permitted abstractions on river discharge at Achers post	51
Map 5.2: Water pans and dams in the Upper Ewaso Ng'iro catchment	53
Map 5.3: Boreholes in the Upper Ewaso Ng'iro catchment	54
Figure 5.8: Water availability for human household consumption	55
Figure 5.9: Water available for households economic activities	58
Figure 6.1 : Abstractions of 6 rivers in the Ewaso Ng'iro catchment	62
Figure 6.2: Type of abstractors by total number of abstractors in the Upper Ewaso Ng'iro catchment	63
Figure 6.3: Type of abstractors by total number of abstractors in the Upper Ewaso Ng'iro catchment	63
Figure 6.4: Method of abstraction by total number of abstractors in the Upper Ewaso Ng'iro catchment	64
Figure 6.5: Method of abstraction by total amount abstracted in the Upper Ewaso Ng'iro catchment	65
Figure 6.6: Percentage of the community that has a water permit in the Upper Ewaso Ng'iro catchment	65
Figure 6.7: Permit details by total number of abstractors	66
Figure 6.8: Permit details by total amount abstracted	67
Figure 7.1: Conflicts about natural water resource in the Upper Ewaso Ng'iro catchment	71
Figure 8.1: Trend in WRUA membership	97

## List of tables

Table 3.1:Critical enabling conditions for sustainability on the commons. By Agrawal (2002)	22
Table 4.1: Agroclimatical zones of the Ewaso Ng'iro catchment	38
Table 5.1: Rainfall patterns in the high and lowlands	46
Table 5.2: Rainfall analyses of three subsystems in the Upper Ewaso Ng'iro catchment	48
Table 5.3: factors that link with water availability for human consumption	56
Table 5.4:Relation between the main location of the household and the water available for human consumption	57
Table 5.5:Relation between the main occupation of the household and the water available for human consumption	57
Table 5.6 : factors that link with water availability for household economic activities	58
Table 5.7: Relation between the main location of the household and the water available for economic activities	59
Table 5.8:Water availability for HH's economic activities: Irrigated agriculture	59
Table 5.9:Water availability for HH's economic activities: livestock keeping	59
Table 5.10: Trend in water availability of the last 10 years	60
Table 5.11: Trend in water available per water source over the last ten years	60
Table 5.12: Water problems in the Upper Ewaso Ng'iro catchment	61
Table 6.1: factors that link with having a water permit	66
Table 6.2:Relation between the main occupation of the household and if they household has a water permit	66
Table 6.3: factors that link with paying for water	67
Table 6.4: Relation between main occupation and paying for water	67
Table 6.5: Relation between being a member of a WRUA and paying for water	68
Table 6.6: Use of water sources	68
Table 6.7: Most important water source in the Upper Ewaso Ng'iro catchment	69
Table 6.8: Trend in water demand	70
Table 7.1: Types of conflicts in the Upper Ewaso Ng'iro catchment	74
Table 7.2: factors that link with experiencing a conflict in last year	74
Table 7.3: Relation between being a member of a WRUA and experienced conflict	75
Table 7.4: Relation between water scarcity for HHs economic activities and experienced conflicts	76
Table 7.5: Significance of the variables in a regression model	76
Table 7.6: factors that link with people's opinions about conflict	77
Table 7.7: Relation between main occupation and opinion about conflicts	77
Table 7.8: Relation between water availability for household economic activities and opinions about conflicts	77
Table 7.9:Relation between ethnic group and opinion about conflicts	78
Table 7.10 : Relation between main location and opinion about conflicts	78
Table 7.11: Relation between member of a WRUA and opinion about conflicts	79
Table 7.12 : Factors that link with opinion about conflict	79
Table 7.13: Trend in conflict over last ten years	80
Table 7.14 :Trend in conflict over last next ten years	81
Table 7.15: Trend in conflict in different sub-basins	81
Table 7.16 : Trend in conflict over coming ten years	81
Table 7.17: Trend in different types of conflicts over the coming ten years	82
Table 7.18: Trend in conflicts in the different sub-basins	82
Table 7.19: Actions most helpful to prevent water conflict	83

Table 8.1: Formation of the WRUAs	85
Table 8.2: Support of WRUAs in development phase	87
Table 8.3: Initial objectives of the WRUAs	88
Table 8.4: Features of the WRUAs	89
Table 8.5: Income of the WRUAs	90
Table 8.6: Professionalism of the WRUA	90
Table 8.7: Influence of large scale farmers	91
Table 8.8: Best achievements of the WRUAs	94
Table 8.9: Professionalism of the WRUA 2	94
Table 8.10: Main potentials of the WRUAs	95
Table 8.11: WRUA membership in sub-basins	96
Table 8.12 : Year became a member	97
Table 8.13: Reasons why people became a member	98
Table 8.14: Main activities of the WRUAs	98
Table 8.15: Influence of the WRUA on water availability	99
Table 8.16: Influence of WRUAs on cooperation	100
 Table 9.1: Number of conflicts addressed by the WRUAs	 107
Table 9.2: Professionalism of the WRUA 2	107
Table 9.3: Influence of WRUAs on conflicts	110
Table 9.4: Influence of WRUAs on new conflicts	110

## **List of abbreviations**

ASAL – Arid and semi-arid lands

B&P - Baland & Platteu

CBNRM – Community based natural resource management

Cocoon – conflict and cooperation over natural resources

EO –Ostrom

HH- Household

RW - Wade

SSA – Sub Saharan Africa

UNHCHR - United Nations High Commissioner for Human Rights

LWF – Laikipia wildlife forum

MOU - Memorandum of Understanding

NGO – Non governmental organization

WDC – WRUA development cycle

WRUA – Water resource user associations

WRMA – Water resource management authority

WSB – Water service board

WSTF – Water service trust fund

# 1 INTRODUCTION

## **1.1 Background**

Water is essential for life. There is no living creature that can survive without water. Our human bodies also foremost consist of water. We not only need water to drink for our physical wellbeing, but even more so need water for other essential aspects of our existence like agriculture, industry and transport (Ohlsson, 1995). Access to sufficient, safe and affordable water is vital for human development (Jayyousi, 2007). Unfortunately, not every person has access to a sufficient amount of water. In 2003 more than 1.2 billion people lacked access to an adequate supply of water and more than 2.4 billion lacked access to adequate sanitation (UNHCR;WHO, 2003). More than 2.4 million people die annually from water related diseases due to an absence of a qualitatively safe water supply; most of them are children (UNHCR, 2003; WHO,2003). Experts fear an even bigger global water crisis in the next few decades and the 2009 World Water Forum held in Istanbul stated 'Assuring universal access to safe drinking water and sanitation is, with no doubt, one of the most challenging items on the world's agenda' (World water forum, 2009). Especially in Sub Saharan Africa (SSA) insecure access to water for consumption and productive uses is a major constraint for poverty reduction. For millions of smallholder farmers, fishermen and herders in SSA, water is one of the most important production assets, and securing access to and control and management of water is key to enhancing their livelihoods (Faures & Santinin, 2008).

## **1.2 Water and conflict**

Homer-Dixon (1999) claims that in less developed countries environmental conflict is likely to arise because of high population growth and high dependency on renewable resources. Therefore management of scarce resources is always conflict management. Homer-Dixon (1999) furthermore believes that violence that results from competition over scarce resources is triggered by failures in governance. Failures such as unequal access to resources and free riding problems. Policy makers are trying to understand how best to cope with increasing water scarcity in the form of new management strategies. Two solutions are frequently proposed. The firsts solution proposed, is giving responsibility to government agencies to act on behalf of all citizens. The second solution often suggested, is to privatize water services so as to utilize market systems for allocation (Ostrom, 2003). According to Ostrom however, the dilemma of water management is not easily solved. She states that there is no best system for governing water resources because the outcome of resource management depends

on a multiple number of factors. Faures & Santini (2008) agree with Ostrom and also suggest that there is no “one size fits all” approach for improving livelihoods. Different contexts and needs require different types of investments to guide the choice for specific interventions.

Much of the problems that arise by management of water resources are believed to originate from the fact that water is a common pool resource. Common-pool resources may be owned by national, regional or local governments as public goods. Communal groups use them as common property resources. Whereas private individuals or corporations use them as private goods. A common pool resource is often misrepresented as being open access. For example, Garreth Hardin uses pastures of nomadic pastoralists as an example for his tragedy of the commons theory. He did so, without ever having visited or spoken to pastoralists. However, these pastures are no free rider places but are regulated by customary law whereby certain areas are set aside. For example, for use during the dry season grazing period. Also individual property of water sources, which is very common, enables pastoralist to control communal grazing in the vicinity of these resources.

If common pool resources are owned or regulated by no institution, group or person, they might be used as an open access resource. Most of the problems which arise in water management occur when water is used as an open access resource. In an open access situation everybody has free access to this resource. This is because it is no other persons', groups' or institution's private property. Because of the lack of restrictions, the source might easily become depleted; tragedy of the commons. Common pool resource problems occur when the resources are managed as open access resources. Resulting in increasing competition over the resource. Therefore the resource becomes scarce. In this situation not everybody will have access to the resource anymore. Thus water as a common pool resource should be well managed, especially in situation of supply-demand unbalances. The most obvious actor to control such a natural resource is the state. But as Leroy (1993) states, the government alone with its control strategies cannot solve all of the environmental problems.

### **1.3 Water management**

A gradual change has occurred in the philosophy and practice of environmental management at regional, national and international scales (Rhoads, 2009). Within the water sector a supply driven approach has been implemented throughout Africa with a massive development of water infrastructure. This has resulted resulting in increased storage capacity, expansion of irrigation schemes, construction of distribution and wastewater networks, improved services and use of high quality technology among others (Perret, 2006). Although resource development and mobilization remain crucial and feasible in some areas, opportunities for further massive development seem unlikely in many countries, owing to financial issues (Perret, 2006). Perret claims it is unlikely that



further significant increase in abstraction of water at reasonable costs is plausible. Most likely this increase will lead to severe environmental or social disturbance. However this statement is a contested one; e.g., a different vision is held by researchers from the Food and Agricultural Organization of the United Nations (FAO) and the International Fund for Agricultural Development (IFAD). These authors claim that small scale investment in water infrastructure can make a difference. Assisting poor people requires giving particular attention to low capital investments and low external input technologies. In other words, there is a need for taking the limited financial assets of poor households and the weaknesses of rural service systems into account. Faures and Santini claim that, agricultural water interventions should no longer be based on the assumption of specialized or increasingly specializing irrigation farm units, managed by full-time professional farmers. The interventions should instead assist in overcoming water bottlenecks in manifold context-specific ways. According to Faures and Santini local interventions in water are needed which can contribute to the rapid improvement of the livelihoods of the rural poor in Sub Saharan Africa (SSA). There are important opportunities for new investments in water. Success will depend on the development of new models of interventions, centered on enhancing the diversity of livelihood conditions of rural populations. The International Livestock Research Institute (ILRI) also believes investments can make a difference in the rural water situation. The ILRI furthermore stated in a recent publication that, although rain fed crop production is quite marginal and restricted to pockets of higher potential areas within Arid and Semi Arid Lands (ASAL) districts. There is also a sizeable area that could support crop production if there could be a greater investment in irrigation (Ericksen et.al., 2011)

Opinions differ on the best solutions to solve the existing water scarcity. Scholars agree on the fact that, unlike today's relatively stagnant supply, demand for water has quickly evolved. Along with diversification of uses and users, rapid urbanization and raising environmental and health related concerns (Perret, 2006). These elements have led to in depth-reforms resulting in new policies in the water sector in many countries in Africa and elsewhere in recent decades (Perret, 2006). This change involves a shift away from top-down strategies. Strategies in which planning, policy formulation, and regulation are conducted primarily by centralized government agencies. A change towards a bottom-up approach, which involves all relevant parties, especially local communities, in the process of environmental management and decision making (Merkhofer et al., 1997; Moote et al, 1997; Vasseur et al., 1997; Smith et al., 1997).

The management of and access to water resources are identified as key aspects of poverty reduction, agriculture and food security, and sustainable development in developing, transitional and developed countries worldwide. Therefore different strategies for water management are introduced in developing countries to overcome the problems of water scarcity and conflict. In 2002 the government of Kenya introduced a new Water Act. This Act has introduced comprehensive and, in

many instances, radical changes to the legal framework for the management of the water sector in Kenya (Mumma, 2007). One of these changes was the legal recognition of the Local Water Resource User Associations (WRUAs). The rules covering the water law define a WRUA as an association of water users, riparian land owners, or other stakeholders who have formally and voluntarily associated for the purposes of cooperatively sharing, managing and conserving a common water resource (Watson, 2007). With the establishment of a legal basis for WRUAs, a new management strategy was established. This means that from now on, instead of the national government, local associations are responsible for local water governance.

#### **1.4 The Upper Ewaso Ng'iro river basin**

The Upper Ewaso Ng'iro river basin is located to the North and West of Mount Kenya and is an important area for agriculture, livestock keeping and tourism. In the last decades, the basin is facing major changes in its socio-economic situation through immigration, rapid population growth and land use transformation. These changes have resulted in a society where several stakeholders claim access to natural resources. Pastoralists, small-scale farmers, large scale vegetable and flower farms, ranches and the tourist industry are now competing over increasingly scarce land and water resources.

In the Upper Ewaso Ng'iro basin there are distinct differences in water use among people living in the highland and lowland parts of the basin (Gichuki, 2001). People living in the highlands are mostly arable farmers on both small- and large scale farms. They grow rainfed crops increasingly supported by irrigation. The lowlands in contrast are inhabited by cattle ranchers and pastoralist. Where the pastoralist are heavily dependent on the mainstream flow of the Ewaso Ng'iro river for their survival. The basin is densely populated with livestock. Muchoki (1998) estimated the livestock in 2005 to reach 521,000. Livestock in the basin consist mainly of cattle, sheep, goats, camels and donkeys. In addition to livestock, the Upper Ewaso Ng'iro has a very dense population of wildlife. The wildlife population is currently estimated to be around 121,000. Consisting mainly of buffalo, eland, elephants, gazelles, impala, gerenuk and giraffe (Gichuki, 2001).

In the Upper Ewaso Ng'iro basin some problems have arisen. Pastures downstream that depend on river floods are threatened as a result of upstream changes (Kohler, 1987). Because of the drying up point backtracking, pastoralist groups are moving into neighboring territory resulting in conflicting situations. Participants from the research program Conflict and Cooperation over Natural Resources (CoCoon) stressed the lack of understanding among downstream users on the river regime changes. In the upstream area, discussions occur between horticultural farmers (Cocoon, 2010). Large firms producing hundreds of hectares of flowers, fruit and vegetables for the European market, may be taking as much as 25% of water normally available to more than 100,000 small farmers (Guardian, 2006). From the 1990's onward, most streams originating from mount Kenya, show a

degrading pattern in river discharge. Even so rainfall patterns do not tend to show a degrading trend. Although rainfall data seems to become less predictable. The most important problem is believed to be the large amount of river water abstractions. This is mostly due to the rise in agricultural activities foremost.

The demand for water continues to rise and the available amount of water is constant. Therefore the stage for water use conflicts, which already have become common in the last decade, is around the corner. In order to counterbalance this trend the new Water Act 2002 provides a different approach to water management. Community based management is considered to be the key solution to prevent outbreaks of violence over water resources in the region. Local community based Water Resource Users Associations (WRUAs) have now been established or recognized to govern the local water situation and to act as forums for conflict resolution.

The introduction of these WRUAs in the Upper Ewaso Ng'iro basin brought about some problems. In the view of the CoCooN research team there is a strong need for participatory research. As mistrust among people, especially among the small scale water users inhabiting the catchment is on the rise. Inclusion of stakeholders is needed to build capacities and educate basin dwellers on their rights and duties, especially towards implementation of the 2002 Water Act. Also information regarding population and resources are aggregated at administrative rather than basin level (Cocoon,2010). Yet, this information is of critical importance for drawing-up appropriate policies for equitable allocation of basin-wide resources.

This study tries to provide insights in how the Water Resource User Associations, which are formed under the 2002 Water Act, affect the occurrence of conflict and cooperation in the rural water situation in the Ewaso Ng'iro North River Basin in Kenya. In particular, a study was made of how these WRUAs are managed, which major problems these WRUAs face internally and how the different water users are affected. Also, the study aims to provide information about the available resources and their users on basin level. The information gathered should provide knowledge which can be used in the Upper Ewaso Ng'iro river basin water management and possibly in other basins in Kenya and other developing countries.

### **1.5 Research questions and hypotheses**

In Kenya every citizen has a right to water, yet millions of Kenyans are currently underserved. Too many citizens continue to drink unsafe water or are forced to use minimal quantities of water. As distance, waiting times, and costs make water inaccessible for them (Faures & Santani, 2008). Inequities in access to water are glaring. The struggle for water by the excluded sections of Kenya's population contrasts sharply with the privileged part of the population. The few who benefit from water delivered to their homes, often at very low prices (Faures & Santani, 2008). The World Bank

(2009) estimates that on a national level the coverage of piped water is between 42% and 59%. This leaves millions of citizens without easily accessible water resources. In their most optimistic estimation, the World Bank indicates that almost 16 million Kenyans rely on water kiosks, protected wells, rainwater catchments and open water resources such as flowing streams and open shallow wells, to meet their daily water needs.

This also applies to the Upper Ewaso Ng'iro catchment. Gichuki (2001) claims scarcity of water resources has become one of the major problems. Due to climate change, growing population and land use changes. In this research insight is provided in to which water resources are available within the Upper Ewaso Ng'iro basin and what determines the availability of water resources in an annual cycle. As scholars define a declining trend in the available water resources, data is provided to underline their statement. Finally insights are provided in the trend of the water situation to for the near future.

As already stated in the introduction, the Upper Ewaso Ng'iro basin is home to a multi-stakeholder society. All these stakeholders claim a proportion of the available natural resource water. There are discussions, however, about the proportion of water every water user is likely to detract. Therefore, this research aims to provide an overview of the main water users, the most important abstractions methods used, i.e., the most important water sources in use and possible changing trends on the demand side.

With such diverse competitors for water in a highland- lowland system, conflict is likely to arise. As discussed in the introduction, the upstream users of water, who have the first opportunity to abstract water. Become the main generators of conflict between upstream irrigators and downstream irrigators. These conflicts mainly arise during dry years. Also, water scarcity in the lower reaches has in some cases led to the upstream migration of wildlife and pastoralists' cattle and consequent destruction of crops and irrigation infrastructure (Gichuki, 2001). However, this seems to be a relatively narrow view. To gain more insight in the different processes which lead to conflict, the major discussions and conflicts about water resources in the basin are discussed.

As the occurrence of conflicts has become common in the basin, new strategies of conflict resolution and prevention are put in place. These strategies are introduced in the form of a WRUA. WRUAs are supposedly formed through the efforts of the major water users within a given river subcatchment. Aside from mobilizing the local community, these WRUAs also provide the necessary financial and logistical support. They have an important role in respect to conflict prevention, resolution and cooperation. As they help to create common understanding among the user groups (Kiteme & Gikonyo, 2002). WRUAs help change people's perceptions and attitudes. In order to enable people to appreciate the need for concerted efforts and action to ensure that water is available to all deserving (Kiteme & Gikonyo, 2002). In theory, the concept of these WRUAs seems to be very clear.

However in reality WRUAs seem not be as established as assumed theory wise. In this thesis, information is gathered about the organizational features of WRUAs.

Following the overview of the organization of the WRUA, the specific role of these bodies in conflict and cooperation over water resources is analyzed. The main question raised is, if the WRUAs are able to play their role of an institution of conflict prevention and resolution.

All of the above results in the central hypotheses of this research project. Water Resource User Associations which are formed under the 2002 Water Act, positively affect cooperation over water resource. Furthermore these organizations will help to avoid conflict between the different water users in the changing rural water situation in the Upper Ewaso Ngi'ro river Basin in Kenya.

## 2 METHODOLOGY

The research strategy used to understand the rural water situation and the role of WRUAs in conflict and cooperation over water in the Upper Ewaso Ng'iro river basin is an in depth case-study. A range of different research techniques have been applied to collect data. A combination of qualitative and quantitative methods has been used. The qualitative data is derived from in-dept interviews and literature study. The quantitative data used is derived from household surveys and analyses of secondary data.

A questionnaire was conducted among a total of 150 households over a period of four months. This survey was carried out in four different sub-catchments, the Nanyuki, the mid-Ewaso Ng'iro, the Sirimon and the Ngusishi sub catchment. These locations are strategically chosen to make sure the sample is a good representation of the population living in the Upper Ewaso Ng'iro catchment. For the WRUAs this meant that the locations were selected based on four criteria; professionalism, period in operation, geographical location, and scale of the WRUA.

1. *Professionalism*: the most professional WRUA , i.e., the Ngusishi WRUA and the least professional one i.e., mid-Ewaso Ng'iro WRUA are both included.
2. *Year of establishment*: whereas the Ngusishi WRUA was already founded in 1999, the mid-Ewaso WRUA was only started in 2008.
3. *Location*: most WRUAs are based in the upstream part of the basin, three of the chosen WRUAs are therefore upstream WRUAs. But to make sure the diversity in WRUAs is covered also a mid-stream WRUA is included.
4. *Scale*: there is a huge difference in the size of the area each WRUA covers. The Ngusishi WRUA only covers a very small and short river, the mid-Ewaso covers a part of the largest river in the Ewaso Ng'iro catchment, the Ewaso Ng'iro river.

To make sure the people and their livelihood systems are also well represented, the sub basins are also selected on criteria as ethnicity, most common land tenure system and most common livelihood within the sub catchment.

Within these four locations the households interviewed were selected at random. Almost all households we chose to interview were present and available during the time we visited the catchment. The only criterion was that the person resided within the sub catchment. Therefore interviews were carried out door to door. To assure all wealth levels were included, we selected

various dwellings. Ranging from small sheds, via middle-class houses to large villas. People from all relevant ethnic groups, namely Kikuyu, Masai, Meru and Samburu were selected. Their age ranged from 15 to 80 years. Although only 25 percent of the sample population is female, the sample can be seen as a good representation of the population in the basin. This is because we aimed to interview the head of the household and only a small proportion of the household is headed by a female. If the male head of the household was absent, the wife of the head of the household was interviewed.

In addition to the questionnaire, several semi-structured in-depth interviews were held with a number of actors. A total of ten semi-structured in-depth interviews were carried out with WRUA officials from ten different WRUAs to get a good grip on the accomplishments, problems and organizational structures of these WRUAs. Because of research – looking into other aspects of the WRUAs - has been conducted recently in the Upper Ewaso Ng'iro catchment, these researchers were also interviewed. In order to collect their opinion on the functioning of WRUAs. Within the catchment a lot of national and international NGOs are working with the WRUAs. For that reason NGO representatives were interviewed to gain further insights in accomplishments and problems of the WRUAs. Finally, relevant local government officials were interviewed.

Besides the questionnaire and the semi-structured interviews, a literature study was also carried out. To provide relevant insights in the theory about water management, the nexus between conflict and the environment, literature dealing with these topics was studied. Ewaso Ng'iro river basin specific studies were also included.

The last source of information used for this research is secondary grey data obtained from some of the stakeholders in the area. These stakeholders consisted of, WRUA officials, NGOs and the local government. They provided rainfall data and river flow data which were very helpful in defining the past, current and future water situation in the catchment. Statistical analyses of this material provided relevant insights.



# 3 THEORETICAL FRAMEWORK

## **3.1 Water availability in the world**

The total amount of water in the world is constant. There are approximately 1,386 million cubic kilometres of water on earth stored in water basins and underground reservoirs and in the atmosphere (Black & King, 2009). Nearly all of this water is salty, contained in the oceans, seas, saltwater lakes and in aquifers beneath the ocean. Only 2.5% is available for human use, of which more than two-thirds is locked up in glaciers, snow, ice and permafrost (Black & King, 2009).

## **3.2 Scarcity**

### *3.2.1 The concept of scarcity*

The concept of scarcity can be interpreted in multiple ways. Scarcity as an economist's concept as interpreted by Smith (1996) is defined as the objective lack of sufficient resources to cover a given demand. This concept refers to absolute water shortages. A resource is scarce when demand exceeds supply at a price of zero (when it is freely available). In a free market system, price is thus an indicator of the relative scarcity of goods; an increase in usefulness (demand) or a reduction in quantity (supply) will lead to an increase in scarcity (price) (Derman & Hellum, 2007). It is thus possible to compare the scarcity of a given resource in different locations or at different times. The easiest way to do this is through its real price when the resource is exchanged in markets. Homer-Dixon (1998) states that absolute scarcity can be measured by the ratio of consumption through time to the total available amount of the resource. However, natural resources are in absolute limited supply, constrained by available areas and volumes of land, water and air and they will tend to become scarcer through time as population will increase (Derman & Hellum, 2007).

A second perspective on scarcity is that of Kronenburg & Vlist (2009). In their perspective, a resource is scarce due to obstacles hampering access to the resource (for example too high price). They see the concept of scarcity as a problem of restricted access. A third perspective also mentioned by Kronenburg & Vlist (2009), is that scarcity is expressed in terms of utility value, for example a lack of clean water, non-contaminated (e.g. non-radioactive) natural resources or healthy food (sufficient nutrients). A fourth and final perspective on scarcity is that demand is not objective but subjective, and whether a resource is considered scarce or not is socially determined (Achterhuis, 1990). Buyers can experience a feeling of scarcity because they are dependent on a small number of producing countries that may use their market power to achieve political or other objectives (Kronenburg &

Vlist, 2009). Following this theory, scarcity is not objective but constructed through human relations and their interventions. Achterhuis (1990) uses this subjectivity concept and claims that objects cannot become scarce until they become the object of competition and conflict. In this thesis, scarcity will be defined as the observed scarcity of natural resources, i.e. scarcity as an economist's concept.

### *3.2.2 Measuring water scarcity*

The tool that is most widely used to measure water stress and scarcity is the Falkenmark water stress indicator. Developed in order to quantify water shortages and based on the relationship between the quantity of water available in a certain territory and the number of inhabitants of that territory. The theory is based on the premise that people need at least a certain minimal amount of water per day to survive. These benchmarks of water stress and water scarcity are not intended to describe Malthusian limits to growth or strict natural thresholds governing population-environment interactions with consistent and unalterable effects. Rather, they serve as indicators of the likelihood of adverse consequences related to water shortage. As such, these benchmarks can help predict the future urgency of problems related to fresh water availability (Gardner-Outlaw & Engelman, 1997).

Falkenmark (1997) states that 1,700 m<sup>3</sup> of renewable water resources per capita per year is the threshold, based on estimates of water requirements in the household, agricultural, industrial and energy sectors, and the needs of the environment. Countries whose renewable water supplies cannot sustain this figure are said to experience water stress. Falkenmark distinguishes five different types of water situations at country level.

1. Countries with little or no problems; they have more than 10,000 cubic meters of water per capita available annually.
2. Countries with occasional problems: they have 1,670 to 10,000 cubic meters of water per capita available annually.
3. Countries with frequent problems, which is called water stress: they have 1,000 to 1,670 cubic meters of water per capita available annually.
4. Countries with chronic problems: they have 500 to 1,000 cubic meters of water per capita available annually.
5. Countries with an absolute shortage, which is called real scarcity: they have less than 500 cubic meters of water per capita available annually.

Although this theory is a simple and easily applicable method to give insight in the water situation of a country, it also has its constraints. Since only the quantity of the water is measured and not the quality, a distorted view of the real situation can arise (Donkers, 1994). In theory it would be possible that a country does indeed have sufficient water, but it cannot be used because it is polluted.

A second point of critique that Donkers introduces is that the indicator considers a country as a homogenous entity. However, there can be regional differences within countries.

However, more research has been performed on water scarcity. Researchers from the United Nations suggest that each person needs at least 20 to 50 liters of water a day to ensure their basic needs for drinking, cooking and cleaning (WWAP, 2012). On top of this water for peoples basic needs, it takes 2,000 to 5,000 liters of water to produce one person's daily food (WWAP, 2012). However, these researchers did not design an indicator that can be used to measure water scarcity in general. Therefore, even though the indicator designed by Falkenmark has some constrains, this indicator will be used to measure water scarcity in the Upper Ewaso Ng'iro basin, since it is considered a good tool to roughly measure the level of water scarcity in a catchment.

### **3.3 Conflict**

In everyday language the term conflict has no positive intonation, and usually dysfunctional phenomena including discord, dispute or fighting are associated with it (Axt, 2006).

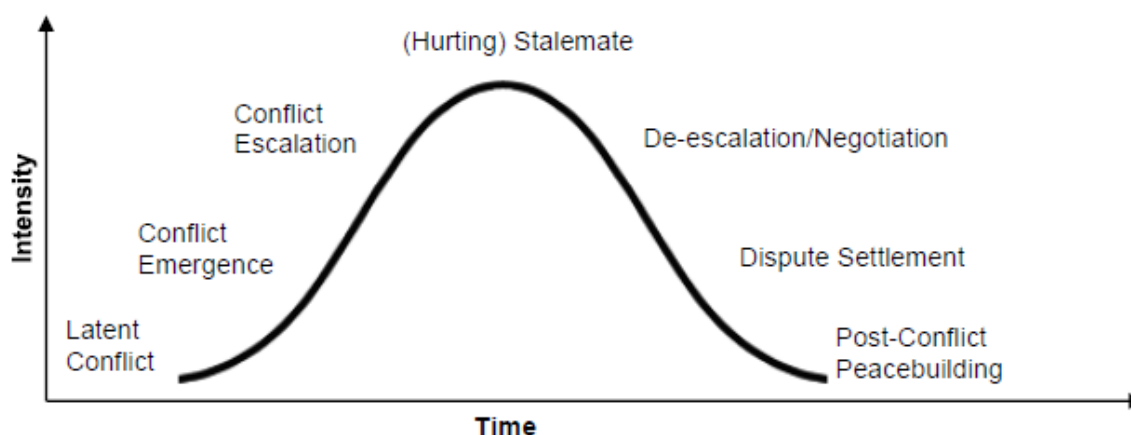
Research into the categories of conflict is usually centred around two approaches, the subjectivist and the objectivist approach (Axt, 2006). The objectivist approach derives from Smith (1968) and looks for the origin of conflict in the social and political make-up and structure of society, and considers that the goals at stake can be thoroughly compatible. On the contrary, the subjectivist point of view focuses primarily on the perceived incompatibility of goals and differences. As Deutsch (1991) puts it: "... it is incompatible differences which give rise to conflict. ... It is not the objective incompatibility that is crucial but rather the perceived incompatibility." Deutsch (1991) states that the level of incompatibility is the most important variable that influences the intensity of the dispute and the dynamics of the conflict.

A conflict, however, is not a stagnant phenomenon. Axt (2006) states that a newly emerging conflict will develop further with certain dynamics and intensity, changing its course and stages. Thus understanding developing stages of conflict and their categorization are crucial, because it may provide indications of what might happen next and what may facilitate management of the conflict.

There are different models in the literature on conflicts that try to categorize conflicts and different stages of conflict, but the most important one is constructed by Pfetsch (1994). In his model five types of conflict are categorized: latent conflict, manifested conflict, crisis, severe crisis and war. The biggest difference between these types of conflicts is that some of them are violent where others are non-violent. According to Gleditsch, Latent conflict and manifested conflict are non-violent and crisis, severe crisis and war are violent conflicts. Absence of violence does not automatically mean an absence of conflict, because violent escalation of every conflict evolves from a non-violent phase of conflict (Axt, 2006). Sandole (1998) defines a non-violent conflict as "manifested conflict process

(MCP)”, as a situation in which at least two parties, or their representatives, try to pursue their perceptions of mutually incompatible goals by undermining directly or indirectly, each other’s goal seeking capability. Yet before a non-violent conflict can exist, the non-violent conflict must be noticed and recognized by the outside world, as well as by at least one of the involved parties. Conflicts enter a violent phase when parties go beyond seeking to attain their goals peacefully and try to dominate, damage or destroy the opposing party’s ability to pursue their own interest (Axt, 2006). Sandole (1998) describes a violent conflict as : ‘a situation in which at least two parties, or their representatives, attempt to pursue their perceptions of mutually incompatible goals by physically damaging or destroying the property and high value symbols of one another and/or psychologically or physically injuring, destroying or otherwise forcibly eliminating one another’. There are different typologies designed to classify the stages of conflict dynamics. One of the most influential authors in this debate is Brahm (2003). He differentiates between seven phases of conflict dynamics, which are shown in figure 3.1.

**Figure 3.1:** Stages of conflict



Source: Brahm (2003)

Alker, Gurr & Rupesinghe (2001) also developed their conflict dynamic trajectory consisting of six phases; dispute phase, crisis phase, limited violence phase, massive violence phase, abatement phase and settlement phase. In general, conflict literature describes conflicts as a dynamic circle that is composed of tension, escalation, de-escalation and settlement phases. Axt (2006), however, places the remark that it is important to bear in mind that these four basic phases neither necessarily follow upon each other after a certain period of time, nor does each conflict pass through all phases in its development.

The causes of conflict are diverse, and there are countless issues over which people can have conflicts. Weber (1947) placed these countless causes in three categories: wealth, power and prestige. However, not every scholar agrees on these three categories. Deutsch (1973), for instance,

designed a model with basic issues: control over resources, preferences and nuisances, beliefs, values or the nature of relationship. Singer (1996) points out other 'usual suspects': territory ideology, dynastic legitimacy, religion, language, ethnicity, self-determination, resources, markets, dominance, equality, and revenge. But the most widely accepted classification by conflict scholars is the one from Pfetsch & Rohloff (2003). They identify nine commodities that have historically proven to be the most disputed conflict issues: territory, secession, decolonization, autonomy, system, nation power, regional dominance, predominance, international power, resources and other.

### **3.4 The environment and conflict nexus**

In recent years, many scholars have indicated a relationship between the availability of natural resources and the occurrence of conflicts. However, the debate about the relationship between natural resources and conflict is not new. In 1798, Malthus published his book, 'An essay on the principle of population' in which he suggests that population growth would overtake economic growth. Out of this simple principle he predicted a food crisis. This negative view on the relation between natural resources and conflict would continue and in 1968 Garreth Hardin published his central concept in human ecology and the study of the environment named the 'tragedy of the commons'. The concept can be explained in a very simple way. There is a resource to which a large number of people have access. The resource might be an oceanic ecosystem from which fish are harvested, the global atmosphere into which greenhouse gases are released or a forest from which timber is harvested (Ostrom, 2002). Overuse of the resource creates problems, often destroying its sustainability. The fish population may collapse, climate change may ensue, or the forest might cease growing enough trees to replace those cut (Ostrom, 2002). Each user faces a decision concerning how much of the resource to use – how many fish to catch, how much greenhouse gases to emit, or how many trees to cut (Ostrom, 2002). If all users restrain themselves then the resource can be sustained. But there is a dilemma: if one limits one's use of the resource but neighbours do not, then the resource still collapses and you have lost the short-term benefit of taking the share (Hardin 1968). Hardin argues that a 'Man is locked into a system that compels him to increase his herds without limit- in a world that is limited" (Hardin, 1968:1244). He further asserted that having a conscience was self-eliminating (Ostrom, 2002). Those who restrain their use of a common-pool resource lose out economically in comparison to those who continue unrestrained use.

This concept has long been a central theory for the relation between the environment and conflict among policymakers. But although the logic of the tragedy of the commons seems inexorable, Ostrom (2002) argues that, the logic of the tragedy of the commons depends on a set of assumptions about human motivation, about the rules governing the use of the commons, and about the character of the common resource. Ostrom states that in the past 30 years important

contributions have been made to clarify the concepts of the tragedy of the commons theory. One point she addresses is that things are not as simple as they seem in the prototypical model. Human motivation is complex and the rules governing real commons do not always permit free access to everyone. The resource systems themselves have dynamics that influence their response to human use. The result is often not the tragedy described by Hardin but what McKay (1996) has described as a 'comedy' – a drama for certain, but one with a happy ending. Ostrom states that if we assume self-interest and one time interactions, then the tragedy of the commons is one of a set of paradoxes that follow.

All of the analyses previously sketched presume that self-interest is the only motivator and that social mechanisms to control self-interest -such as communication, trust and the ability to make binding agreements-, are lacking or ineffective (Ostrom, 2002). Although these conditions certainly do describe some interactions, they do not describe all, because people may sometimes move beyond self-interest. As McKay (1996) argues, communication, trust, the anticipation of future interactions, and the ability to build agreements and rules sometimes control behaviour well enough to prevent a tragedy.

Thus, the use of common pool resource by a group of people does not always have to end as a tragedy. If managed properly, a drama with a happy ending like McKay (1996) described could also be the outcome. Moreover, Adano & Witsenburg (2007) give examples of strong common property regimes governing water resources coping well with increased water scarcity. The water management regime in Marsabit as described by them shows that water, as a scarce common property resource, is not used as an open-access resource, because only through maintenance, labour or financial contributions use rights can be built. In this situation, where it is needed to avoid conflict, they state that a strong enforceable property regime over natural resources exists, which does not change when population pressure increases.

But Hardin was not alone in being pessimistic about the relationship between the environment and conflict. Forrester, in the 1970s with his pessimistic world models, and Chouchri and North (1975), who assessed the role of environmental change as a cause of conflict, contributed to this trend in the debate.

Also in more recent years, the debate about the relationship between natural resources and conflict continues. In conflict studies, development studies, political science and policy circles there has been, over the last decade, a vivid and sometimes fierce debate on the nexus of environment and conflict (Frerks, 2007). The debate started with scholars like Homar-Dixon (1991), Peluso and Watts (2001) and Baechler (1998) stating that environmental scarcities lead to violent conflict, but there are not only researchers that see the environment as a conflicting factor. Researchers like Wolf (2009) and Witsenburg and Roba (2007) view the environment as a window for peace making.

One of the most important authors in the 1990s on the conflict and environment nexus is Homer-Dixon. Homer-Dixon's (2000) research focused on renewable resource and showed three sources increasing environmental scarcity, i.e., environmental degradation and destruction; population growth and increasing inequality in access to and control over environmental resources. He showed that environmental scarcities are already contributing to violent conflicts in many parts of the developing world and that these conflicts are probably the early signs of an upsurge of violence in the coming decades that will be included or aggravated by scarcity. The violence will usually be sub-national, persistent and diffuse (Homer-dixon, 1997). Also Witsenburg & Roba (2007) believe that it is widely assumed that in less developed countries environmental conflict is likely to happen because there is high population growth and high dependency on renewable resources. They argue that, poor countries cannot allocate (enough) wealth for research and development to invent new techniques to produce or substitute scarce resources. In addition, it is argued that developing countries lack well-defined or enforceable property rights to govern renewable resources. Therefore common property resources are used as open-access resources (Homer-Dixon, 1999, Maxwell & Reuveny 2000). Thus according to Homer-Dixon (1999), violence due to competition over scarce resources would be triggered by failures in governance such as unequal access to resources and free riding problems.

Homer-Dixon (1997), however, also argues that, social conflict is not always a bad thing: mass mobilization and civil strife can produce opportunities for beneficial change in the distribution of land and wealth and in the process of governance. But fast-moving, unpredictable, and complex environmental problems can overwhelm efforts at constructive social reform (Homer-Dixon, 1997). He further states that, scarcity can sharply increase demands on key institutions, such as the state, while it simultaneously reduces their capacity to meet those demands and that these pressures increase the chance that the state will either fragment or become more authoritarian. He concludes that the negative effects of severe environmental scarcity are therefore likely to outweigh the positive and mismanaged environmental scarcity causes violent conflict. This statement, however, is heavily criticized by other scholars (as discussed below), who argue that Homer-Dixon tend to somewhat overstate the issue. They question the definitional clarity, theoretical foundation, (causal) analysis and empirical basis of the studies.

Witsenburg & Roba (2007) claim that numerous studies have falsified some of the hypotheses in the scarcity-causes-violence-paradigm. The first argument they use is that of Berkes (1989) and Bromley (1992) who argue that most common property resources are not used as open-access resources and are in fact used in a sustainable way. The second argument is borrowed from Platteau (1996) who showed in his critique of the evolutionary theory on land rights that well-defined and enforceable property rights in the form of title deeds in sub-Saharan Africa are not always a solution to insecurity of land tenure, and can eventually lead to violence. Third they use the



argument of Fairhead and Leach (1996) and Tiffen et al. (1994) that, widespread resource degradation is not always unidirectional. Fairhead and Leach (1996) and Tiffen et al. (1994) show that West African forests seemed to be much more resilient than was assumed and resource productivity in semi-arid Machakos increased with rising population numbers.

Another well known criticus of Homer-Dixon is Derman. Derman (2007) states that, 'The research of Homer-Dixon and Baechler tends to become a victim of its scale and ambition on the one hand and its lack of rigorous quantitative methodology on the other, 'the need to integrate a wide number of disparate cases while unable to gauge the relative importance of different explanatory variables '.

Agmann (2005) has more fundamental points of critique on the concept of environmentally induced conflict. He believes the concept itself is fundamentally flawed, as it neither allows for convincing empirical substantiation nor for sound theory-building. He further states that, 'a critical review of the literature reveals the shakiness of the concept's core assumption: the idea that "environmental concerns are indeed associated with greater conflict". There are three elements central to Agmann's argument. First, research on the "ecologic sources of conflict" (Lind & Sturman, 2002) has been characterized by a one-sided fixation on causality. Second, environmental conflict literature amalgamates eco-centric and anthropocentric conceptions of agency that are incompatible. Third, the field has failed to take into account how social actors contribute to, perceive, and cope with environmental change and degradation.

Furthermore, Baechler (1998), Wolf (2001) and Yoffee & Giordano (2005) are other well known researchers that come to different conclusion then Homer-Dixon. Their approaches contain three elements;

1. the creation of a deep historical database documenting water relations linked to the intensity of cooperation and conflict;
2. the construction of a geographic information system of countries and international basins current and
3. historical with associated indicator variables; the formulation and testing of hypotheses about factors associated with water conflict (Derman, 2007).

On the occasion of these three elements, the researchers concluded that cooperation over freshwater resources exceeds international conflict. However, Wolf (2009) states that water management is by definition conflict management. He bases this conclusion on arguments given by Postel (1999) that, 'water, unlike other scarce, consumable resources, is used to fuel *all* facets of society, from biologist to economies to aesthetics and spiritual practice.' (Postel, 1999). Moreover, it fluctuates wildly in space and time, its management is usually fragmented, and it is often subject to vague, arcane, and/or contradictory legal principles. He further states that 'there is no such thing as

managing water for a single purpose – *all* water management is multi-objective and based on navigating competing interests’ (Wolf, 2009:21).

The Oregon State University undertook a three-year research project that attempted to compile a data set of *every* reported water-related interaction between two or more nations, whether incidents of conflict or cooperation, over the past 50 years (Wolf, 2003). The study documented more than 1,800 such interactions that involved water as a scarce and/or consumable resource or as a quantity to be managed (Wolf, 2006). Out of this study came a number of conclusions. First, despite the potential for dispute in international basins, the record of cooperation historically overwhelms that of acute conflict over international water resources (Wolf, 2006). Second, despite the fiery rhetoric of politicians, often aimed at their own constituencies rather than at the enemy, most actions taken over water are mild (Wolf, 2006). Third, nations find many more issues on which to cooperate with regard to water resources than to fight over (Wolf, 2006). So Wolf (2006) believes that while the potential for paralyzing disputes is especially high in these basins, history shows that water can catalyse dialogue and cooperation, even between especially contentious riparian’s. The reason for the fact that international water wars usually not occur is that, ‘the institutions countries have created to manage the basin frequently prove to be resilient over time and during periods of otherwise strained relations’ (Wolf 2006:14).

More scholars have come to the conclusion that natural resources are not always the key factor in explaining conflict. Hauge & Ellingsen (1998) found that although countries suffering from environmental degradation – and in particular from land degradation - are more prone to civil conflict economic factors are far more important in predicting domestic and armed conflict than environmental degradation.

Besides comments on the scarcity-causes-violence-paradigm there are also researchers like Soysa (2002) and Gleditsch (2001) that claim that not resource scarcity, but abundance might be related to armed violence. De Soysa (2002) posits a direct link between recourses and conflict. He stipulates that ‘abundant supplies of valuable natural resources create incentives for conflict groups to form and fight to capture them. Conflict would be caused more by greed of rent-seeking groups than by the grievances of deprived segments of a country’s population (Soysa, 2002).

Also the World Bank (2003) and Klem (2003) explored whether grievance or greed explains armed violence. They showed that availability of easily tradable and valuable resources like diamonds and arms would correlate stronger with violence than scarcity of natural resources. Collier & Hoeffler (1998) and Collier (2000) provided evidence to support these hypotheses. Their findings relying on the share of primary commodities exports in total exports have repeatedly shown a positive correlation between that variable and the onset of conflict. Also Ross (1999), Fearon (1994) found

evidence to support the so called honey pot hypothesis.; abundance, not scarcity of natural resources spawns conflict by providing a “honey pot” over which to fight (Soysa, 2002).

Another way of thinking about violence in relation to increasing scarcity of resources refers to alternating stages of conflict and response. For example, Witsenburg & Adano (2007) claim that, as resources become scarcer, the incentive for conflict increases; but because conflicts are costly, so does the incentive for conflict avoidance and resolution. Therefore, they argue it is interesting to distinguish responses to short-term scarcity situations and long term scarcity situations. Because, increasing resource scarcity could lead to increasing violence in the short term, both in frequency and intensity. However, violence could eventually generate institutional changes that reduce conflict (Witsenburg & Adano, 2007). After studying conflict in the Marsabit region in the long-term they suggest that, there is no long-term trend of increasing violence. Despite population growth people might have found ways to share and cooperate. They state that there is less violence in drought than in wet years which means that the violence occurring in Marsabit district is not related to drought induced scarcity of resources. For this argument they give a number of causes. They say that raiders like to attack during wet, years because the grass in the range is high which is important for hiding before and after the attack. In addition, during wet years animals are strong enough to trek vast distances, it is of no use to steal weak animals from the enemy in a drought because it is not easy to feed and water them (Witsenburg & Adano, 2007).

However, the conclusions reached by Witsenburg & Adano after their Marsabit research are contested. Rutten (2012) argues that there are some methodological problems in their research. He argues that definition of drought years, the use of rainfall/drought years as a unilateral proxy for resource scarcity, while disregarding geographical and temporal variety of the annual totals, needs to be addressed. Next the cause of the conflict, resource scarcity due to low rainfall, could have originated elsewhere, for example across the border in Ethiopia and not in northern Kenya for which the rainfall data are presented. Rutten also argues that population data for the area is not reliable. Another critique is that, conflicts are mainly reported as interethnic fights, yet it is known that several African (pastoralist) communities are split along (sub)clan and section (geographical) lines. These groups have been fighting over resources at time as well. These internal conflicts are a mixture of resource capture and political leadership twists (Rutten, 2012). The key argument Rutten (2012) raises is that, abundance of grass and water is linked by Witsenburg & Adano to the killing and fights between pastoralists. However, the reason why these conflicts occur is not fights over abundant water or pasture but over lack of cattle. Moreover this is not so much a natural but a productive resource which is in shortage after a major drought that decimated the herd.

From 2001 onwards scholars tends to promote a multi-causal, multilevel and multi-actor perspective in which the role of environmental factors is mediated through or combined with other

factors, often of a socio-political nature (Gleditsch, 2001). Mono causal approaches highlighting the environment as the reason for war in the 21st century have given way to a more modest approach. In this approach environmental factors are certainly not discarded as a conflict factor, but positioned into a broader and more complex framework (Goodhand & Hulme, 1999). The economic agenda in civil wars project of the international peace academy (Ballentine, 2004) concluded: none of the conflicts studied can be accurately characterized as pure 'resource driven' wars. The outbreak of conflict was triggered by the interaction of economic motives and opportunities with long-standing grievances over the mismanagement or inequitable distribution of resource wealth. Furthermore, Exclusionary and repressive political systems, inter-group disputes and security dilemmas further exacerbated by unaccountable and ineffective states, are other triggers found to be more important than natural resources. (Frerks, 2007). In summary, in the last decade the main stream position is that the environment and associated factors like environmental degradation, resource scarcity and more recently climate change, do or may play a role in the rise and continuation of conflicts but are seldom the only or most important factor (Frerks, 2007). Environmental issues have become politicized before they will lead to violent mobilization. These views are shared by Ballentine (2004) who states that 'the correlation between natural resource dependency and conflict risk is not direct: variations in the state's governance are critical intervening factors. Richards (2005) also states that, 'there is no Malthus with guns'. Gleditsch elaborates further that environmental degradation may be seen as an intervening variable between poverty and poor governance on the one hand and conflict on the other, in this sense environmental degradation may be seen as a symptom that something has gone wrong rather than a cause of the world's ill. Direct and immediate linkages between environment and conflict have found to be absent or weak according to these scholars. Therefore it seems safe to conclude that the prospect of environmental wars as such is pretty remote.

Frerks (2007) believes that, At sub-national or local levels conflicts may indeed occur due to resource scarcity or mal-distribution. Though occasionally there are instances of violence and incidental casualties, these fights so far are still somewhat sporadic often not systematically organized or enduring to such a degree that they would fall under the usual definitions of violent conflict or low-intensity wars. But he does also argue that there is a clear possibility that these local 'green-wars' will escalate into more prominent national violence or even spill over to neighbouring countries. Therefore these 'green-wars' need to be positioned and monitored in terms of declining rural livelihoods and related patterns of resource plunder, predation, overexploitation and depletion. Because at present it seems that rural livelihoods are allowed to deteriorate further and chances on this type of conflict increase (Frerks, 2007).

In case of water conflicts, Warner (2004a, 2004b) suggests, it appears that water conflict is usually not so much about the allocation of the resource but about rules and procedures of its allocation or become flashpoints of very different struggles, with deep historic roots.

### **3.5 Management of common pool resources**

Water is often a common pool resource, which means that in theory everybody has access to this resource, because it is no one's private property. Though everyone can use water, it can become depleted. Common pool resource problems occur when water becomes scarce and competition for the resource increases. Then not everybody will have access to water anymore. Thus water as a common pool resource should be managed. But as we have seen managing common pool resources brings about some problems. Therefore the question is: How should common pool resources such as water be managed in order to achieve sustainable use for all users?

One way of managing common pool resources is through institutions. Institutions are the rules that people develop to specify the 'do's and don'ts' related to a particular situation (Ostrom, 2002). In regard to common-pool resources, rules define who has access to a resource; what can be harvested from, dumped into, or engineered with a resource; and who participates in key decisions about these issues and about transferring rights and duties to others (Ostrom, 2002). The best tool for sustainable management of common-pool resources, or the creation of institutions to manage these resources depends on the characteristics of the resources and users. National governments in most developing countries have turned to local-level common property institutions in the past decade and focus on new policy to decentralize the government of the environment. According to Agrawal (2002), however, 'This shift in policy is no more than a belated recognition that sustainable resource management can never be independent of sustainability of collective human institutions that frame resource governance'. Furthermore, local users are often the ones with the greatest stakes in sustainability of resources and institutions. This is based on the assumption that under some combination of frequently occurring conditions members of small groups can design institutional arrangements that help sustainable management of resources (Agrawal, 2002).

In light of this argument Agrawal (2002) designed a set of critical enabling conditions for sustainable management of common-pool resources. Following Wade (1994), Ostrom (1990) and Baland & Platteau (1996), Agrawal added variables which many scholars of common property would consider most important for achieving institutional sustainability for the commons. The factors he presents can be found in Table 3.1 and can be subdivided in four groups; resource characteristics, group features, institutional arrangements, and the external environment.

However, it cannot be claimed that this list forms an exhaustive set of critical enabling conditions for sustainability on the commons, but it is also not likely that an undisputed exhaustive set will ever be created.

**Table 3.1:** Critical enabling conditions for sustainability of the commons. By Agrawal (2002)

Abbreviations: RW= Wade (1994), EO=Ostrom (1990), B&P =Baland & Platteau (1996)
1) Resource system characteristics i) Small size (RW) ii) Well-defined boundaries (RW, EO) iii) Low levels of mobility iv) Possibilities of storage of benefits from the resource v) Predictability  2) Group characteristics i) Small size (RW, B&P) ii) Clearly defined boundaries (RW, EO) iii) Shared norms (B&P) iv) Past successful experiences—social capital (RW, B&P) v) Appropriate leadership—young, familiar with changing external environments, connected to local traditional elite (B&P) vi) Interdependence among group members (RW, B&P) vii) Heterogeneity of endowments, homogeneity of identities and interests (B&P) viii) Low levels of poverty  (1 and 2) Relationship between resource system characteristics and group characteristics i) Overlap between user-group residential location and resource location (RW, B&P) ii) High levels of dependence by group members on resource system (RW) iii) Fairness in allocation of benefits from common resources (B&P) iv) Low levels of user demand v) Gradual change in levels of demand  3) Institutional arrangements i) Rules are simple and easy to understand (B&P) ii) Locally devised access and management rules (RW, EO, B&P) iii) Ease in enforcement of rules (RW, EO, B&P) iv) Graduated sanctions (RW, EO) v) Availability of low-cost adjudication (EO) vi) Accountability of monitors and other officials to users (EO, B&P)  (1 and 3) Relationship between resource system and institutional arrangements i) Match restrictions on harvests to regeneration of resources (RW, EO)  4) External environment i) Technology a) Low-cost exclusion technology (RW) b) Time for adaptation to new technologies related to the commons ii) Low levels of articulation with external markets iii) Gradual change in articulation with external markets iv) State

- |  |
|--|
| a) Central governments should not undermine local authority (RW, EO)<br>b) Supportive external sanctioning institutions (B&P)<br>c) Appropriate levels of external aid to compensate local users for conservation activities (B&P)<br>d) Nested levels of appropriation, provision, enforcement, governance (EO) |
|--|

Source: Agrawal (2002)

Although this method to characterize the sustainability of a common pool resource is helpful there are some problems attached. One important issue stems from the fact that most of the conditions cited in Table 3.1 are expected to pertain to all common-pool resources and institutions, rather to or dependent on some aspects of the situation. The most significant problem of this method is a consequence of the sheer numbers of conditions that seem relevant to the successful management of common-pool resources (Agrawal, 2002). Furthermore, because the effects of some variables may depend on the state of other variables, any careful analysis of sustainability on the commons needs to incorporate interaction effects among variables (Agrawal, 2002).

### **3.6 Community based water management**

In the last 20 years, a gradual change occurred in the philosophy and practice of environmental management as well at regional, national, and international levels. This change involves a shift away from top-down strategies, in which planning, policy formulation, and regulation is conducted primarily by centralized government agencies, towards a bottom-up approach, which involves all relevant parties, especially local communities, in the process of environmental management and decision making (Merkhofer et al., 1997; Moote et al, 1997; Vasseur et al., 1997; Smith et al., 1997). The new philosophy that occurred is described by Blaikie (2006) as ‘ that communities, defined by their tight spatial boundaries of jurisdiction and responsibilities, by their distinct and integrated social structure and common interests, can manage their natural resources in an efficient, equitable, and sustainable way’ . This idea is based on arguments from researchers like Ostrom (1990) and Agrawal (2002) who believe that sustainable resource management can never be independent of sustainability of collective human institutions that frame resource governance, and that local users are often the ones with the greatest stakes in sustainability of resources and institutions. It is also based on the assumption that under a combination of frequently occurring conditions members of small groups can design institutional arrangements that help sustainable management of resources. Cooperation, collaboration, conflict resolution, and social negotiation are therefore emerging as central issues in the community-participation paradigm (Rhoads, 2009).

Proponents of community-based resource management like Bradshaw (2003) believe that, situating decision-making closer to the place of resource use and subjecting decision-makers to the repercussions of their decisions creates the potential for more flexible and prudent resource



management. Furthermore, by empowering communities to develop their own strategies for local economic development, greater community stability may be achieved (Bradshaw, 2003).

Critique on the theory and practice of community based resource management (CBRM) has been aired. Bradshaw (2003) for example, argues that neither of these potentials will be realized if the credibility and capacity of communities are assumed rather than interrogated. The desired end will not be achieved if newly empowered communities are not credible in their management of local resources or have insufficient capacity to do so. That is, communities must display a genuine desire to steward local resources in the interests of all stakeholders—including future generations and non-locals—and have sufficient capacity to manage the resource base in order to achieve adequate and stable return (Bradshaw, 2003). Also Blaikie (2006) raises critical arguments on Community based resource management, he argues that ‘the attractiveness of CBRM rides on a heterogeneous set of theories and sentiments but has been increasingly criticized from within the academy and in some professional evaluations. He argues that monitoring the outcomes of CBRM programmes has been very rare, and non-existent and evaluations of CBRM by the communities themselves have been conspicuously absent, so that their voices have not been articulated and heard. He goes further by claiming that their “success” is reproduced within a network of multi-lateral and bi-lateral agencies, international NGOs, in-country NGOs and a limited number of senior government officials in recipient countries.

Researchers like Crance & Draper (1996), Maser (1995) and Selin & Chavez (1995) argue that not only the community should be involved but also scientific and technical experts. According to them the decision making process needs to consist out of effective communication between local people and scientific/technical experts to generate positive outcome.

### **3.7 The Kenyan water sector**

#### *3.7.1 The 2002 water act*

In 2002, the present Water Act was enacted, ‘to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of the rights to use water’ (GOK, 2002). The 2002 Water Act, has introduced comprehensive and radical changes to the legal framework of the water sector in Kenya. These reforms revolve around the following four themes as described by Mumma (2007):

1. the separation of the management of water resources from the provision of water services;
2. the separation of policy making from day-to-day administration and regulation;
3. decentralization of functions to lower-level state organs; and
4. the involvement of nongovernment entities in both the management of water resources and the provision of water services.

The 2002 Water Act separates the management of the water resource from the delivery of the water services. In the act two autonomous public agencies are established. One to regulate the management of water resources and the other to regulate the provision of water and sewerage services (Mumma, 2007). The Water Resource Management Authority (WRMA) was established to regulate the management of water resources. WRMA is responsible for the allocation of water resources through a permit system (GOK, 2002). Next to WRMA the Water Services Regulatory Board (WSRB) was established. The WSRB is mandated to license all water and sewerage services that provide to more than 20 household (GOK, 2002).

The 2002 Water Act also decentralizes functions to lower level institutions. It does not, however, go as far so to devolve these functions to the lower level entities, ultimate decisionmaking remains central (Mumma, 2007). Kenya is divided into six catchment areas. WRMA is mandated to formulate a catchment management strategy for the management, use, development, conservation, protection and control of water resources within each catchment area (Watson, 2007). The authority appoints a committee of up to 15 persons for each catchment area to advise its officials at the appropriate regional office on matters concerning water resources management, including the grants and recitation of permits (Mumma, 2007). With regard to the provision of water and sewerage services, water services boards (WSBs) are established. WSBs cover an area of service which may encompass the area of jurisdiction of one or more local authorities and is responsible for the provision of water and sewerage services within its area of coverage. For this purpose it must obtain a license from the regulatory board (Mumma, 2007). The Act, however, prohibits the WSBs to engage in direct services provision. The WSB must identify another entity as its agent to provide water services. In most cases the provisioner is a private company.

The 2002 Water Act has continued and even enhanced a long standing Kenyan tradition of involving non-governmental entities and individuals in the management of water resources, as well as in the provision of water services (Mumma, 2007). Both in the authority as in the regulatory board. The act, however, enacts the principle of local users taking responsibility for the guardianship of their own resource (Watson, 2007). This is a complete change in resource management strategy, which in turn will require a major reassessment in thinking on the part of both consumers and managers (Watson, 2007). In the Water Act a role for the community in water management is recognized. The community organized in water resource user associations is seen as an important link in the management of water resources. The 2002 Water Act relies on voluntary membership associations rather than on other institutional mechanism such as local authorities (Mumma, 2007). The reason for this is the belief that, being voluntary in nature, these associations can draw on the commitment of the members as social capital, as opposed to attempting to rely on more formal statutory structures, which might not necessarily be able to call on that social capital (Mumma, 2007). The act



resources. Second, since their livelihood is at stake, the water resource users can be mobilized to undertake water resource management activities that serve their best. Third, It is more efficient (with respect to the WRMA) for the WRUA to mobilize the water users to solve problems at the grassroots level. WRMA and WSTF (2007) also see 'The WRUA as a suitable vehicle around which to mobilize and coordinate the participation of water users in water resource management' and argue that, 'the experience to date indicates that WRUAs, if properly encouraged, can provide a significant contribution where other institutions might struggle to achieve the same impacts'.

### *3.7.3 Formation of a WRUA*

In parallel with the growing competition for water in Kenya, the idea evolved of its users grouping together in an effort to better manage the resource (Watson, 2007). On some rivers the forum for the management and more equitable distribution of water emerged as a direct response to a crisis; on others it was and sometimes remains more a realization that it was better to be prepared to face shortages than to wait to react to them as and if these occurred (Watson, 2007). But not along all rivers initiatives for setting up WRUAs occurred spontaneously. In some cases WRUAs only appeared because the 2002 act prescribes that all rivers in Kenya should be managed by a WRUA.

The 2002 Water Act already obliged the establishment of WRUAs. Yet, it was not until the water rules in 2006 formal processes of registration of the WRUAs were elaborated. The rules cover the registration of the WRUAs with WRMA, Rule 10 describes that 'for a WRUA to be considered for registration by the authority, it should be legally registered, which is specified as 'an organization, corporate body or person that has legal status'. However, it is not easy to form an association. A combination of the need for a lengthy constitution, bureaucratic paranoia in the registry of societies and a formation time often measured in years rather than months make their establishment expensive in terms of time, energy and money (Watson, 2007). WRUAs often start as self-help groups or community based organizations (CBO) registered with the department of social services (Watson, 2007). An important reason for this is that the foundation of a CBO is relatively easy. However, associations have stronger legal standing, backed up by the detailed provisions of the Society Act. They also have a better structured system of governance and membership and so prove more acceptable receptacles for donor funds (Watson, 2007). Thus although setting up a WRUA can be a long-lasting process it creates benefits. To structure the process of establishing a WRUA, in 2006 WRMA and WSTF designed the WRUA development Cycle (WDC). The WDC is the framework upon which the WRMA/WSTF will give financial support to eligible WRUAs for the implementation of the Sub-Management Catchment Plans (SCMP) so as to improve the catchments and water resources.

Forming of a WRUA takes place in three stages; the formation stage, the infant stage and the mature stage. The stages as described by WRMA and the WSTF can be found in Figure 3.3.

**Figure 3.3:** Formation stages of a WRUA

WRUA Development Stage	Defining Features	Indicators
<b>Formation Stage</b>	Membership is poorly defined	Membership list not yet developed
	Management arrangements are interim	Management committee memberships interim
	Financial systems are weak, no financial security	No bank account, no record of transactions
	Registration in progress	No registration
	Constitution being developed	No constitution
<b>Infant Stage</b>	Official Registration confirmed	Registration Certificate
	Management systems are new and tentative	Management uncertain
	Governance systems are new and un-tested	Low awareness of provisions in constitution, low adherence to constitution
	Membership criteria is not widely understood, membership numbers growing	Membership records
	Financial systems improving	Operations Manual Financial Manual & systems Procurement Manual
	Resource conflicts identified	Resource conflicts persist without convincing resolution
	Action Plans tentative and limited in scope	Action Plans partially implemented
<b>Mature Stage</b>	Governance structures are operational and tested	AGM, elections, quality of leadership, adherence to constitution
	Financial systems well established, accountable and transparent	Audited Records
	Membership is clear, active, and stable	Membership records Membership awareness of CBO activities (communication system functioning)
	Management is professional, efficient, and performance driven	Management minutes, implementation of action plans
	Systems in place to handle resource conflicts	Resource conflicts identified and action taken
	Action Plans developed covering broader scope and scale	Action Plans implemented

Source: WRMA & WSTF (2008)

#### 3.7.4 The objectives and activities of WRUAs

The WDC suggest the following objectives for WRUAs

- Promote controlled and legal water use activities;
- Promote good management practices to make efficient and sustainable use of the water resource;

- Promote water conservation practices to ensure sufficient water reserves that meet the demands of the environment, the wildlife, the livestock and all the communities who rely on the water resource;
- To work towards reducing conflict in use of the water resource and participate in solving those that arise;
- Promote catchment conservation measures to improve water quantities and quality.

In order to pursue and realize the above objectives, the WDC suggest the following activities for the WRUA.

- a) Exchange of information and ideas on the water resource use;
- b) Discuss potential projects and developments that may affect water usage with a view to obtain the consent of other WRUA members and the public;
- c) Resolve conflicts on water use;
- d) Monitor water availability and use;
- e) Lobby for resources to improve availability, reliability, quality or other aspects of the water resources.

However in the WDC some notes can be found on the issue of objectives and activities. It is stated that, it is important to note that some of the listed activities are the mandate of WRMA. Consequently, it is recommended that the WRUAs undertake them on the basis of cooperation and not through delegation from WRMA. This will make the WRUAs be accountable primarily to their membership and not WRMA.

### *3.7.5 Membership of WRUAs*

Membership of WRUAs is detailed in their constitution, the contents of which are largely governed by their legal status (Watson, 2007). To make sure all members are represented in the WRUA, different categories of membership are created. WRMA and WSTF (2007) suggest four categories of members : Riparian Members; Abstractor Members; on-consumptive Members; Observer Members.

Riparian members are described in the WDC, A riparian land owner (i.e. the land adjoins the river course) is entitled to membership of the Association as a Riparian Member, even if the member does not abstract water directly from the water body (WRMA & WSTF, 2007). A riparian owner is entitled to one membership only, regardless of the size or number of riparian plots that he/she owns (WRMA & WSTF, 2007). Riparian membership in no way entitles the member to river water abstraction(WRMA & WSTF, 2007).

Abstractor Members are described in the WDC as a person, scheme or project who abstracts water from the water body and who should normally have a permit to support his/her/its abstraction

(WRMA & WSTF, 2007). This type of member is further sub-divided in the WDC. This is done to reflect the different types of abstractors, and may include:

- i. Water Projects or Schemes – primarily for domestic water but serving many households;
- ii. Individuals – primarily for domestic water;
- iii. Irrigation abstractors;
- iv. Industrial abstractors – primarily for industrial purposes;
- v. Livestock Production abstractors;
- vi. Other commercial type abstractors;

The third category of members described in the WDC is that of a Non-Consumptive Member. A non-consumptive member is a person, enterprise or other legally registered entity, who uses the water body as part of his/her/its business or livelihood, but who does not abstract from the water body (WRMA & WSTF, 2007). A fishing cooperative serves as an example. The fourth and last category of members is the Observer Member. The Observer Member is a non-voting category (WRMA & WSTF, 2007). This membership is open to any individual, organization, or government department who wish to participate in the activities of the association (WRMA & WSTF, 2007). Technical advisers and government officials requested to serve in the interests of the association are categorized as observer members.

### *3.7.6 Management of WRUAs*

Like membership of the WRUA also management of the WRUA is detailed in their constitution. The Management of the WRUA develops upon an executive committee, usually made up of the association's office bearers and also of others either from different sections of the river or varying interest groups (Watson, 2007).

### *3.7.7 WRUA Finances*

Like all other organizations WRUAs need finances to operate and undertake activities, therefore they need to design a proper financial system. According to Watson (2007) two basic issues dominate the funding of a WRUA; how much does it need – which usually depends generally on its ambitions – and how is it going to raise this money. The most important expenses of the WRUA's according to WRMA and the WSTF (2007) are;

1. to implement the sub-catchment management plan,
2. to build compliance of regulations,
3. develop small to medium scale storage,
4. for catchment conservation and riverbank protection,
5. for training and capacity building for WRUA stakeholders,

6. Mobilization of water resources users in WRM activities,
7. Activities associated with mitigation of water use conflict,
8. Formulation and implementation of water allocation plans ,
9. Settling ponds, composting pits and other structures to reduce effluent discharge
10. Works to control runoff and soil erosion,
11. Works associated with the protection,
12. conservation or enhancement of the water resource quality.

To cover these expenses WRUAs need to come up with a way to raise funds. Six ways of raising funds are described in the WDC. These six ways are split up in internal ways of raising funds and external ways.

- i). Internal: Membership registration fee and annual subscriptions, voluntary contributions, payment for services rendered by the WRUA;
- ii). External: Water Resource Management Authority. WRMA might support WRUAs directly or indirectly depending on need, priority of the intended activity, and confidence in the WRUA to implement the activity. These activities may include capacity building activities, planning workshops, riparian demarcation, catchment protection, designs and proposal development for larger water resource infrastructure (dams, flood protection, etc).
- iii). External: Water Services Trust Fund (WSTF). The option for WRUAs to be able to submit proposals, vetted by WRMA, to WSTF for support is being developed
- iv). External: Constituency Development Fund through CDF committee
- v). External: Community Development Trust Fund – they have two programmes; community development programme and community environment facility both of which have a water and sanitation component. WRUAs can apply through CDTF application forms available through the respective district development officers.
- vi). External: Proposal writing to NGOs with interest in water and sanitation.

However, WRMA and WSTF reckon that, although there are options for fund raising, the value of internal resource mobilization is frequently overlooked, the experience from the Mt. Kenya WRUAs indicates that WRUAs may be able to operate up to a point based on voluntary contributions by members (WRMA & WSTF, 2007).

### *3.7.8 Interaction between WRUAs and WRMA*

The fact of WRUAs being set up outside the Water Act makes them fully autonomous, operating beyond any influence of WRMA can make for an awkward relationship between the two (Watson, 2007). However, WRMA suggests that its duty is to provide an enabling environment for the establishment of WRUAs but it may use the eventual autonomy of a WRUA as an excuse to deny it



assistance (Watson, 2007). To structure the relationship between WRMA and the WRUA, the Authority may enter into a Memorandum of Understanding (MOU) with a WRUA for the purposes of collaborative management of the water resources. The MOU may provide for administrative, technical or financial support to the WRUA by WRMA in respect of activities related to collaborative water resource management (WRMA & WSTF, 2007). The MOU however is still based following four premises of the water law.

- A. The WRMA is responsible for the regulation of the use of water resources with a view to ensuring the sustainable management of the nation's water resources.
- B. The mandate of the WRMA includes facilitating the establishment of Water Resources Users Associations and assisting them in their development and operation.
- C. The Water Act 2002 and the National Water Resources Management Strategy makes provision for and encourages WRUAs to engage in the management and development (of water resources) within their areas of jurisdiction.
- D. "Water Resource User Association (WRUA)" is an association of water users, riparian land owners, or other stakeholders who have formally and voluntarily associated for the purposes of cooperatively sharing, managing and conserving a common water resource.

WRMA and WRUA recognizing the above, now come to an understanding on collaboration arrangements for supporting each other in regard to their shared desires to improve the management of the water resources within the subcatchment, through this MOU (GOK, 2006).

The purpose of the MOU is to outline an acceptable framework and provide details of a partnership arrangement between the Parties with clearly outlined mandates and responsibilities of each party towards achieving improvement in regard of water resources management (WRMA & WSTF, 2007). The MOU provides a foundation, to establish the basis cooperation that may develop with time and be augmented through specific potential contracting arrangement that are mutually agreed upon (WRMA & WSTF, 2007). Such arrangement will not affect or supersede the understandings reached within this MOU. Once signed, WRMA will allow the WRUA to assume certain roles in the management of the catchment for a period of 3 years which are as described in the MOU.

### *3.7.9 Resolving conflicts*

WRUAs are not only formed for the concept of community based water management the government of Kenya also sees them as important actors in conflict resolution. In section 15 (5) of the 2002 Water Act is stated that 'these associations will act as forums for conflict resolution and cooperative management of water resources'. Researchers like Gikonyo & Kiteme (2002) even argue that WRUAs were formed primarily to address the concerns of river water conflicts.

They see the most significant contributions of the WRUAs in the prevention and resolution of water conflict through direct intervention to deal with the major causes of conflict, such as over abstraction of water, illegal water abstraction, wasteful means of conveyance and irrigation and delayed issuance of water permits. Those guilty of such offenses are compelled by the respective Association to take the necessary corrective measures; otherwise, they are reported to the relevant authorities for appropriate legal action. Furthermore, they see WRUAs as pressure groups to press for speedy issuance of water permits by the concerned authorities and as fora for dialogue and arbitration of potential and existing water conflicts.

Furthermore, Practices (and developments) within the sub catchment that have the potential to cause use conflicts are identified by the water situation monitors and reported to the executive committee (members of the association effected can also report directly to the executive committee) who move quickly to address the problem, either directly or through the district water office (Gikonyo & Kiteme, 2002).

# 4 THE UPPER EWASO NG'IRO BASIN

## **4.1 Introduction**

In this chapter a situational analyses of the study area, the Upper Ewaso Ng'iro basin, will be provided. The Upper Ewaso Ng'iro catchment is a landscape comprised of communal and trust lands, cattle ranches and private wildlife conservancies managed by pastoralist communities and commercial enterprises. As well as agricultural plots managed by agribusinesses and smallholder farmers (ILRI,2010). Although parks and protected areas cover less than 10% of the catchment it is home to the greatest diversity and density of wildlife in east Africa outside of the Serengeti-Mara park system (Georgiadis et al., 2007; Ojwang & Wargute, 2009)

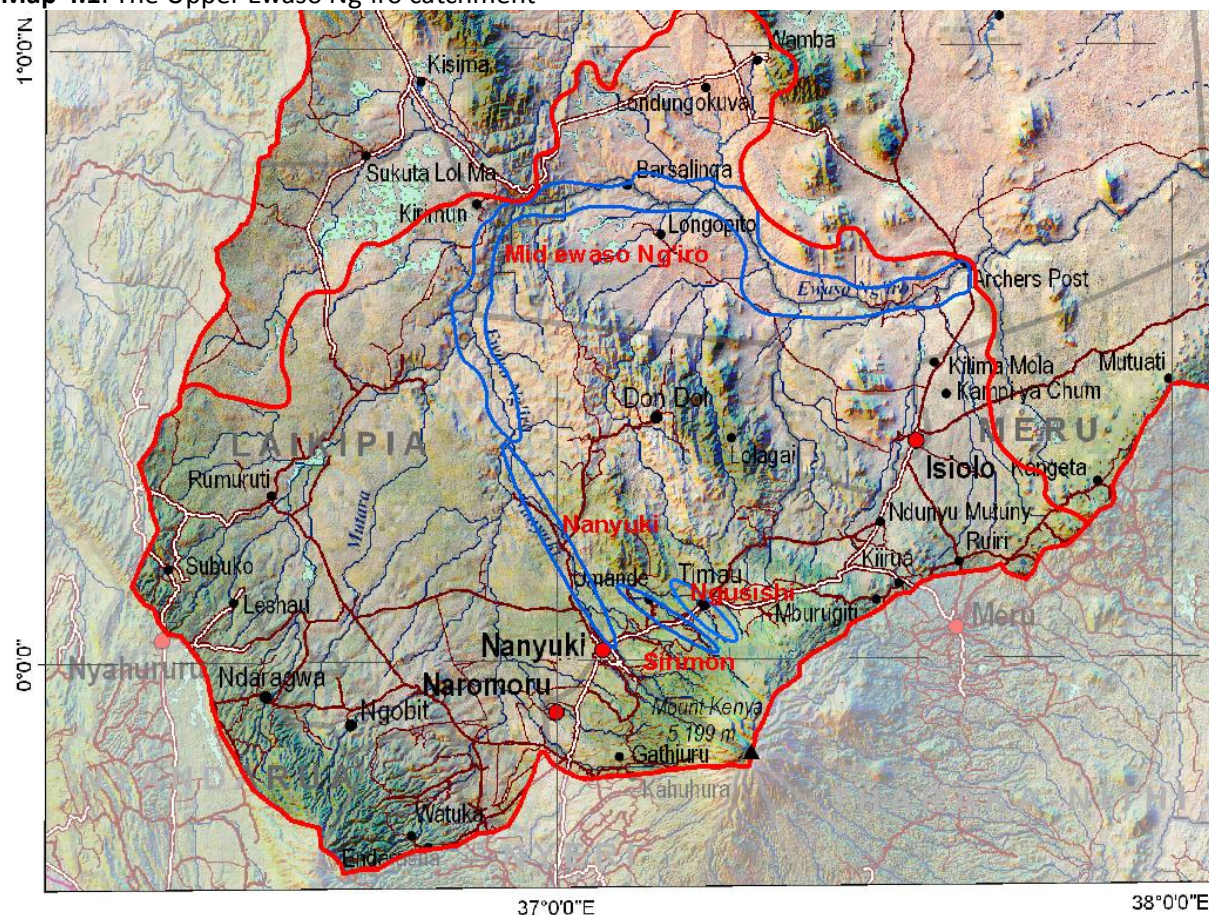
Nevertheless, the Ewaso Ng'iro catchment faces some challenges. These challenges are related to increasing human pressure, unsustainable land use practices and declining size of wildlife areas (Ojwang & Wargute, 2009). However these are not the only challenges the basin is facing. It also faces challenges resulting from climate change, droughts and declining river flows. In this chapter an overview of the physical and human geography of the Upper Ewaso Ng'iro catchment will be given. The available water sources will not be taken into account and are discussed in a following chapter.

## **4.2 Physical geography**

The Upper Ewaso Ng'iro North River Basin is located to the North and West of Mount Kenya. It extends between longitudes 36° 30' and 37° 45' East and latitudes 0° 15' South and 1° 00' North (Kiteme, 2005). The upper basin covers an area of 15,200 km<sup>2</sup>. Approximately 6% of the Ewaso Ng'iro North Drainage Basin, and straddles three provinces namely, Central, Eastern, and the Rift Valley (Kiteme, 2005). Topographically, the Upper Ewaso Ng'iro Basin is characterized by the tertiary volcano ranges of Mt. Kenya (5'199 m), the Aberdares and Nyandarua Range (3'999 m). Between which the vast, gently undulating Laikipia Plains extend at an elevation of 1700 – 1900 m. To the north of the Plains, the Loldia Hills on the so-called basement complex reach altitudes of 2500 m before dropping to the lowlands around Archers Post (862 m) (Notter, 2002). The Upper Ewaso Ng'iro Basin is a classical example of highland-lowland system. Topographic and atmospheric circulation produce steep climatic and ecological gradients. The conditions result in humid and sub humid conditions in the Mt. Kenya and Aberdare ranges. Semi-arid conditions in the Laikipia Plains and arid conditions in the lowlands around Archers Post (Notter, 2003) The Catchment is shown on

map 4.1. this study will focus on four sub catchments; the Ngusishi subcatchment, Nanyuki sub catchment, Mid-Ewaso Ng'iro sub catchment and the Sirimon sub catchment.

**Map 4.1: The Upper Ewaso Ng'iro catchment**



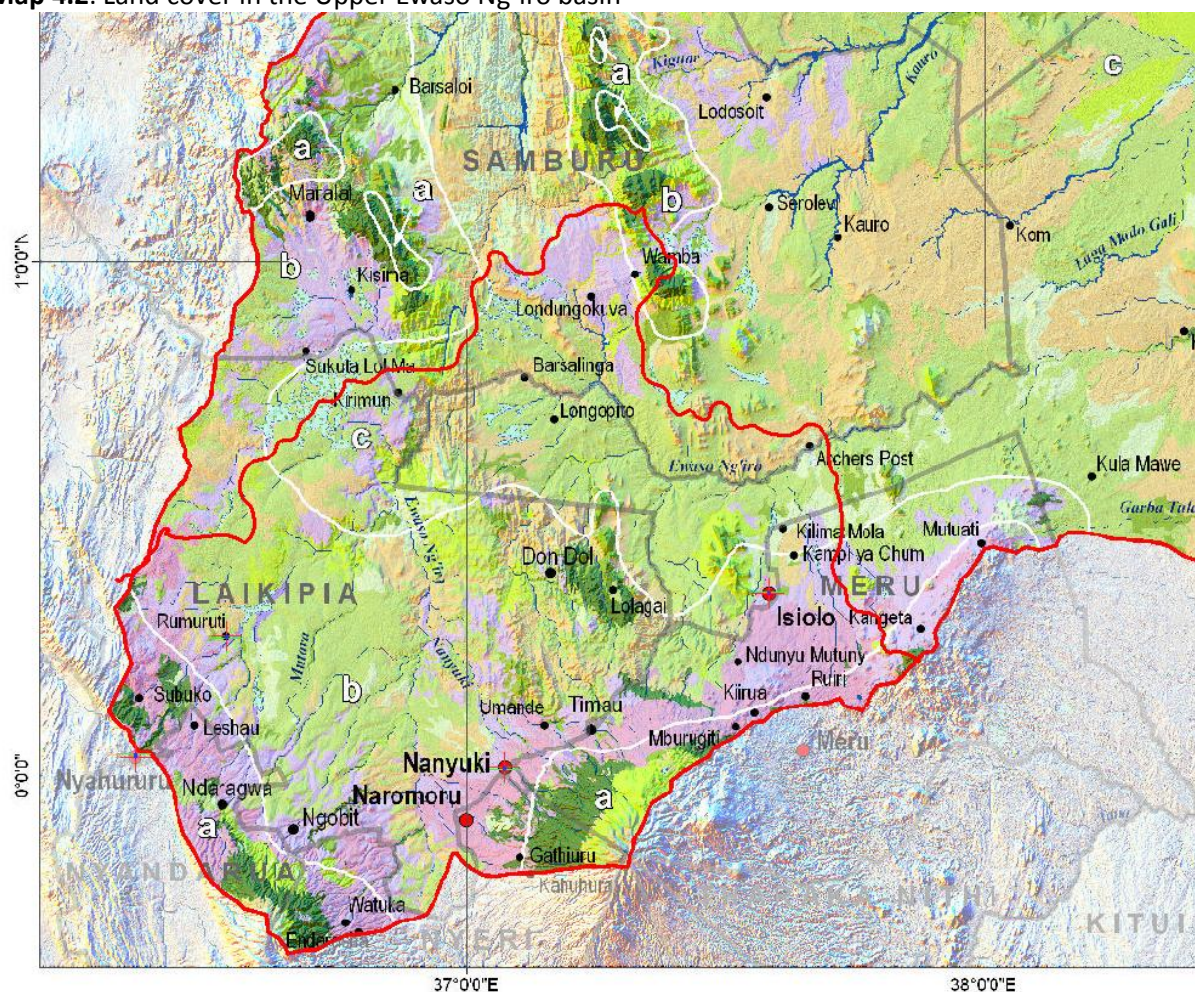
Source: ILRI (2011)

### **4.3 Land cover**

The Ewaso Ng'iro catchment has a very diverse land cover. Map 4.2 shows the different types of land cover in the basin. The most important land cover is savannah , the second most important is scrubland and these are followed by cover classes, forest, woodland, bush lands, grasslands, rainfed crop, irrigated crop, scattered rain fed crops, wetlands, the bare areas and urban and settlement.



**Map 4.2:** Land cover in the Upper Ewaso Ng'iro basin



Source: ILRI (2011)

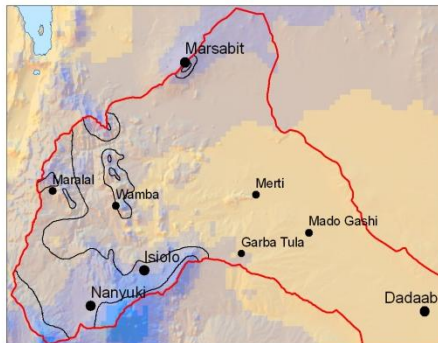
#### **4.4 Climate and agro climatological zones**

Kenya is divided into seven agro-climatic zones based on the aridity index as created by Sombroek et al. (1982). The aridity index is the ratio between rainfall and evaporation. Areas with an aridity index greater than 50% have high potential for cropping. These areas are designated as high agricultural potential areas and consists of agro climatic zones I, II, and III (ILRI, 2011). The semi-humid to arid regions (zones IV, V, VI, and VII) have indexes of less than 50%. Resulting from a mean annual rainfall of less than 1100 mm (ILRI, 2011) These zones are generally referred to as the Kenyan Arid and semi arid lands (ILRI, 2011).

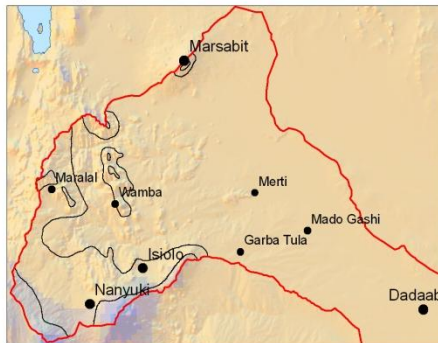
In table 4.2 the agroclimatological zones of the Ewaso Ng'iro catchment are summarized. On map 4.3 they are visualized.



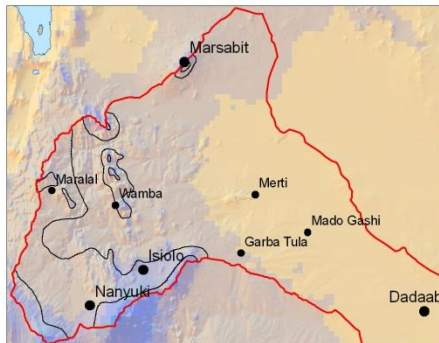
January



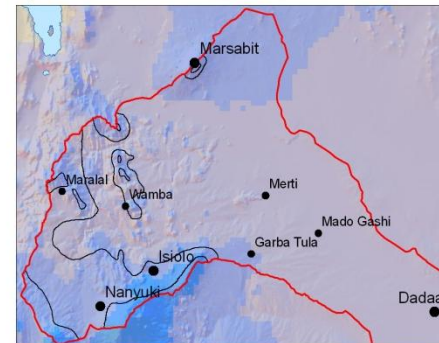
February



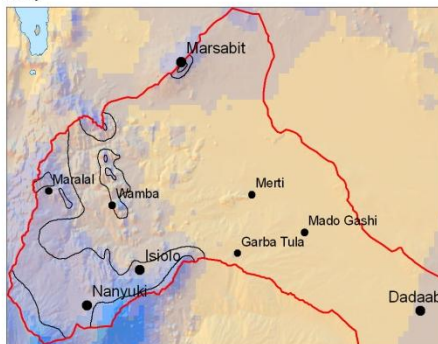
March



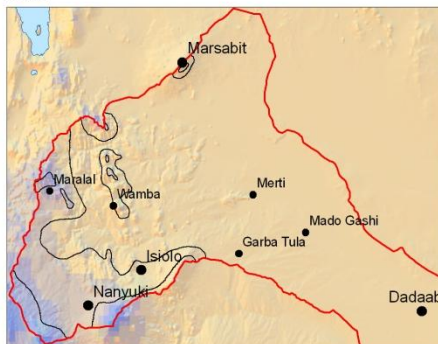
April



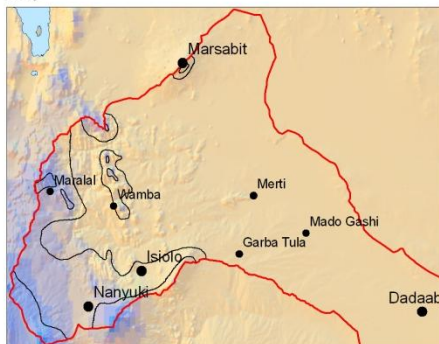
May



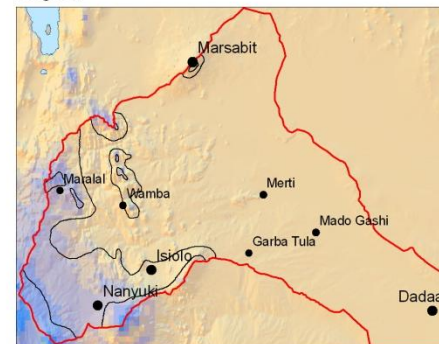
June



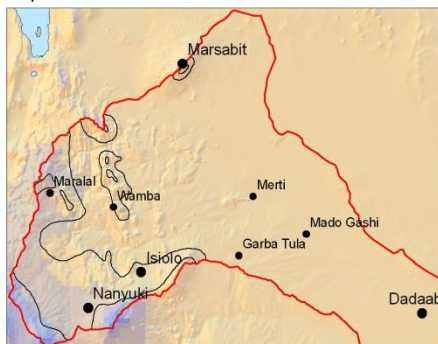
July



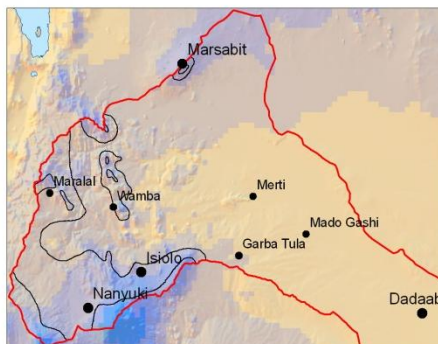
August



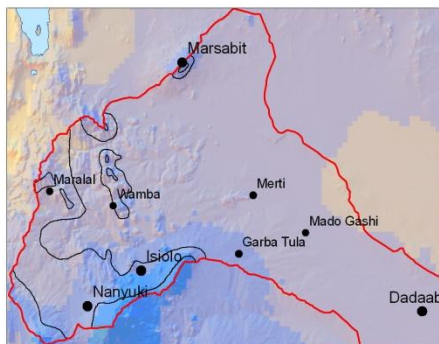
Septemb



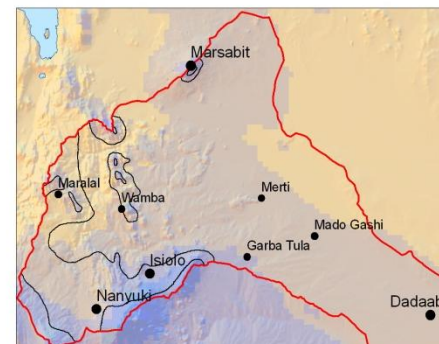
October



Novemb



Deceml



### Monthly aridity index

Legend

## Aridity Index



Very arid      ◀ — — — — — ▶      Humid

Source: Ilri (2011)

**Table 4.1:** Agroclimatic zones of the Ewaso Ng'iro catchment

Agroclimatic Zones	ACZ	Zones	Area (km <sup>2</sup> )	Area (%)
Humid	I	a	386	0.5
Sub-humid	II	a	815	1.0
Semi-humid	III	a	2011	2.4
Semi-humid to semi-arid	IV	b	3568	4.3
Semi-arid to arid	V	b	10855	12.9
Arid to very arid	VI	c	14124	16.8
Very Arid	VII	c	52088	62.1

Source: ILRI (2011)

### **4.5 Socio-economic settings**

In terms of socio-economic and socio-cultural aspects, the basin has experienced dramatic changes. Immigration, rapid population growth and land use transformation in the past decades have resulted to a multistakeholder societal composition (ILRI, 2011). From a simple pastoral society, in the beginning of the 20th Century, to a multistakeholder society, of more than 8 ethnic groups in the beginning of the 21st Century (Kiteme & Gikonyo, 2002). This societies comprises of an urban population in the regional towns and trading centers. Large-scale horticultural farmers, small-scale horticultural out growers, smallholder agro pastoralists, large-scale ranchers, pastoralists, and international tourist concerns (Kiteme & Gikonyo, 2002).

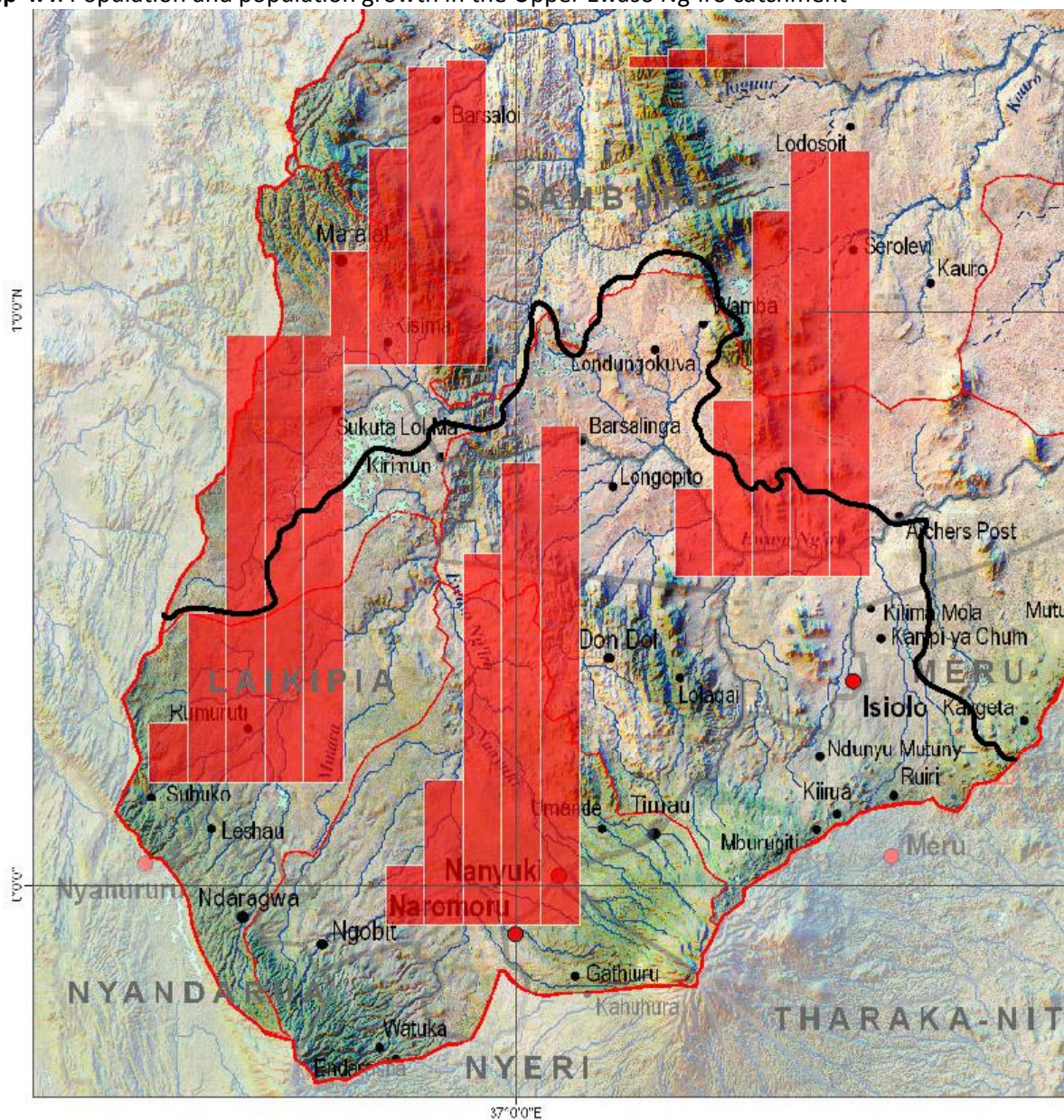
### **4.6 Population and immigration**

The population in the basin is rapidly growing. In 1960 50,000 people inhabited the catchment, in 1999 this number has grown to 730,000 (GOK, 1999). The growth rate is thus estimated at 5-7% per annum. This population growth is mainly due to immigration from the adjacent densely populated and high agricultural potential areas (Ngigi, 2005) . The population however is not equally distributed over the catchment. The average population density in the catchment is about 60 persons per km2.



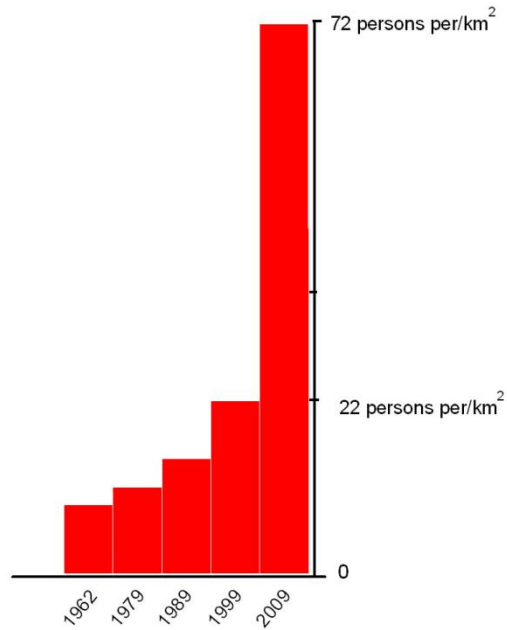
Yet, the distribution ranges from 212 persons per km<sup>2</sup> on the highland small-scale farming areas to less than 24 persons per km<sup>2</sup> in the lowland pastoral areas (Huber & Opondo, 1995).

**Map 4.4:** Population and population growth in the Upper Ewaso Ng'iro catchment





Legend

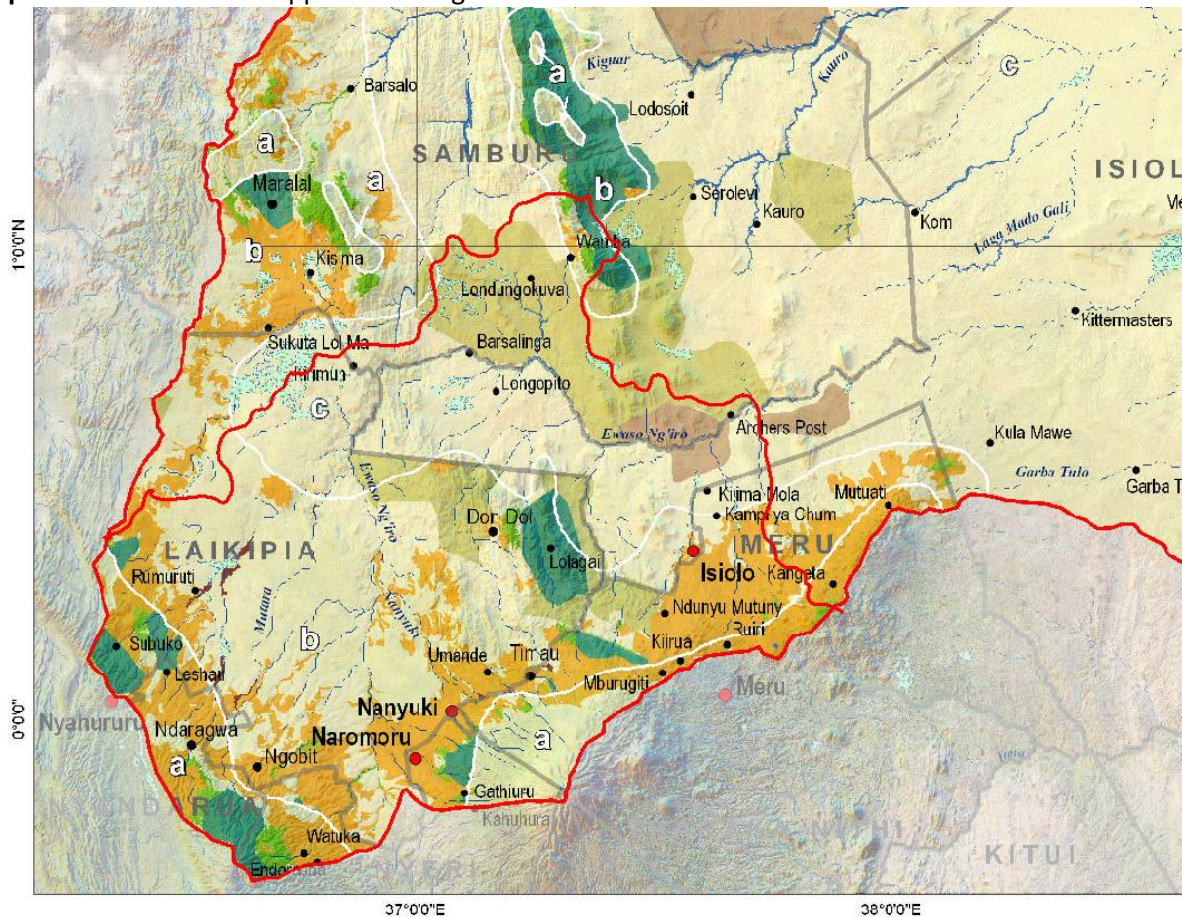


Source: ILRI (2011)

#### **4.7 Land use**

Within the Ewaso Ng'iro catchment, seven main types of land use can be identified. Map 4.5 shows the land use distribution in the catchment. Livestock production is by far the dominant land use, occupying 82% of the catchment area (ILRI, 2011). In the Laikipia province livestock production is mostly practiced on individually owned ranches. However in the rest of the catchment it is practiced mostly on communal and trust land. The land tenure conditions are important factors influence the land use in the catchment. Several individual ranches are fenced, thus compromising animal mobility. The communal and trust lands are not fenced, thus allowing mobility of livestock. This is an important strategy allowing communities to move around with their animals to avoid the adversaries of erratic rainfall in these arid to very arid lands (ILRI,2011).

**Map 4.5: Land use in the Upper Ewaso Ng'iro catchment**



Source: ILRI (2011)

Mixed crop-livestock production, the second most important land use in the catchment overall (6.2% of the area, Table 3.6). This type of land use is restricted mostly to higher rainfall areas in Agroclimatic zones A and B (ILRI, 2011). Conservancies, where people practice conservation and livestock keeping, are the third largest land use category (ILRI, 2011). Conservation forestry and wildlife conservation are other important land uses. Conservation forestry is practiced in and restricted to Forest Reserves. Production forestry, confined to forests and woodlots outside protected areas is mostly located in agro climatic zone A (ILRI, 2011). In this high rainfall zone we further observe a considerable area under mixed crop-livestock production. This area is located on the foot slopes of Mount Kenya, the Aberdares and the Matthews range (ILRI, 2011). Most of these plots are under private individual ownership (ILRI, 2011). In total, however, irrigated crop production (less than 0.1%) is a limited land use practice (ILRI, 2011).

#### **4.8 Land use changes**

A number of land use changes closely linked to socio-economic developments can be observed in the Upper Ewaso Ng'iro basin. Land-use changes in the Ewaso landscape have occurred primarily as a result of once-nomadic pastoralists shifting to sedentary lifestyles (due to multiple factors that are both favorable and unfavorable). This shift resulted in increases in stocking densities, fencing, habitat fragmentation, and depletion of grass, browse and water. All these have negative implications for livestock and wildlife management (Ojwang' & Wargute 2009).

The first notorious land use change that can be seen is that from savannah to cropland. The subdivision of the large scale ranches to small-scale farms has brought an enormous intensification of agriculture (Notter, 2002). At the footstep zones of Mt. Kenya and the Aberdares cropland has almost doubled between 1984 and 1995. This increase took place at the expense of mainly grassland and grassland with trees (Niederer, 2000). Until 2012 a steady increase can be seen in croplands at the foot zones of Mt. Kenya and the Aberdares. Map 4.5 shows the most important land use at these foothills, mixed-crop farming land.

Another change is the conversion of forest into cropland. Over the 1984 – 1995 period natural forest lost one tenth of its area. This happened foremost in the lower river reaches. There the alley vegetation had to give way to the farms along the rivers, resulting in riverbank erosion. On the other hand illegal clearings in the mountain forest zone were increasing until 1998, when a change of policy allowed Mt. Kenya National Park to protect its area by force (Notter, 2002).

A third change is the conversion of wetlands to croplands. Thenya et al. (2001) warn that with no intervention wetlands would disappear from the area in a few years. On map 4.5 still a reasonable amount of wetlands can be seen. The declining wetlands, however, also have an influence on the biodiversity and the hydrology of the catchment. The swamps are refuges to animals in the dry season, wetlands act as a sponge during floods. Also the resulting cropland will rapidly decrease in fertility because of the oxidizing soils (Notter, 2002).

There is also an expansion of urban areas within the catchment. Urban areas have increased by 300% between 1984 and 1995 (Niederer, 2000). However, data seems to show a slower pace of urban increase from 1995 to 2012. The population census of 1999 and 2009 show a population increase of Nanyuki of only 0.079 % per year between 1999 and 2009 (Gok, 1999 and Gok, 2009).

The fourth and last change of land use in the catchment is the conversion of natural to plantation forest. Under the rotating shamba system forested areas are cleared continuously, while others are replanted. As a consequence natural forest is increasingly replaced by plantation forest with exotic species such as eucalyptus or pine (Notter, 2002).

# 5 AVAILABLE WATER RESOURCES

## 5.1 Introduction

In this chapter the water situation in the Upper Ewaso Ng'iro basin will be presented. Following the Falkenmark water stress index, the degree of water scarcity is discovered. Also the perception of people about water scarcity, the trend in water availability and the main water problems are discussed.

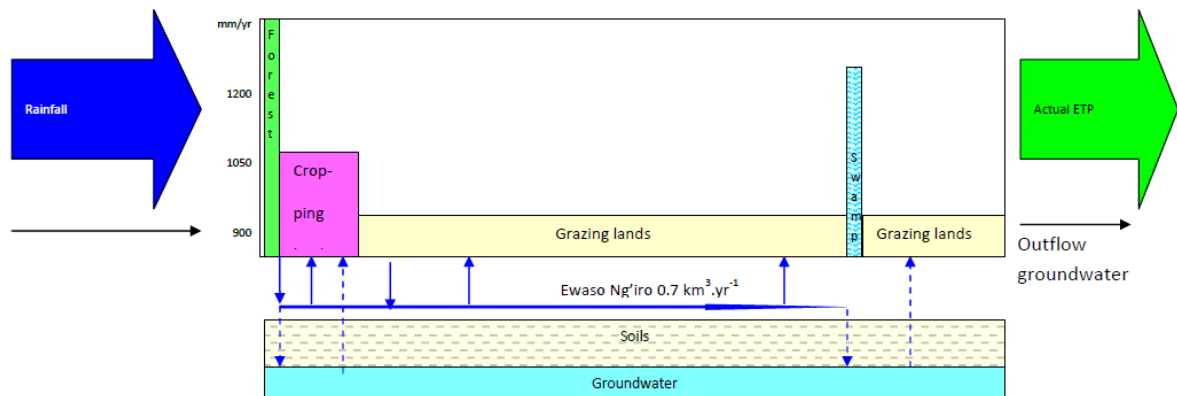
## 5.2 Water supply

The ultimate water source feeding the Upper Ewaso Ng'iro river basin is rainfall. Rainfall supports all water dependent ecosystem services in this catchment. The support function of rain water can take different forms: the runoff in rivers, lakes and groundwater aquifers. These support functions are classified as the blue water supply. The fraction of rainfall that infiltrates through the land surface and forms soil moisture is the green water resource (Hoekstra, 2008). The green water availability is quantified by the total evapotranspiration over land (minus human-induced evapotranspiration of blue water (Hoekstra, 2008).

There is no data of the Upper Ewaso Ng'iro basin concerning the inflow of rainfall, therefore data of the whole Ewaso Ng'iro basin will be used. The average annual volume of rain entering the whole of the Ewaso Ng'iro catchment (83,847 km<sup>2</sup>) is 37.2 km<sup>3</sup>. This is based on an average annual rainfall over the catchment of 444 mm (ILRI, 2011). A relatively minor fraction ends up as blue water. For example, the volume of water flowing through the Ewaso Ng'iro at Archers Post, estimated at 0.67 km<sup>3</sup> per year (1960-2010), represents 1.81% of the total volume of rainfall entering the catchment (ILRI, 2011). An even smaller volume of the blue water ends up as the groundwater or is stored in water pans and lakes.

According to the International livestock research institute (ILRI, 2011) it is difficult to estimate the fraction of total rainfall that ends up as blue water because the volume of recharge and stagnant surface water is poorly known. Based on the flow of the Ewaso Ng'iro river and assuming that less water resides in ephemeral rivers, pans and aquifers they estimate that less than 5% of the water in the catchment ends up as blue water. This means that 95% of the water balance is green water. Figure 5.1 is a diagrammatic depiction of the hydrological balance in the Ewaso Ng'iro basin. Figure 5.1 shows the different ways that precipitation is partitioned in the catchment, among land use, the Ewaso Ng'iro river, and groundwater recharge (ILRI, 2011).

**Figure 5.1:** The water balance in the Upper Ewaso Ng'iro catchment



Source: ILRI (2011)

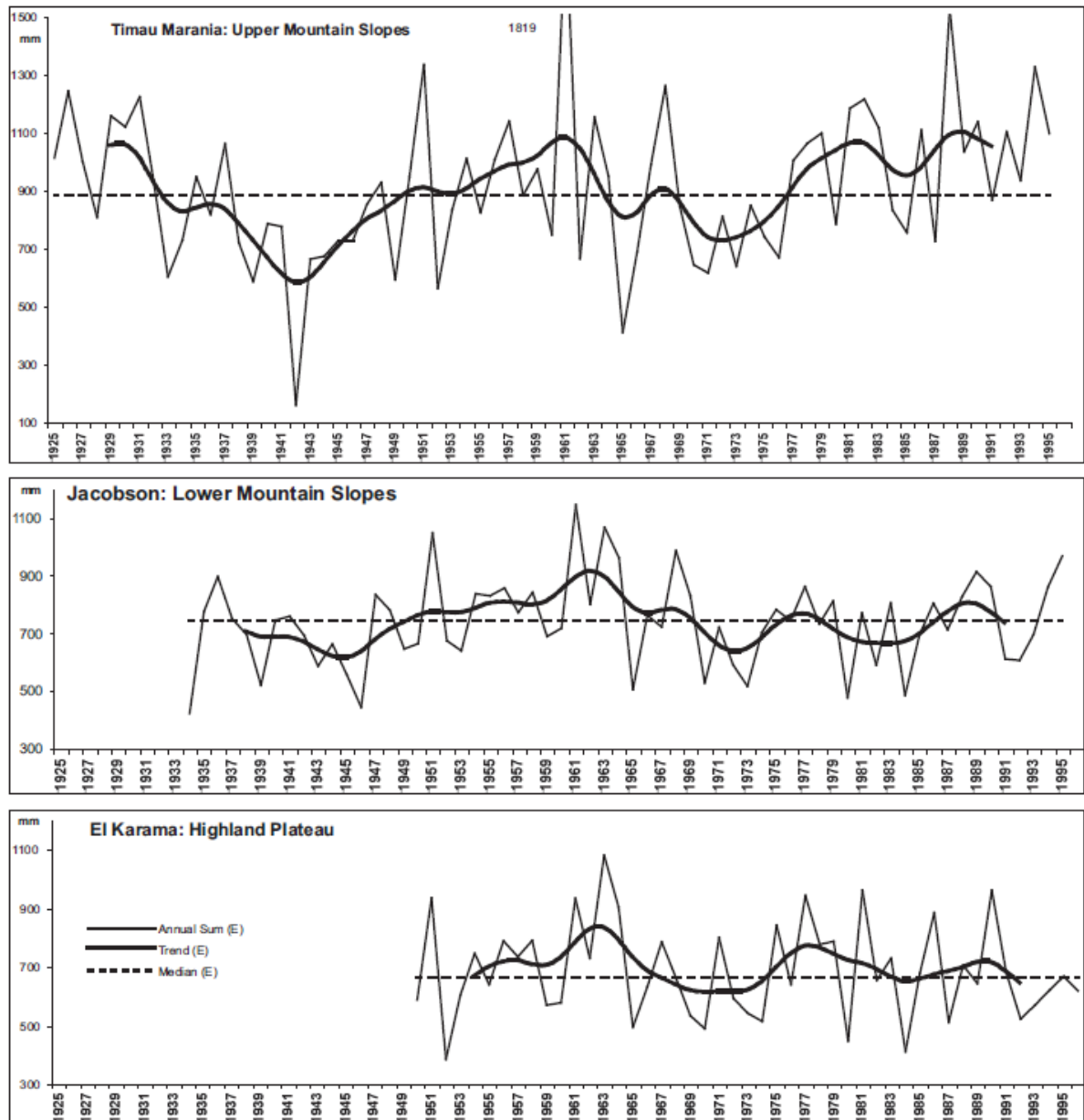
Researchers from ILRI (2011) further claim that the catchment is a virtually closed system. With an unknown but presumably relatively small amount of groundwater flowing out of the systems towards Somalia. Thus the water balance would have on average annually 37,2 km<sup>3</sup> entering the system in the form of rainfall and an evapotranspiration equaling the amount of rainfall minus the outflow of the groundwater.

### **5.3 Rainfall and evapotranspiration**

Within the catchment, there is a great variation in rainfall. Rainfall over the basin is primarily influenced by the direction of the prevalent moisture-bearing air currents and by the height and orientation of the major highlands. The mean annual rainfall ranges from, 1500 mm in the forest areas of Mt. Kenya to 350 mm in the arid lowlands around Archer's Post (Gichuki, 2001). The basin rainfall can be divided into four three-month seasons; the long rains (mid March to mid June), continental rains (mid June to mid September), short rains (mid September to mid December) and a dry season (mid December to mid March) (Gichuki, 2001). However, not all areas experience all three rainy seasons. Some parts in the basin receive only uni-modal rainfall. Others receive bio-modal or even trio-modal rainfall. The long rains, with over 25% of mean annual rainfall, constitute the main rainy season for the majority of the basin. In western areas, the long rains are followed by the continental rains, creating a uni-modal seven-month period of rainfall (60-70% of the annual total) (Gichuki, 2001). In the central part of the basin, the continental rains are absent and the long rains dominate in a bimodal distribution with the short rains (Gichuki, 2001). Between the two areas, all three rainy seasons occur, separated by a short dry period (usually of one month), producing a tri-modal rainfall pattern. The short rains are the dominant season in the eastern part of the basin and

in the area between Mt. Kenya and the Nyandarua (Aberdare) Mountains (Gichuki, 2001). With the continental rains absent, they fall into the bimodal category with the long rains (Gichuki, 2001). Figure 5.2 shows the year-to-year and long-term variability of annual rainfall (1925-1997) across the basin from the northern upper slopes of Mt. Kenya (Timau-Marania) to the lower mountain slopes (Jacobson) and plateau (El Karama).

**Figure 5.2:** Rainfall data of three gauging stations; Timau Marani, Jacobson & El Karama.



Source: Gichuki, et. al (1998).

There is no clear trend in all three rainfall stations. However there are clear fluctuations between periods of above- and below-average rainfall. There is also a difference in the rainfall patterns between highland and lowland areas. In the low rainfall region of the plains, the ten



greatest daily rainfall events contribute 70% of the annual rainfall as can be seen in table 5.1. This data reflects the episodic nature of rainfall interspersed by long periods of drought (Gichuki, 2001). The influence of the ten heaviest storms decreases with increasing annual rainfall (Table 5.1), reflecting a more even distribution of daily rainfall within the seasons in the highland area.

**Table 5.1:** Rainfall patterns in the high and lowlands

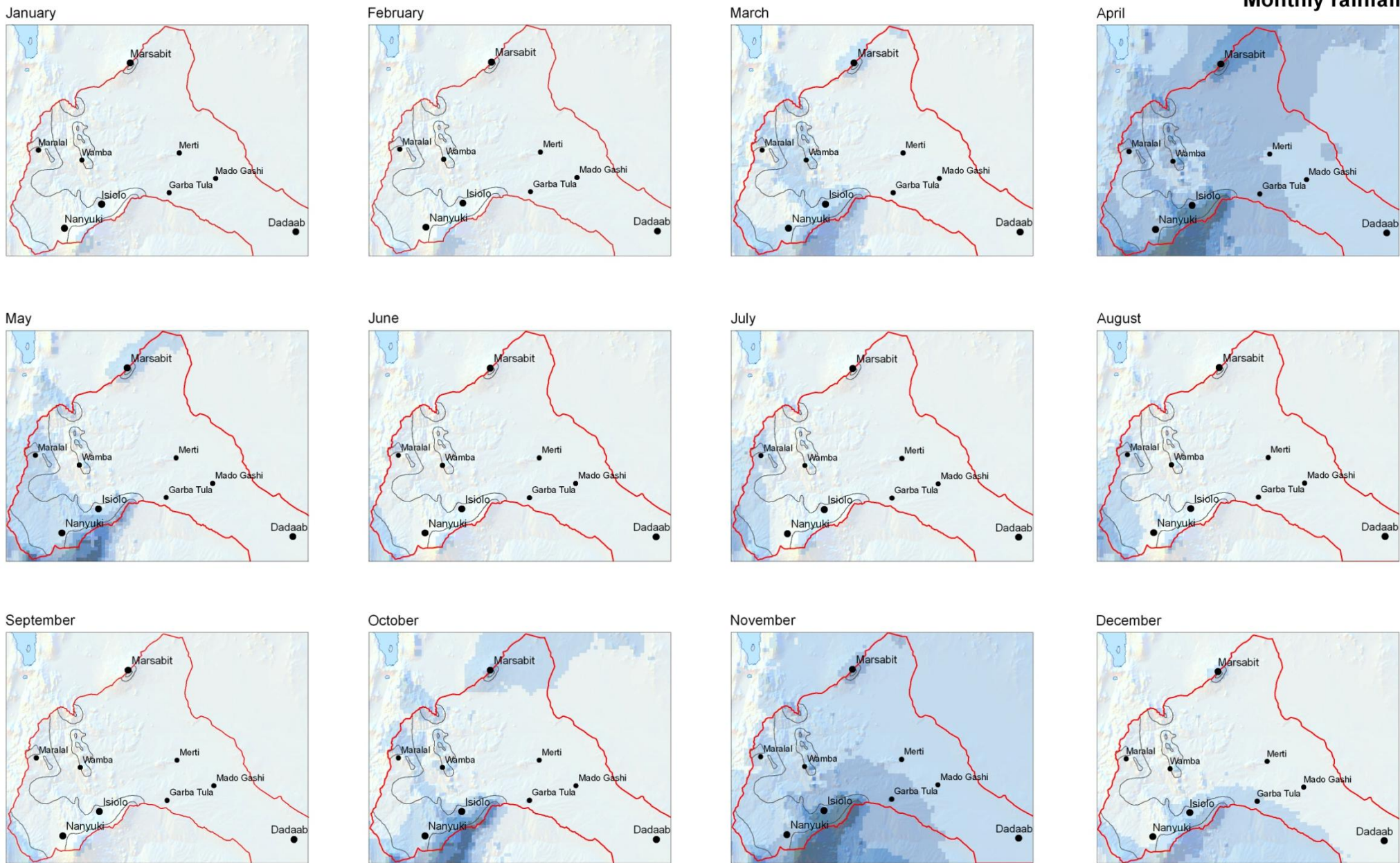
Area	Mean annual rainfall	% of annual rainfall of 10 greatest rainfall events
Upper mountain slopes	1000-1500 mm	<30 %
Lower mountain slopes	700-1000 mm	30
Highland plateau	500-700	40-55
Lowland plains	300-500	70

Source: Gichuki, et. al (1998).

It is not only rainfall that influences the water availability also the potential evapotranspiration (PET) has an influence. The potential evapotranspiration is relatively low in the upper, high rainfall, part of the catchment, at less than 1200 mm per year. Yet, over the dry lowland areas, PET is greater than 1800mm (ILRI, 2011). On an annual basis, all of the catchment apart from Mt. Kenya has a water deficit, nevertheless there is significant seasonal variation in the intensity of the water deficit. To quantify the water deficit which derives from the ratio between rainfall and evapotranspiration a tool is designed by Sombroek et. al. (1982). This tool is called the 'aridity index'. The monthly variation in this aridity index is shown on map 4.3. The Map reveals variation in aridity index, or the ratio of rainfall over potential evapotranspiration. The lower the index, the higher the aridity

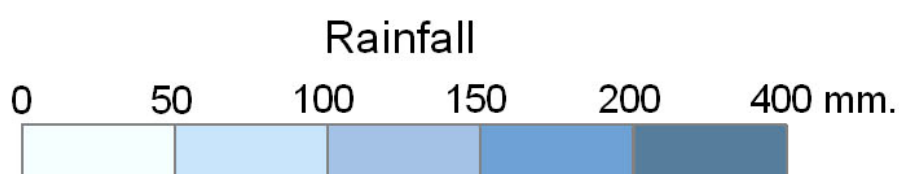
Map 4.3 and 5.1, show a big variation in rainfall and evapotranspiration within the catchment. Only a few pockets on the slopes of Mount Kenya have annual rainfall that exceeds potential evapotranspiration. The location of these slopes is shown on map 5.1. These slopes have over 1200 mm of rainfall and less than 1200 mm evapotranspiration (ILRI, 2011). It is these humid and semi humid areas with a rainfall excess that contribute significantly to the discharge of the Ewaso Ng'iro river. The sub-humid to semi-arid and the semi-arid zones, with rainfall between 600 and 900 mm occupy a larger part of the catchment, notably the Laikipia plateau (ILRI, 2011). However, the largest part of the catchment is in the semi-arid to arid and in the very arid zone, with average annual rainfall below 600 mm (ILRI, 2011).

Map 5.1: Monthly rainfall





Legend



Source: Ilri (2011)

#### **5.4 Surface water**

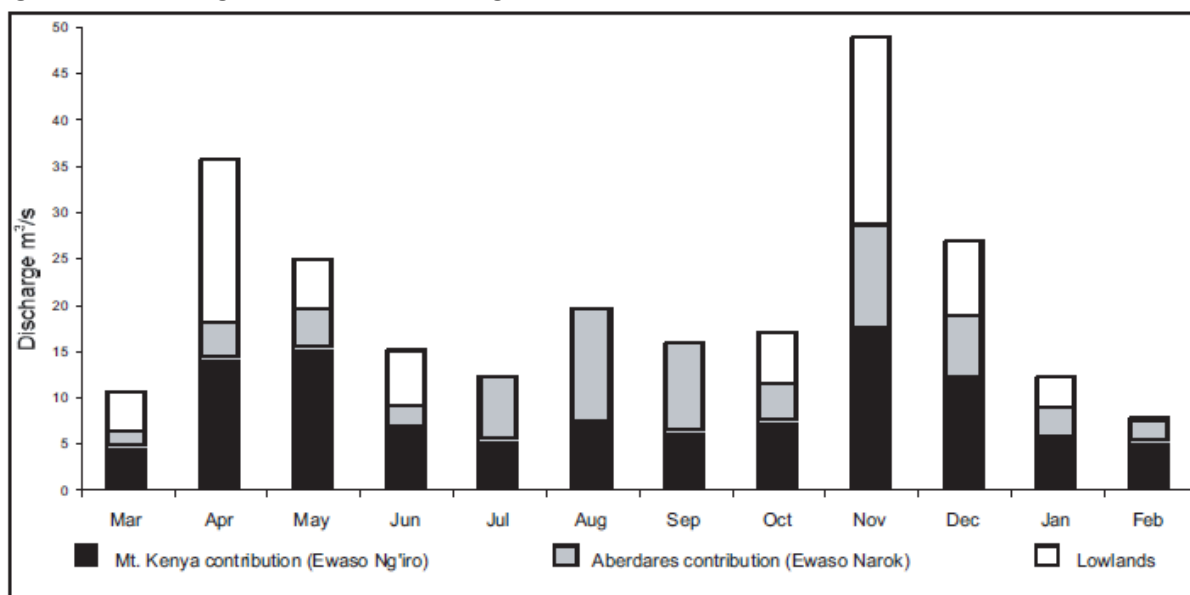
The Upper Ewaso Ng'iro North river basin consist of three subsystems, the Ewaso Narok catchment ,the Ewaso Ng'iro-Mt. Kenya catchment, and the Ewaso Ng'iro lower basin sub-system. The Ewaso Narok and the Ewaso Ng'iro-Mt. Kenya catchments drain high mountain regions, producing perennial flows which are characterized by the forest and moorland hydrology and in the case of Mt. Kenya, glacial hydrology (Gichuki, 2001). The Ewaso Ng'iro-lower basin subsystem below the confluence of the Ewaso Narok and Ewaso Ng'iro rivers is characterized by runoff from ephemeral catchments, perennial flow from the upstream highland sub-systems, and spring flow close to the outlet of the basin (Gichuki, 2001). Analyses by Gichuki (N.D) of flows of gauging stations at the outlets of the three sub-systems indicate that the source of flow varies as the rainfall regime across the basin changes. From this analysis some key features of the Ewaso Ng'iro flow system can be illustrated, these illustrations are shown in Table 5.2 and Figure 5.3.

**Table 5.2:** Rainfall analyses of three subsystems in the Upper Ewaso Ng'iro catchment

	Ewaso Narok Sub-system (3380 km <sup>2</sup> )	Ewaso Ng'iro-Mt. Kenya sub-system (4640 km <sup>2</sup> )	Ewaso Ng'iro Lower Catchment sub-system (7180 km <sup>2</sup> )
1951 (wet year)	22%	22%	56%
1952 (dry year)	18%	75%	7%
1960 ( average year)	11%	67%	22%
April (weth month)	11%	40%	49%
September (dry month)	59%	41%	0%
November (wet month)	23%	36%	41%
February (dry month)	28%	69%	3%
Annual mean	30%	46%	24%

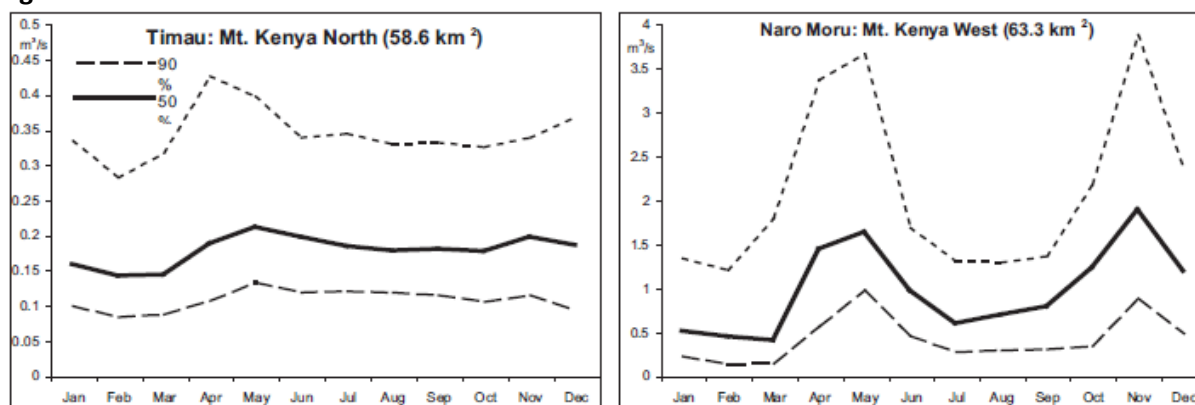
Source: Gichuki, et. al (1998).

**Figure 5.3:** Discharge data of the Ewaso Ng'iro river and Ewaso Narok.



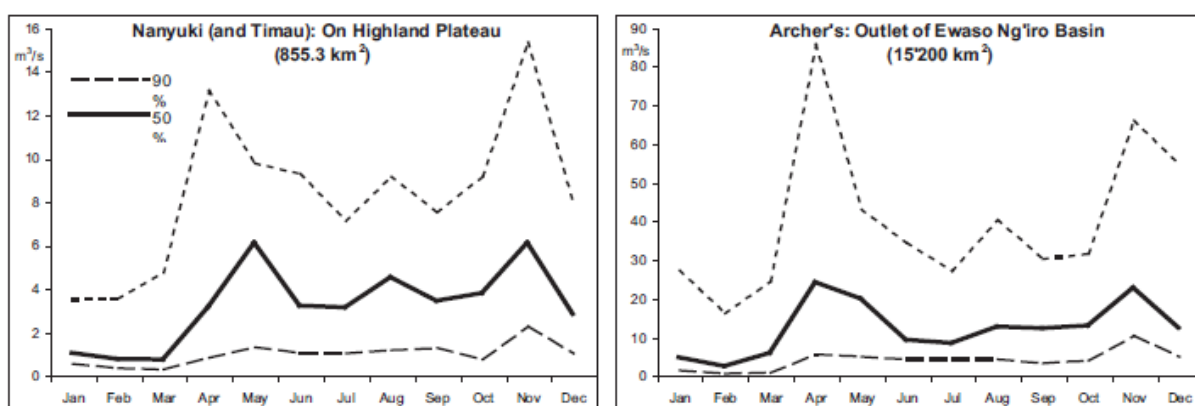
Source: Gichuki, et. al (1998).

**Figure 5.4:** River flow data of the Timau and Naro Moru river.



Source: Gichuki, et. al (1998).

**Figure 5.5:** River flow data of the Nanyuki and Ewaso Ng'iro river



Source: Gichuki, et. al (1998).

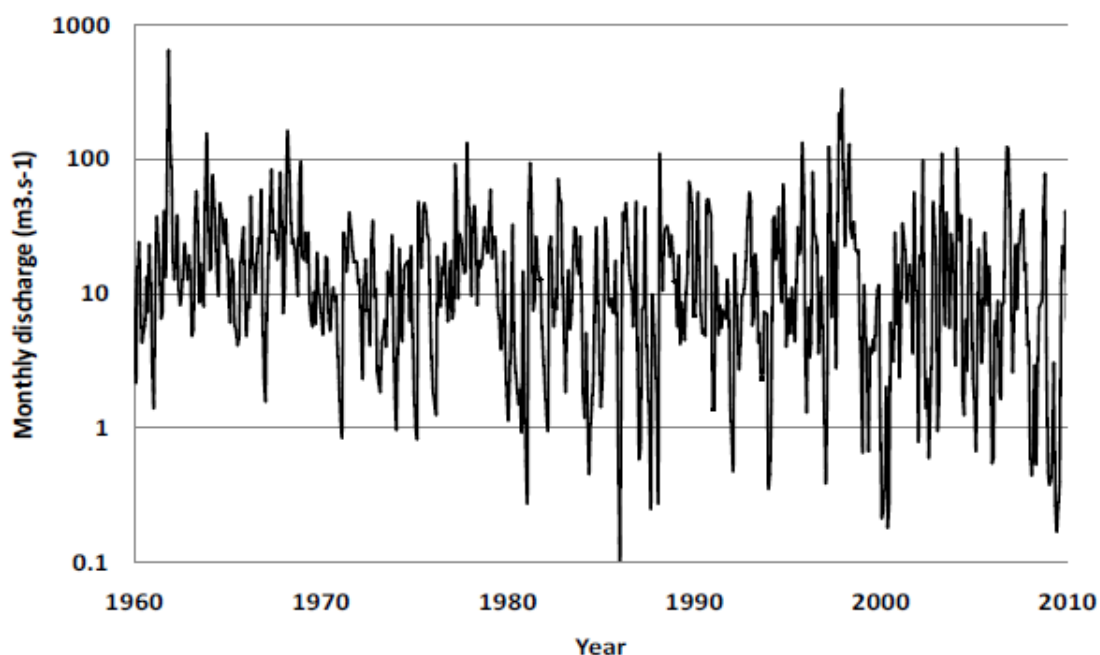
As shown in figure 5.4 and 5.5, the Timau river, which flows at the northern slopes of Mt Kenya, shows little variation of discharge during the year. However there are two clear peaks in the rainfall during the long and short rains. According to Gichuki (1998), the river flow is dominated by contributions from continuous springs which have little seasonal variation. The Naro Moru River, which is based at the western slopes, exhibits a bimodal pattern, with the highest peaks occurring in May and November in tandem with the rainy seasons (Decurtins, 1992). The low flows in this instance are supported by melt water from the glaciers of Mt. Kenya and groundwater discharge (Gichuki, 1998). The same bimodal pattern is seen further downstream on the Nanyuki River (at the base of the lower mountain slopes and on the Ewaso Ng'iro at the outlet of the basin (Figure 5.5). According to Gichuki (1998), the seasonal peaks are particularly accentuated at Archer's Post. This reflects the increased contributions of direct surface runoff from the lowlands during the rainy seasons. Furthermore he claims that highland flows are of great importance for lowland flows.

Gichuki (2001) further states that the Ewaso Ng'iro, flowing from Mt. Kenya, provides most of the total flow during the long and short rains and the wet years and months. The Ewaso Narok river provides most of the water during the period of the continental rains. The flow of the Ewaso Ng'iro at Archer's Post in a dry year or month is heavily dependent on the contribution of Mt. Kenya. The lowland plains produce a significant proportion of the total flow in wet years and months. This is mainly attributable to the high surface runoff generated from the almost bare catchments at the beginning of the rains. Gichuki (2001) concludes by stating that there is a decreasing trend in the lowest dry season flows. The median decade river flow at Archer's Post in February was reported to have dropped from 9 m<sup>3</sup>/s in the 1960s, to 4.5 m<sup>3</sup>/s in the 1970s, 1.2 m<sup>3</sup>/s in the 1980s and 0.9 m<sup>3</sup>/s in the 1990s.

Gichuki et. al (2001) provide an extensive insight in rainfall, natural springs and melt water as factors that influence the river flow in the Ewaso Ng'iro river. In contrast to this view researchers from the ILRI (2011) have taken a different approach to explain the variations in river discharge of the Ewaso Ng'iro river. Both agree discharge of the Ewaso Ng'iro river at Archers Post is declining. However the focus of both researches differ. Research from ILRI focus on abstractions of water in the upstream part of the catchment which are withholding water upstream, reducing the discharge to downstream users. They thus focus on the abstraction of river water as the main cause of declining river flow in the Ewaso Ng'iro river.

Using discharge data from 1960 to 1979 as baseline to the discharge from 1980 till 2010, researchers from ILRI (2011) show an average monthly discharge declining. In this period the discharge declined from 24.1 m<sup>3</sup>.s<sup>-1</sup> during the baseline period to 18.8 m<sup>3</sup>.s<sup>-1</sup> during the post 1980 period. This is a reduction of 5.3m<sup>3</sup>.s<sup>-1</sup>. They attribute this declining trend to an increasing volume of abstractions. More detailed information about the discharge can be found in figure 5.6.

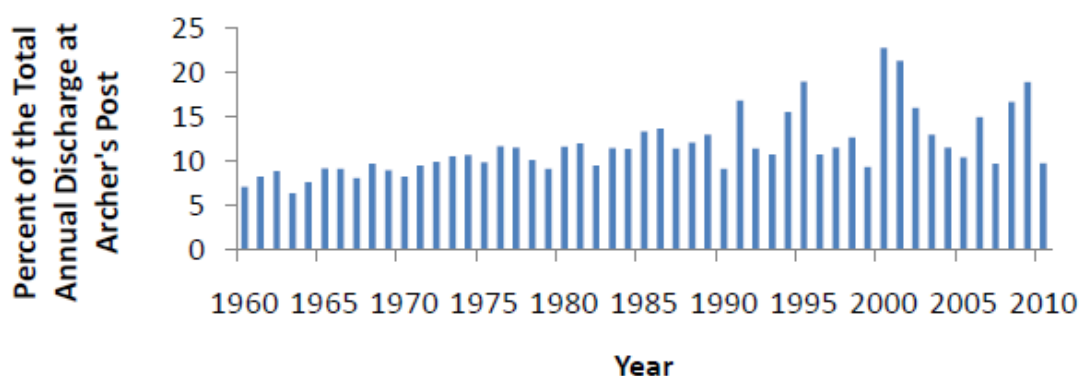
**Figure 5.6:** Variation in monthly discharge of the Ewaso Ng'iro at Archer's Post 1960 -2010.



Source: ILRI (2011)

Figure 5.7 displays the volume of permitted abstractions in the Ewaso Ng'iro basin increased from below 10% of the discharge at Archer's Post to above 10% of discharge in most years in the period since 1990 (ILRI, 2011)

**Figure 5.7:** Influence permitted abstractions on river discharge at Achers post.



Source: ILRI (2011)

Researchers from ILRI (2011) used a water evaluation and planning system (WEAP) model, a software environment to model water resources for the upper part of the basin to assess the impacts of the permitted abstractions on the water discharge at Archer's Post. WEAP is an integrated and

water resources management tool designed for simulation of water resources systems and trade-off analysis (SEI, 2008). They calibrated the model 1960-1970 and validated it with data from 1970-1990. With this model they predicted that the discharge would be 3.4 and 2.9m<sup>3</sup>.s<sup>-1</sup> higher without permitted abstraction than the situation with permitted abstractions. Hence, you can state that the permitted abstractions upstream resulted in a reduction of the average discharge at Archers Post. In reality however the effect of abstractions is likely to be higher. The model only takes into account permitted abstractions and not the illegal abstractions. According to researchers like Notter (2007) Mutiga (2010) and Gikonyo (2002) about 60 to 95% of the available river water in the upper reaches of the Ewaso Ng'iro river basin is abstracted during the dry season with up to 90% of the abstractions being illegal. This results in decreased river flows and in some cases even drying up of the river in the lowlands.

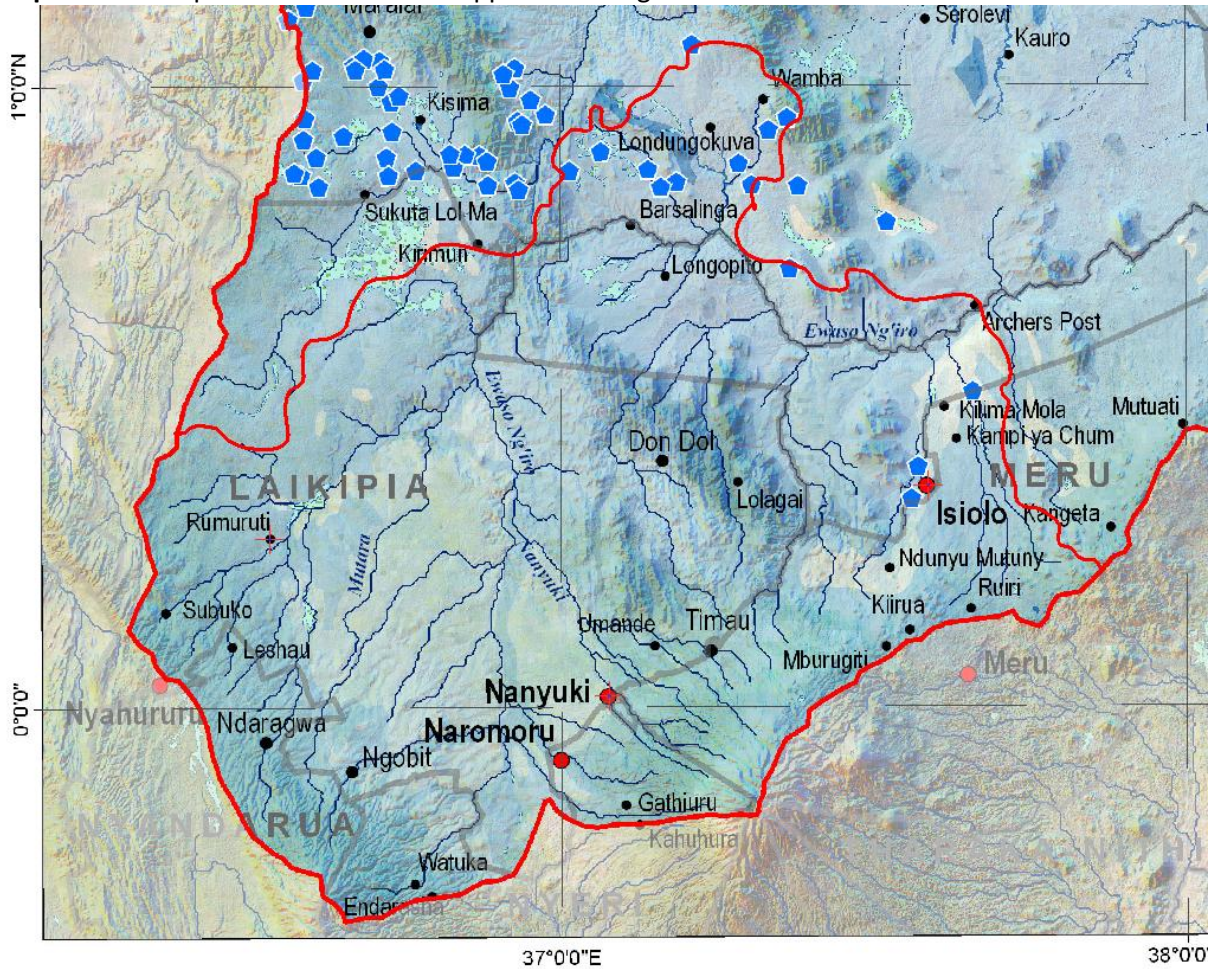
### **5.5 Groundwater**

There are various groundwater systems within the Upper Ewaso Ng'iro catchment. On the lower forest slopes of Mt. Kenya, local groundwater systems have been identified where stored water emerges as springs (ILRI, 2011). This groundwater, with its recharge area situated in the high permeability soils of the upper forest zone, has been dated as being young (Schotterer & Mueller 1985). The total amount of groundwater replenished in the upper catchment is estimated to range between 120 and 220 million m<sup>3</sup> per year (WRAP, 1987). A conservative estimate of recoverable groundwater was put at 5% of the recharge, meaning that the upper catchment will be sufficient for withdrawals up to the year 2010 (ILRI, 2011). Groundwater levels in the catchment however vary from 18 to over 200 m in depth. This constrains owing to the high cost of drilling boreholes and water pumping, groundwater abstraction groundwater abstraction,

### **5.6 Natural springs and infrastructure for blue water**

The distribution of various blue water sources in the catchment are illustrated in map 5.2 and 5.3. These include: pans, dams and wells, boreholes and springs. Map 5.2 illustrates the infrastructure to provide blue water is not evenly distributed within the catchment. The more humid western part of the catchment is endowed with a relatively dense network of water point infrastructure. This contrasts with the Central and the Eastern side of the catchment where such infrastructure is scarce. However, blue water is not only provisioned through pans and dams, boreholes and wells and springs, also rivers play an important role (ILRI, 2011).

**Map 5.2 : Water pans and dams in the Upper Ewaso Ng'iro catchment**

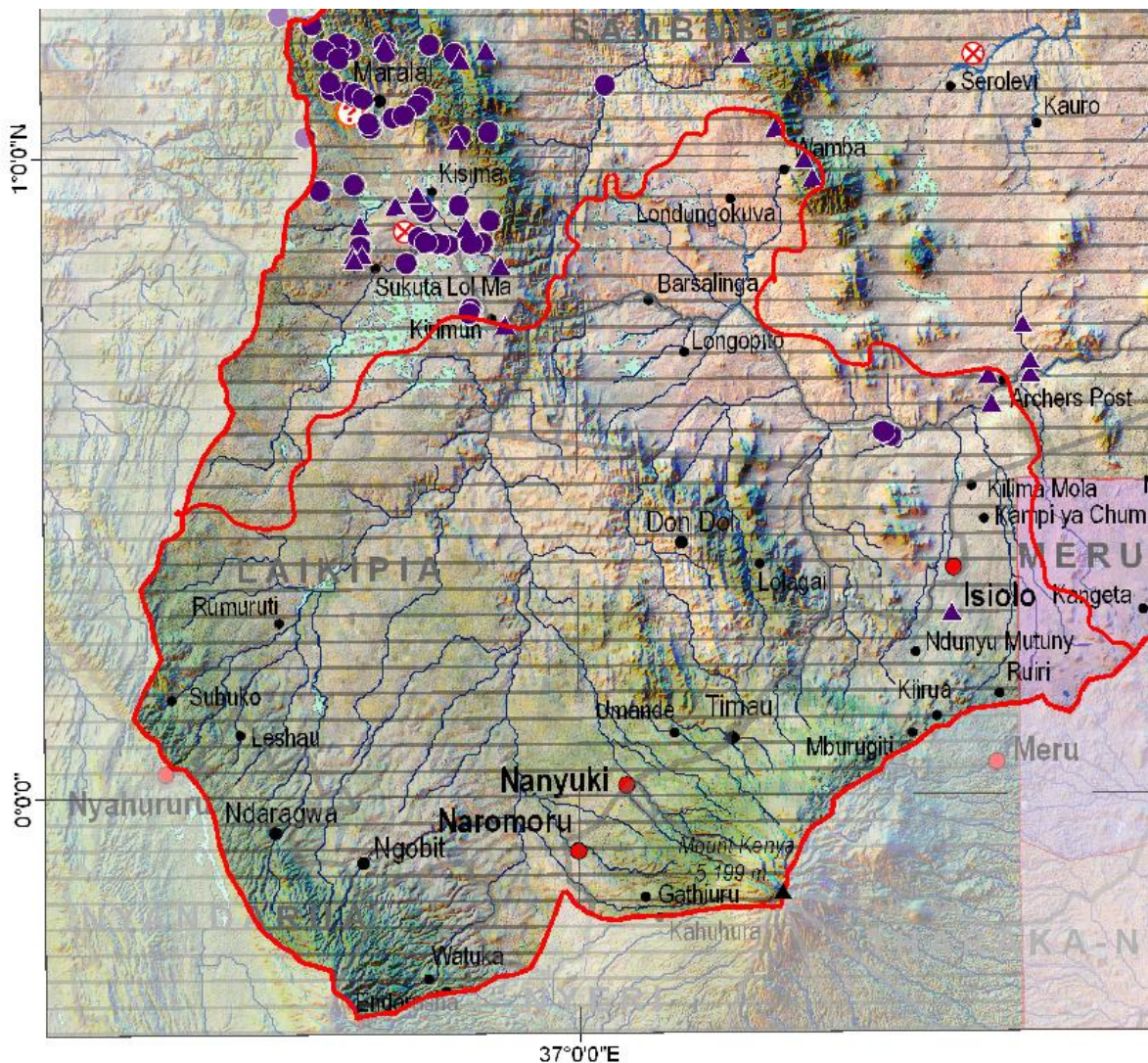


Source: ILRI (2011)

The blue water provisioned through boreholes depends on the groundwater resources in the catchment. The catchment hosts the Merti aquifer (Map 5.3), which has numerous boreholes being developed (ILRI, 2011). Researchers like Said (2011) question the sustainability of the exploitation of the aquifer. They doubt if also in the future the aquifer will provide enough water to provide for people's needs. Since the recharge of the Merti aquifer is by far not fully understood, although a recent study considered that the current withdrawals were sustainable (GIBB 2004).



**Map 5.3:** Boreholes in the Upper Ewaso Ng'iro catchment



Source: ILRI, (2011)

### **5.7 Theory of Falkenmark**

Using the water stress indicator of Falkenmark the water stress in the catchment was measured. In 2009, 1.85 million people were living in the Ewaso Ng'iro catchment (Gok, 2009). Using the predicted growth percentage of 6%, in 2011 around 2.1 million people were predicted to live in the catchment. The total amount of water available in the catchment was estimated to be 37.2 km<sup>3</sup> in 2011 (ILRI, 2011). This means that 17740 m<sup>3</sup> of water per annum is available per person. Following the indicator of Falkenmark people living in the catchment therefore have little or no problems concerning the available amount of water.

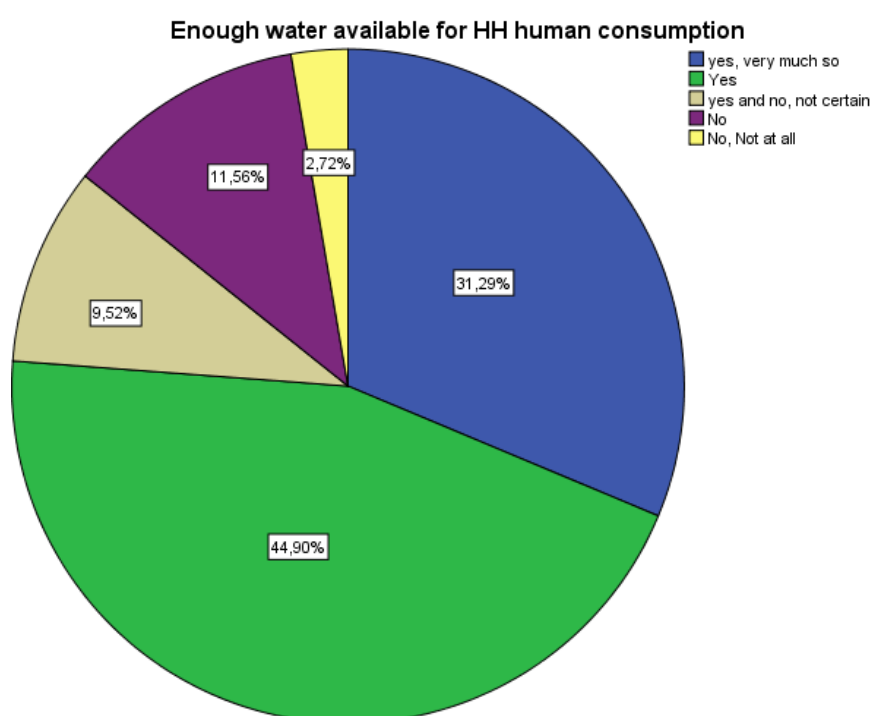
## **5.8 Perception of people about water availability**

Data from the international livestock research institute and researchers like Gichuki (1998) show a drying up of the river in the dry season, from which can be concluded that there is an actual water scarcity in the catchment. Yet, how do the people in the catchment experience the water situation. Do they experience water scarcity ? Is there scarcity of water for all their needs and activities ? Has the available amount of water changed in the last ten years in their eyes ? and what are the main water problems according to them? These are the questions that will be answered in the next paragraphs.

### **5.8.1 Water availability**

75% of the community believes that there is enough water available for human consumption. 9.5% is not certain if there is enough water available and 14.5% believes that there is not enough water available for their household human consumption. One can thus conclude that water scarcity for human household consumption is not a big issue within the catchment.

**Figure 5.8:** Water availability for human household consumption



Source: author's fieldwork 2011



### 5.8.2 Relationships

One would expect that not all people in the basin experience the same level of water scarcity for human consumption. To provide insight in the difference in water scarcity Anova analyses were performed. Assumed was that people who lived in one of the upstream area WRUAs; Ngusishi, Nanyuki and Sirimon WRUA experienced less water scarcity than people living in the area of the midstream WRUA mid-Ewaso Ng'iro. Another possible relation is that people who are a member of a WRUA would experience less water scarcity compared to those who are not a member of a WRUA. Further more, we are interested if livestock keepers would experience more water scarcity then farmers. Lastly we expected that the wealth of people would have an influence on water availability, with rich people less likely to experience water scarcity. To prove these statements an Unianova test is carried out, the results from this analyses are shown in table 5.3.

**Table 5.3:** factors that link with water availability for human consumption

Variable	P-Value	F-Value	Significant relationship
Main location of the head of the household	0.00	6.38	+
Main household occupation	0.03	4.86	+
Being a member of a WRUA	0.42	0.67	-
Wealth of the household	0.627	0.238	-

Source: author's fieldwork 2011

Some conclusions can be drawn following this test results. The main location of the household and the main occupation of the head of the household have a significant influence on the water availability of the household for human consumption. Being a member of a WRUA and the Wealth of the household do not have a significant influence on the amount of water available. Furthermore one can conclude that the main location of the household has the biggest influence on the water availability of the household for human consumption. Since this variable has the highest partial Eta squared (0.145).

Taking a closer look at the relation between the main location of the household and the water available for human consumption an interesting conclusion can be drawn. Not the people living in the Mid-Ewaso-Ng'iro sub catchment experience the most water scarcity but the people living in the Nanyuki sub catchment. Table 5.4 shows further details on this matter.

**Table 5.4:**Relation between the main location of the household and the water available for human consumption

		Main location			
Enough water available for human household consumption		Mid Ewaso Ng'iro	Nanyuki	Ngusishi	Sirimon
	++	9.8	3.2	60.0	46.4
	+	61.0	61.3	30.0	25.0
	+ -	24.4	0.0	2.5	10.7
	-	2.4	35.5	2.5	14.3
	--	2.4	0.0	5.0	3.6

Source: author's fieldwork 2011

Taking a closer look at the differences in water availability for the household human consumption between farmers and livestock keepers, one can conclude that farmers experience a little less water scarcity than livestock keepers. Table 5.5 shows details on this matter.

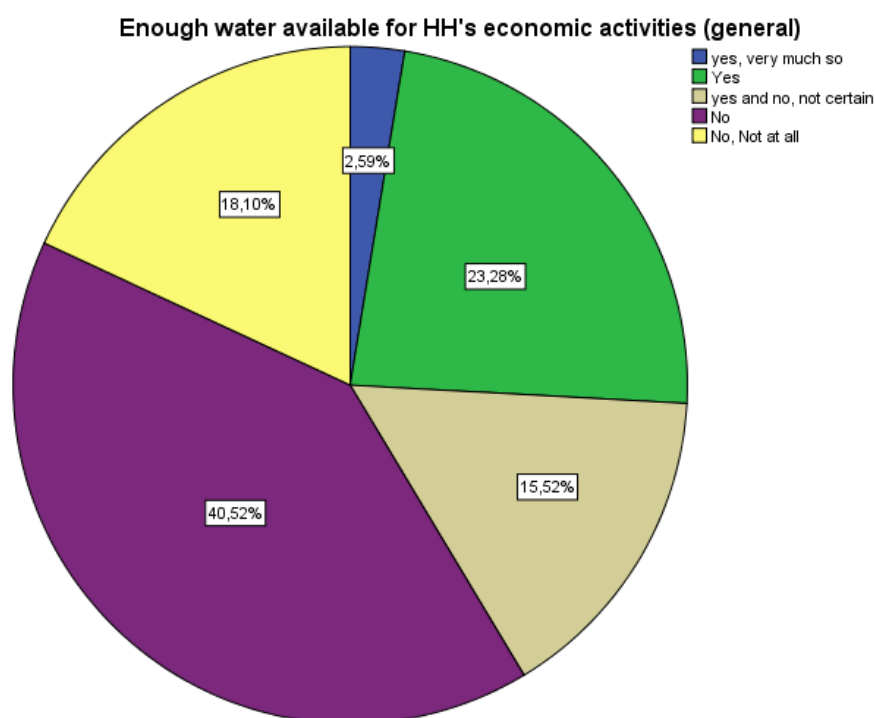
**Table 5.5:**Relation between the main occupation of the household and the water available for human consumption

		Main occupation	
Enough water available for human household consumption		Livestock keeping	Farmer
	++	22.5	35.5
	+	45.0	43.0
	+ -	22.5	5.4
	-	5.0	14.0
	--	5.0	2.2

Source: author's fieldwork 2011

Looking at the community's perception of water available for the households main activities, one can see that only 25% of the people living in the catchment believes there is enough water available for the households economic activities. 15.5% of the people is not certain if there is enough water available for their economic activities. Almost 60% of the people state that there is not enough water available for households economic activities. Thus water scarcity for the household economic activities is a much bigger issue than scarcity of water for human consumption.

**Figure 5.9:** Water available for household's economic activities



Source: author's fieldwork 2011

One would expect that not all people in the basin experience the same level of water scarcity for economic activities. Analyses show that the main location of the household significantly influences the actual scarcity of water human household economic activities. Other characteristics such as being a member of a WRUA wealth and main occupation are not related. These statistics are shown in table 5.6.

**Table 5.6 :** factors that link with water availability for household economic activities

Variable	P-value	F-value	Significant relationship
Main Location of the head of the household	0.04	4.87	+
Main household occupation	0.939	0.01	-
Being a member of a WRUA	0.129	2.35	-
Wealth of the household	0.059	3.67	-

Source: author's fieldwork 2011

Taking a closer look at the relation between the household's main location and the water availability for economic activities, the following conclusions are reached. In the Sirimon catchment water

scarcity is the most severe. In the mid-Ewaso Ng'iro sub catchment the water scarcity experienced is least is severe.

**Table 5.7:** Relation between the main location of the household and the water available for economic activities

Enough water available for households economic activities		Main location			
		Mid Ewaso Ng'iro	Nanyuki	Ngusishi	Sirimon
	++	5.6	0.0	2.7	0
	+	61.1	3.6	32.4	11.5
	+ -	16.7	3.6	27.0	11.5
	-	5.6	92.9	21.6	34.7
	--	11.1	0.0	16.2	42.3

Source: author's fieldwork 2011

There is also a difference in water in the level of water scarcity experienced for various activities. 60% of the people do have enough water for livestock keeping, but only 15.2% of the people believe there is enough water available for irrigated agriculture. 25.5% believes there is enough water for rainfed agriculture. Table 5.8 and 5.9 show more detailed numbers on this matter.

**Table 5.8:**Water availability for HH's economic activities: Irrigated agriculture

Enough water available for HH's economic activities: Irrigated agriculture	%
Yes, very much so	7.6
yes	7.6
yes and no, not certain	23.9
no	47.8
no, not all	13.0

Source: author's fieldwork 2011

**Table 5.9:** Water availability for HH's economic activities: livestock keeping

Enough water available for HH's economic activities: Livestock keeping	%
Yes, very much so	21.0
yes	37.1
yes and no, not certain	11.3
no	25.7
no, not all	4.76

Source: author's fieldwork 2011

## 5.9 Trend

Looking at the perception of the people about the trend in the water availability, one can see that there is a predominantly negative perception of the trend. 79.2% of the people interviewed believe there is now less water available than 10 years ago for rainfed agriculture. In contrast, only 11.7% believes there is now more water available 10 years ago. For irrigated agriculture these percentages are respectively, 79.4%, and 10.3%. Looking at the perception of people about the trend of water available for livestock, the opinions are a little bit less negative, although still predominantly negative. Percentages concerning these matters are shown in table 5.10.

**Table 5.10:** Trend in water availability of the last 10 years

Trend over the last ten years in %					
	Positive	Negative	Same	Don't know	Total
Rainfed agriculture	11.7	79.2	5.2	3.9	100
Irrigated agriculture	8.8	79.4	1.5	10.3	100
Livestock	17.9	69.2	5.2	7.7	100

Source: author's fieldwork 2011

Looking at the opinion of people about the water availability for different water sources, one can conclude that except for water in shallow wells people believe that there is now less water than years ago. In general people thus believe that there is now less water available for their economic activities than 10 years ago.

**Table 5.11:** Trend in water available per water source over the last ten years

Water available in % as compared to ten years ago.			
	More	Same	Less
shallow well	28.6	14.3	7.2
Borehole	17.4	15.2	67.4
Waterpan	8.3	10.4	81.3
Dam	17.9	12.5	69.6
Roofcatchment	29.9	21.6	48.5
Pipeline	23.8	13.9	62.6
River	29.9	7.5	62.6
<b>General</b>	<b>15.5</b>	<b>24.8</b>	<b>59.7</b>

Source: author's fieldwork 2011

## 5.10 Main water problems

To provide insight in the main water problems in the Upper Ewaso Ng'iro basin, people were asked to react on 9 statements. These statements that can be found in table 5.12.

**Table 5.12<sup>1</sup>:** Water problems in the Upper Ewaso Ng'iro catchment

Water problem	Score
1. Not enough water	127
2. Water shortages in some months	120
3. Some users are not following the water laws	76
4. To many people want to use water	67
5. Bad water infrastructure	66
6. The community is not able solve the water problems	-2
7. People are not ready to share the water	-14
8. Authorities are not able to solve the water problems	-18
9. Bad water quality	-27

Source: author's fieldwork 2011

Apparently the biggest problem in the catchment is that there is not enough water available. People do not see the quality of water as a problem but the quantity of water that is available as problematic. Especially in the months during the dry season, there are severe water shortages. The community believes, these water shortages are partly created by the fact that too many people want to use water but also because there is a bad water infrastructure.

---

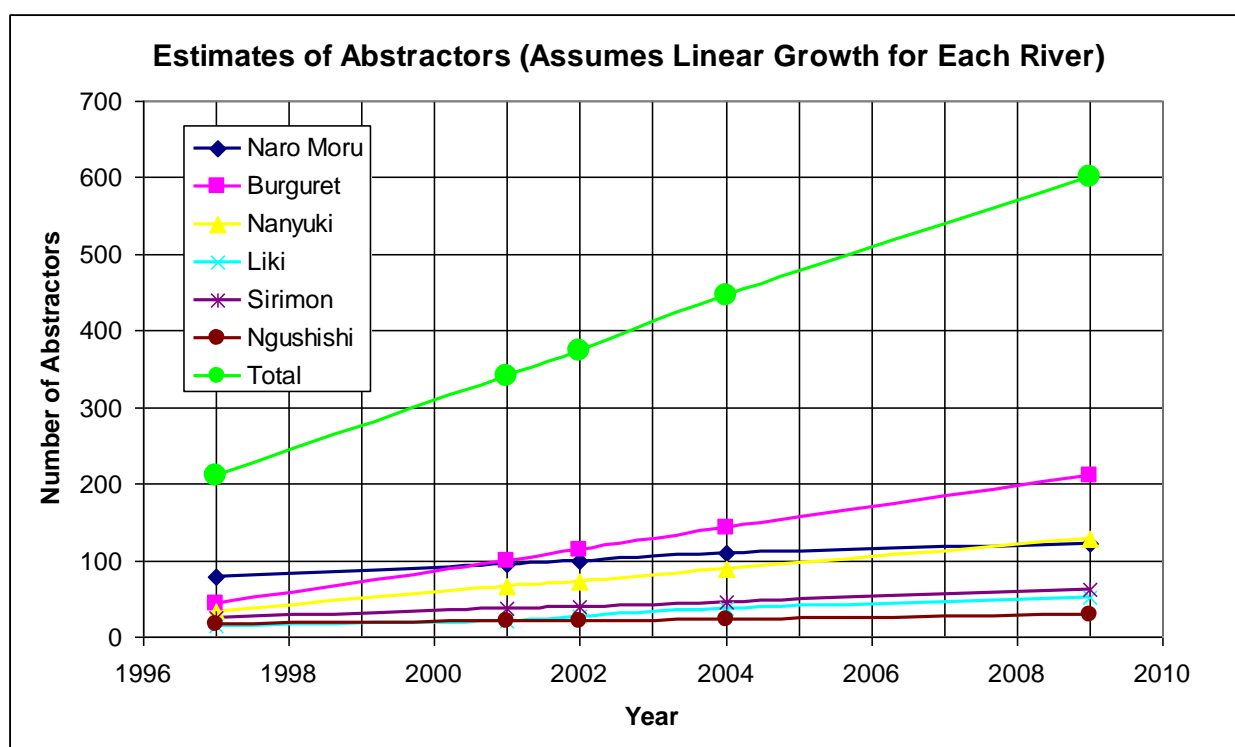
<sup>1</sup> People had five response categories, ++ which meant that they though the water problem stated was a very big problem, + which meant that they though the water problem stated was a problem, +- which meant yes and no, not certain, - which meant that they though the water problem stated was not a problem, -- which meant they though the water problem stated was not a problem at all. These response categories were recoded, ++=2, +=1, +=0, -=-1, --=-2. Then the total scores on the variable are calculated, by adding the scores of each respondent on the variable together. The numbers under score in the table represent these total scores. These numbers can be interpreted as followed, a score higher then 0 means that in total people think this problem is actually a problem, a score below zero means that people in total think this presumed problem is not a problem. A higher score means that more people think this problem is actually a problem.

# 6 WATER DEMAND

## 6.1 Introduction

This chapter will discuss the demand for water within the Ewaso Ng'iro catchment, in particular reviewing the main water users, the water sources and the trend in water demand. The information provided is foremost based on field surveys by the author.

**Figure 6.1** : Abstractions of 6 rivers in the Ewaso Ng'iro catchment



Source: Rural focus (2006)

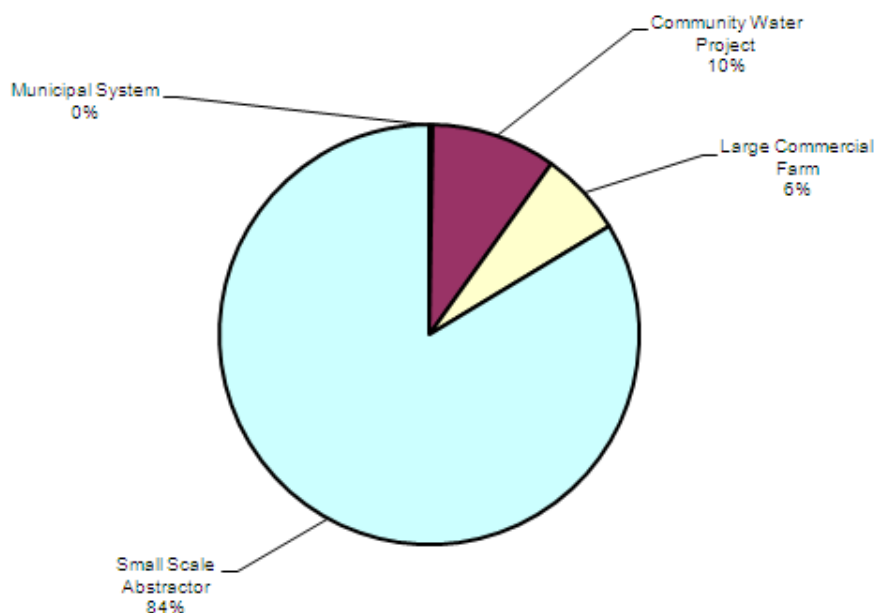
## 6.2 Main water users

An extensive river abstraction survey carried out in 2002 and 2004 by Rural Focus provides insight in the main water users in the Upper Ewaso Ng'iro catchment. The surveys focused on the number of abstractors and the amount of water abstracted. The research was carried out on the rivers Naro Moru, Burguret, Nanyuki, Likii, Sirimon, and Ngushishi during the dry season.

The group of water users consists mainly of small scale abstractors (84%), followed by community water projects (10%) and large commercial farms (6%). However, based on the total amount of water abstracted, a different picture can be presented. Community water projects use 67%

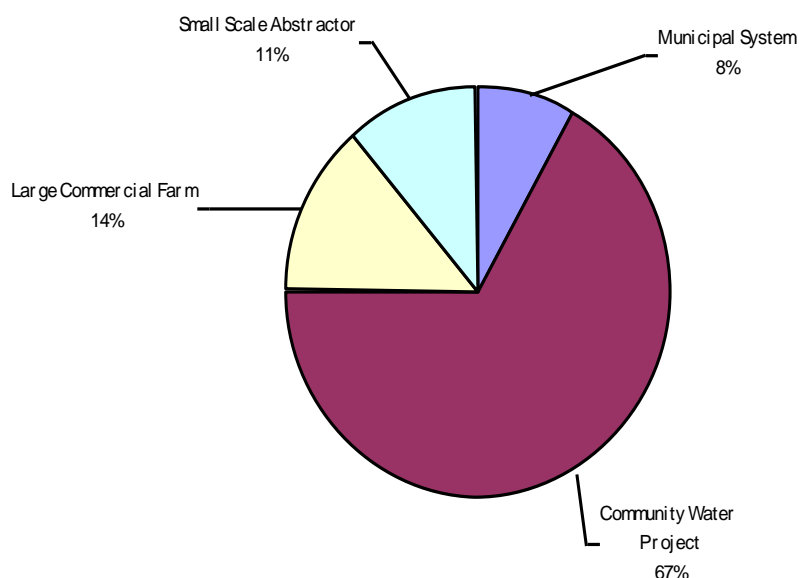
of the total amount of water abstracted. Second are the large scale commercial farms (14%), followed by small scale abstractors (11%) and the municipal system (8%).

**Figure 6.2:** Type of abstractors by total number of abstractors in the Upper Ewaso Ng'iro catchment



Source: Rural focus (2006)

**Figure 6.3:** Type of abstractors by total amount abstracted in the Upper Ewaso Ng'iro catchment



Source: Rural focus (2006)

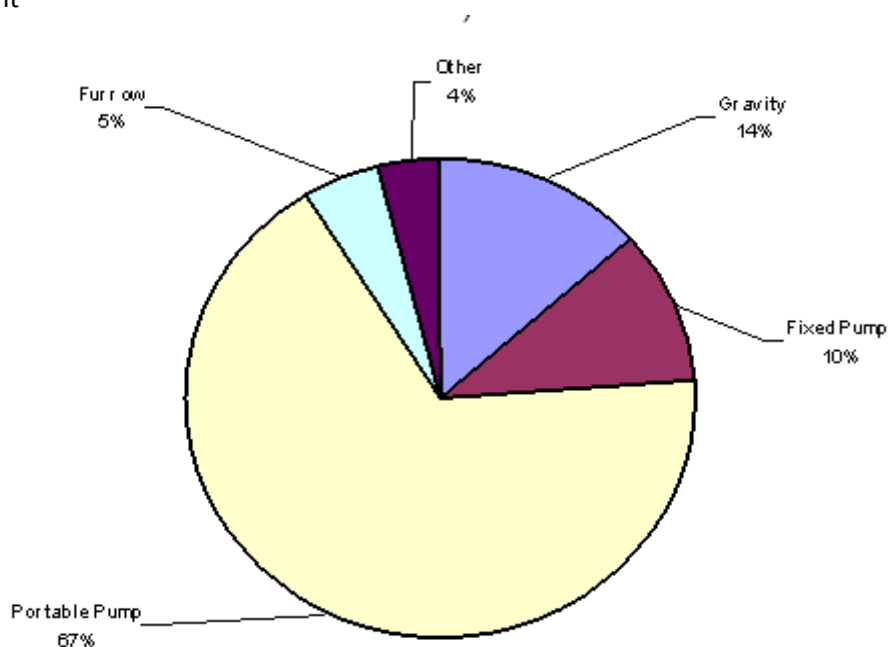
Thus small scale abstractors are numerous but are taking a fairly small volume of water. There are few large scale abstractors which take a fairly small volume of water. The main water users are the community water projects. Although there are few community water projects, these are the biggest water users within the catchments.



### **6.3 Method of abstraction**

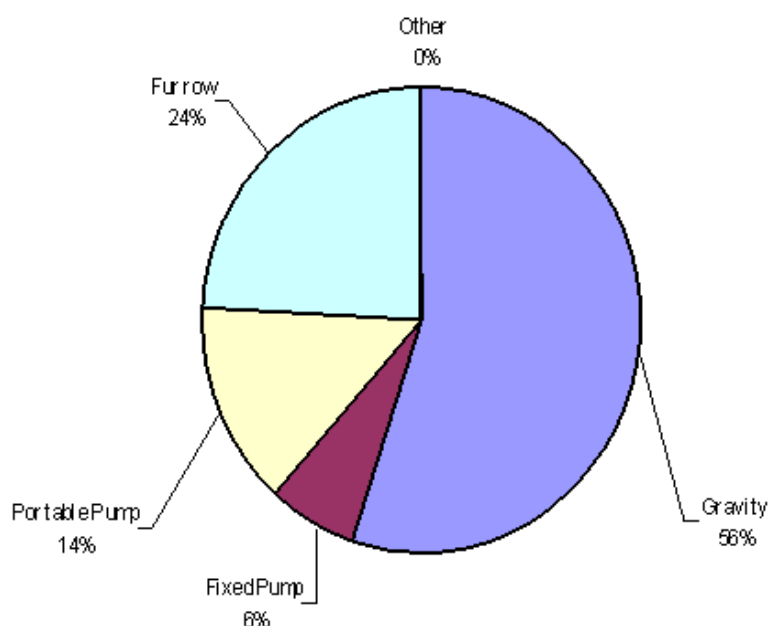
Looking at the method of abstraction by total number of abstractors, one can conclude that most (67%) the abstractions are done by portable pumps. 14% of the abstractions is via gravity, 10% via fixed pumps and 5% via furrows. With reference to the amount of water abstracted versus the method of abstraction some interesting conclusions can be drawn. More than half of the total amount of water abstracted from the river is abstracted via gravity schemes, 24% by furrows, only 14% by portable pumps and 6% by fixed pumps. Thus widely used portable pumps take small amounts of water compared to their numbers. In contrast, gravity pipelines and furrows are few, yet account for the bulk of abstraction.

**Figure 6.4:** Method of abstraction by total number of abstractors in the Upper Ewaso Ng'iro catchment



Source: Rural focus (2006)

**Figure 6.5:** Method of abstraction by total amount abstracted in the Upper Ewaso Ng'iro catchment

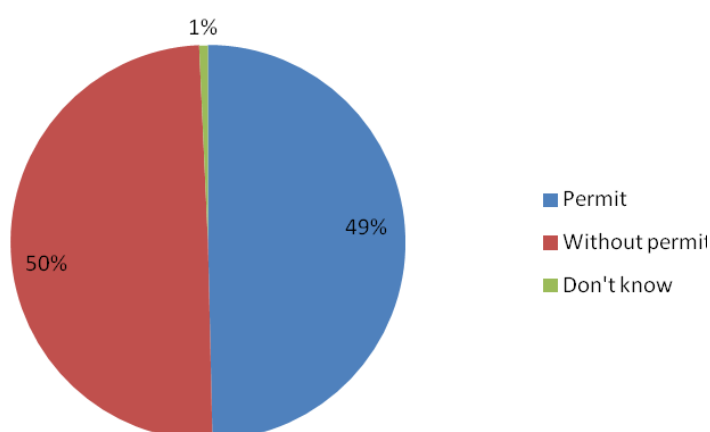


Source: Rural focus (2006)

#### **6.4 Abstraction permits**

Furthermore the survey provides data about legal and illegal abstraction. Out of the total number of abstractors, only 22% is permitted, 60% is not permitted and 18% is under authorization<sup>2</sup>. Concerning the mount abstracted, 48% is permitted, 40% not documented and 12% under authorization. Further details are shown in figure 6.4 and 6.5.

**Figure 6.6:** Percentage of the community that has a water permit in the Upper Ewaso Ng'iro catchment.



Source: author's fieldwork 2011

<sup>2</sup> Under Authorization means that they have applied for a water permit and have been authorized to construct their intake. They will not get a water permit itself until after the intake construction is complete and WRMA has inspected the intake and confirmed that it has been built as per the authorization to construct

A large part of the abstractors thus do not have permits. Most large scale abstractors however do have permits. In 2011 a new survey was carried out which examined the number of abstractors that did have a permit. At this time 49% of the abstractors did have a permit, 50% did not have a permit and 1% did not know if they had a permit

**Table 6.1:** factors that link with having a water permit

Variable	P-value	Significant relationship
Main occupation	0,001	+

Source: author's fieldwork 2011

Another interesting fact is that there are significant differences between farmers and livestock keepers. Table 6.1 shows, that almost all (90%) of the livestock keepers do have a permit to abstract water as compared to only 62.9% of the farmers.

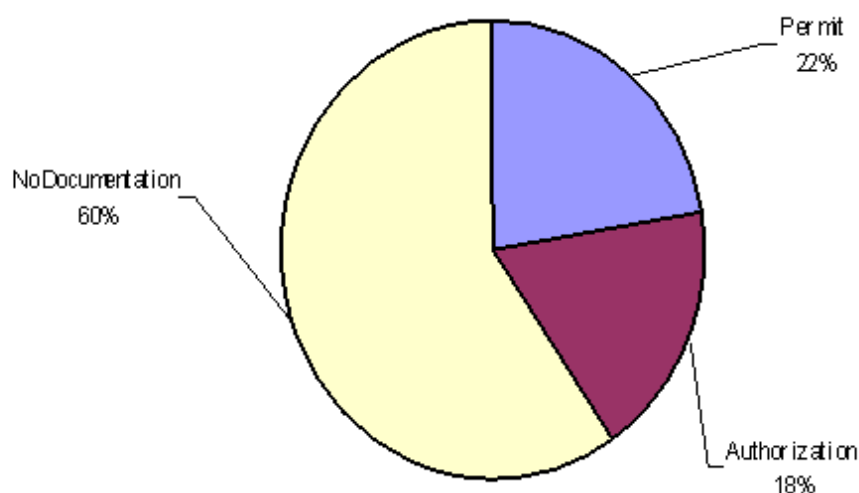
**Table 6.2:** Relation between the main occupation of the household and if they household has a water permit.

	Main occupation		
	livestock keepers		Farmers
Do you have a Water permit	yes	90	62.9
	no	10	38.1

Source: author's fieldwork 2011

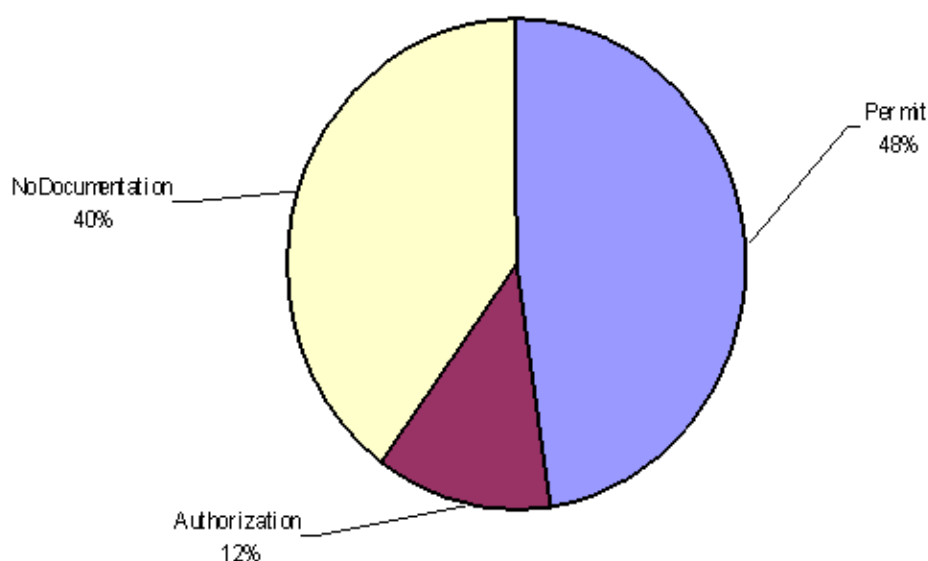
However, the variable 'being a member of a WRUA', which was expected to have an influence on the fact if people had a permit to abstract water does not have a significant influence.

**Figure 6.7:** Permit details by total number of abstractors



Source: Rural focus (2006)

**Figure 6.8:** Permit details by total amount abstracted



Source: Rural focus (2006)

### **6.5 Payment for water**

The 2011 survey collected data concerning payment for water. 52% of the respondents pay for water, 48% that does not. Thus there are also people without a permit that do pay for water. These people use water from their neighbour's water source and pay for this water or use commercial boreholes. Furthermore, it is interesting to look at relations between various variables and the fact if people pay for water. This is done for the variables: main occupation, member of a WRUA.

**Table 6.3:** factors that link with paying for water

Variable	P-value	Significant relationship
Main occupation	0.00	+
Member of a WRUA	0.00	+

Source: author's fieldwork 2011

The main occupation has a significant influence on the fact if people do pay for water, as can be seen in table 6.3. Taking a closer look at the relation between the main occupation and paying for water one can conclude that more livestock keepers (64.5%) pay for their water then farmers (23.1%).

**Table 6.4:** Relation between main occupation and paying for water

	Main occupation		
		Livestock keepers	farmers
Do you pay for water	yes	23.1	64.5
	no	76.9	35.3

Source: author's fieldwork 2011

In this case also being a member of a WRUA does have a significant influence on the fact if you pay for the water you use. As shown in table 6.5, 80% of the members of a WRUA do pay for the water they use, whereas only 26.3% of the people who are not a member of a WRUA pay for water.

**Table 6.5:** Relation between being a member of a WRUA and paying for water

	Member of a WRUA		
		yes	No
Do you pay for water	Yes	80	26.3
	No	20	73.7

Source: author's fieldwork 2011

## **6.6 Water sources used**

The 2011 survey provides data about the water sources people use. In table 6.6 the percentage of people that use water from various sources in different situations and for different purposes is given. It can be concluded, for example, that 4% of the people interviewed always use water from a shallow well. The river is most used in general, both in stress periods as normal periods. Moreover it is the number one source as well for human consumption, livestock and irrigation. The pipeline water tap is the second most popular source in all of these consumer classes.

**Table 6.6:** Use of water sources

Water source						
	Always	after rains only	stress periods only	human consumption	livestock	irrigation
Shallow well	4	2	2	1	3	2
Borehole	14	1	3	16	7	1
waterpan	7	1	0	5	5	7
Dam	21	3	1	15	20	5
Roof catchment	12	4	1	51	35	26
Home pipeline	49	4	2	51	46	39
River	55	2	19	69	62	35

Source: author's fieldwork 2011

## **6.7 Most important water source**

Section 6.6 stated that the river and pipeline are the most frequently used water sources. In this paragraph insight will be provided which water source is most important for the people (see Table 6.7). For watering livestock 64% of the people state that the river is the most important water source, 28.9% of the community members mentions the pipeline and 5% the dam as the number one

source for watering their livestock. The second most important water source for watering the livestock is the dam (35%) followed by the pipeline (26%).

For human consumption 59% of the people indicate the river is their most important water source, 4% mention the pipeline, and 8% the roof catchment. The second most important water source for human consumption are the roof catchment and dam with both 29% followed by the pipeline at 19%.

For cultivation purposes 50% of the people indicate that the river is the most important water source, while the pipeline scores 45% as the most important water source for cultivation. The second most important water source for cultivation is the roof catchment with 33%, followed by the river with 27%. We can conclude that the most important water source for the people is the river followed by the pipeline.

**Table 6.7:** Most important water source in the Upper Ewaso Ng'iro catchment

Most important water source in %									
	Livestock			Human consumption			Cultivation		
	1	2	3	1	2	3	1	2	3
Shallow well	0	2	3	0	1	0	0	0	0
Borehole	0	6	28	2	9	30	2	6	5
waterpan	0	3	3	0	4	3	0	3	0
Dam	5	35	0	0	29	3	4	9	11
Roof catchment	2	23	45	8	29	40	0	32	68
Pipeline	29	26	3	32	19	3	44	24	0
River	64	6	17	59	10	21	50	27	16

Source: author's fieldwork 2011

## **6.8 Trend demand**

Next to the current water situation, we were also interested in the trend. A clear trend can be seen in the water demand in the last ten years (See table 6.8). 76.2% of the community members need more water than ten years ago. This trend is especially noticeable for water from the river, the pipeline and the roof catchment. From this water source, respectively, 80.8%, 72%, 74.4% of the people indicated that they needed more water than 10 years ago.

**Table 6.8:** Trend in water demand

Water demand in %			
	More	Same	Less
shallow well	46.2	33.7	20.6
Borehole	38.2	26.5	34.3
Waterpan	48.5	30.3	21.3
Dam	50	22.5	27.5
Roof catchment	72	17.1	10.9
Pipeline	74.4	16.7	8.9
River	80.8	10.1	9.1
<b>General</b>	<b>76.2</b>	<b>19.1</b>	<b>4.7</b>

Source: author's fieldwork 2011

Previous chapters reported a vast decline of water availability over the last ten years. This chapter shows a steadily rising demand. One can thus conclude that scarcity of water is on the rise. Does this situation lead to more conflicts? Let us turn to chapter 7 to follow up this question.



# 7 CONFLICTS OVER WATER RESOURCES

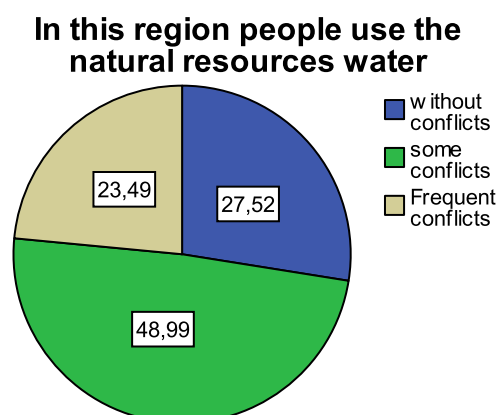
## 7.1 Introduction

In the preceding chapters we have seen that there is a scarcity of water resources within the catchment, both of an actual as well as of a perceived nature. The availability of water is on the decline while the demand is growing. This situation will, eventually lead to a serious scarcity of water resources. But what does this mean for the livelihood and overall economy in the basin? Have conflicts arisen because of a changing environment as Choudri and North (1975) suggest. Has this environmental scarcity led to violent conflicts as scholars such as Homer-Dixon (1999), Peluso & Watts (2001) and Baechler (1998) suggest or has the urgent need to collaborate served as a window for peace making as is claimed by other researchers like Wolf (2009) and Yoffee & Giordano (2005).

## 7.2 Water and conflict

A fairly large part of the community living in the catchment believes there are conflicts over water resources within the catchment. In fact, 23.5% of the people state that there are frequent water related conflicts. 49% of the respondents believes there are some conflicts about water and only 27.5% of the people indicate that water is used without conflicts. This response shows that according to the majority of the people,, i.e., three out of four, there are some or even frequent conflicts over water in the upper streams of the Ewaso Ng'iro North basin.

**Figure 7.1:** Conflicts about natural water resource in the Upper Ewaso Ng'iro catchment



Source: author's fieldwork 2011

### **7.3 Different forms of conflict**

There are different opinions concerning the causes that lead to these water conflicts in the area. From semi-structured interviews with WRUA officials, researchers and NGO officials, one can conclude that experts see a link between water scarcity and conflict. Although most people do agree on the fact that water scarcity can be a cause of conflict, they give different explanations to how this water scarcity originates and actually leads to conflicts. They do, however, all make a distinction between five categories of conflicts :

1. Intra-group conflicts, i.e., conflicts within a single group of water users,
2. Inter-group conflicts, conflicts between different groups of water users,
3. conflicts between groups of water users and the government,
4. conflict between groups of water users and private businesses.
- 5.conflict between humans and wildlife

ad 1. *Intra-group conflicts* can exist in many different forms, but the most common intra group conflicts within the catchment are the conflicts within the community water projects. Although all water users in a community water project seem to be homogeneous, this is not entirely true. Clear differences exist between different participants within the water projects as water is not always evenly distributed among the project participants. Conflicts can arise in the dry season because some are thought to have more water available than others.

Ad. 2 According to several experts the most severe problems occur during the *Inter-group conflicts*. These outside professionals focus mostly on the conflicts between the upstream and downstream users. They claim that scarcity of water is very local and results from an uneven distribution of water, due to inadequate management. Water is distributed unevenly, because some people over abstract water from the river. People upstream are said to take all the water, so there is hardly anything or even nothing left for the people downstream. Subsequently, people downstream move upstream to destroy the intakes of the people living upstream. The aim of the downstream users is to make sure the river does flow again. The other option for downstream people is to migrate upstream along the river in search for water. This will likely also create conflicts because people upstream will blame them for having invaded their territory.

Other observers argue that scarcity of water results from the lack of sufficient water storage opportunities. A lack of conservation of the catchment area is also mentioned, although many informants confirm the conflict between upstream and downstream users.

Ad 3. A third type of conflict is between different *water user groups and the government*. This conflict exists in different forms. The most common version of this conflict is between farmers and the Kenyan government (WRMA). In the dry season farmers are not allowed to use water from the

river for irrigation purposes. All the farmers, however, use water for irrigation during the dry season. When WRMA officials discover that farmers illegally use river water for irrigation the procedure is that WRMA has to enforce the law and confiscate their pumps. In practice this procedure is not always strictly followed. WRMA officials tend to give warnings first. Still, this does often lead to conflicts as irrigators often ignore warnings from WRMA. Especially poor people who are not able to comply for a water permit tend to be the victim of this type of conflicts. On the one hand because they do not have the knowhow on how to apply for a permit, on the other hand because they also lack the money for the permit.

Ad 4. The fourth type of conflict is between *private businesses and groups of water users*. Two varieties of this kind of dispute stand out and are most severe. The conflict between pastoralist and large scale ranchers and the conflicts between large scale horticultural farmers and small scale water users. Several large ranchers and pastoralists stated that they are sometimes in conflict. In the dry season, with no or too little water available, pastoralist take their animals into the pastures of the private ranchers to use water from their water sources. This problem, however, is not only connected to water but also to land. Part of the reason that pastoralist invade the territory of large scale farmers, is in search for grazing land. Large scale ranchers do never or seldom allow this trespass which at times leads to serious conflicts. This can be partly explained by the fact that pastoralists claim the territory now occupied by the large scale ranchers as traditionally belonging to them. They lost access to these pastures as a result of colonial settlers, and some questionable treaties from the beginning of the 20<sup>th</sup> century onwards.

Small scale abstractors are in conflict with large scale horticultural farmers concerning the amount of water used. In the dry season when the river is completely dried up, small scale abstractors argue this is because of the large amount of water abstracted by the large scale horticultural farms. These small scale abstractors therefore come in conflict with horticultural farmers.

Ad 5. The fifth and last type of water related conflict in the Upper Ewaso Ng'iro catchment is the conflict between *humans and wildlife* over water. People interviewed indicated that in the dry season, the livestock of pastoralists comes into conflict with the wildlife at the few water sources that are left. Pastoralists are losing livestock to predators, and wildlife is killed by pastoralists to protect their animals.

To provide insight in which of these conflicts are most common within the catchment, people were asked to write down the number of cases of conflicts of the different categories, they themselves had experienced last year or conflict cases they heard about last year.

**Table 7.1:** Types of conflicts in the Upper Ewaso Ng'iro catchment

Type of conflict	Mean
Intra-group	2.039
Inter-group	1.938
group-government	3.276
group-private business	1.605
human-wildlife	1.150

Source: Author's fieldwork 2011

The Type 3 'group-government' conflict seems to be most severe in the Upper Ewaso Ng'iro catchment. On average people stated that last year there were 3.276 conflicts about water between the government and the different groups. This is mentioned more often than Type 4 conflicts between groups and private businesses which scored a mean of 2.95, Type 2 (Inter group-conflict), 2.67, Type 1 (intra-group conflicts) 2.77, or Type 5 (human-wildlife conflict) at a mean of 1.94.

#### **7.4 Factors that link with the experience of conflict**

Several issues play a potential role in triggering conflicts over water. The following variables are expected to have an influence if someone encountered a conflict in the year preceding the interview: main occupation, the residential area, ethnicity, wealth. WRUA membership, water scarcity for human household consumption, water scarcity for the household economic activities.

Cross tabulation analyses tell that only the variables 'being a member of a WRUA' and 'the amount of water available for household economic activities' have a significant influence as is shown in table 7.2.

**Table 7.2:** factors that link with experiencing a conflict in last year

Variable	P-value	Significant relationship
Main occupation	0.474	-
Main Location	0.064	-
Member of WRUA	0.005	+
Water availability for human household consumption	0.285	-
Water availability for household economic activities	0.0027	+
Ethnicity	0.935	-
Wealth class	0.678	-

Source: Source: Author's fieldwork 2011

Taking a closer look at the significant variables some interesting conclusion can be drawn.

#### 7.4.1 Member of a WRUA

A significant influence could be seen between the variables, If the head of the household is a member of a WRUA and whether the household experienced a conflict last year or not.

However, taking a closer look at this analyses using percentages in the cross tabulation a remarkable notion comes to light. Almost 60% of the WRUA members encountered at least one conflict during the preceding year, among non-members this figure stood at 40% only. The expected outcome was that people connected to a WRUA would have experienced less conflict than people not connected to a WRUA. This assumption was made because WRUA are established to prevent and resolute conflict. There are, however, possible explanations for this relationship. One could argue that a conflict of a household A is now experienced by another household, household B. Not as a party in itself but because of the WRUA household B now is aware of the conflict of household A. Another argument is that the WRUA helps underserved households to get water. The WRUA makes people aware of the situation and helps them to find ways to abstract water. If these people get a possibility to abstract water there is a chance conflicts might erupt with other water users.

**Table 7.3:** Relation between being a member of a WRUA and experienced conflict

		Member of a WRUA	
Experienced conflict last year		yes	no
	yes	75.14	34.00
	no	24.86	66.00

Source: Author's fieldwork 2011

#### 7.4.2 Water availability for household economic activities

A significant relation is also found between the variables water availability for household economic activities and the fact if the household has experienced a conflict last year.

Again the relationship is not as one would expect. In chapter 3 we saw that scholars, like Homer & Dixon (2000) claimed that a scarcity of resources would lead to conflict in a certain area. So the hypothesis that was tested was if people who experienced more water scarcity also experienced more conflicts in the area, this did not seem to be the case. Namely 66.7% of the people who do not experience water scarcity do experience conflict, where only 55.6% of the people who experience a little water scarcity experience conflict, and only 38.2% of the people that experience severe water scarcity experience conflict. However, some remarks can be made on this conclusion. Namely, this analysis takes only a very short time span into consideration. Therefore it is possible that two years ago there was a big conflict and the 'winners' of that conflict are now interviewed. Therefore it would be possible this conclusion is biased. Another remark that can be made on this analysis is that

ideally, people would be questioned about their water scarcity before and after the conflict. Unfortunately, this was not possible in this research.

**Table 7.4:** Relation between water scarcity for hh's economic activities and experienced conflicts

		Experienced water scarcity for household economic activities		
		yes	Not certain	No
Experienced conflict last year	yes	66.7	55.6	38.2
	no	33.3	44.4	61.8

Source: Author's fieldwork 2011

#### 7.4.3 Logistic regression model

To control the effects of the variables for each other a logistic regression model is created. A logistic regression model that includes all relevant variables, does not show any significant relationship, as is shown in table 7.5. Even the variables *Being a member of a WRUA* (Q85.1) and the variable *water scarcity for their economic activities* (Q33.A.recoded) do not seem to have a significant relationship whether people experience a conflict, if controlled by other variables as is done in a logistic regression model. Therefore, based on this model we can not conclude that any variable tested links with the fact if people experienced conflict in the last year.

**Table 7.5:** Significance of the variables in a regression model

Variable	Significance
Wealth category	0.277
Q.4 Ethnic group	0.98
Q5 Main location	0.857
Q9 Main occupation	0.723
Q85.1 Being a member of a WRUA	0.546
Q33 water scarcity for their economic activities	0.311
Q30 water scarcity for human household consumption	0.996

Source: Author's fieldwork 2011

#### **7.5 People's opinions about conflict**

Besides linkages to people experiencing a conflict, it is also interesting to evaluate if certain variables have an influence on people's opinion on conflict in the area. Variables that are expected to have an influence in this respect are main occupation, main location and ethnicity among others. In table 7.6 an overview is given of the relation between these variables and people's opinions about conflict.

**Table 7.6:** factors that link with people's opinions about conflict

Variable	P-value	Significant relationship
Main occupation	0.00	+
Main Location	0.00	+
Member of WRUA	0.018	+
Water availability for human household consumption	0.214	-
Water availability for household economic activities	0.002	+
Ethnicity	0.00	+
Wealth class	0.271	+

Source: Author's fieldwork 2011

### 7.5.1 Main occupation

Table 7.7 shows that the variable main occupation has a significant influence on the opinion of people about water conflicts. A closer analyses provide more insight and shows that, Livestock keepers state there are less conflicts in the area than farmers.

**Table 7.7:** Relation between main occupation and opinion about conflicts

Opinion about conflicts	Main occupation	
	Livestock keeper	Farmer
Without conflicts	52.5	17.2
Some conflicts	32.5	59.1
Frequent conflicts	15.5	23.7

Source: Author's fieldwork 2011

### 7.5.2 Scarcity of water for household economic activities

There is also a significant difference in opinions about conflicts about water in the area, between groups of people that experienced no water scarcity and groups of people who experienced severe water scarcity. Out of table 7.8 one can conclude that people that have a lot of water available for their economic activities, state that there are conflicts more often than people who have very little water available.

**Table 7.8:** Relation between water availability for household economic activities and opinions about conflicts

		Enough water for household economic activities				
Opinion about conflicts		very much	much	not certain	no	not at all
	Without conflicts	13.04	33.85	57.14	17.65	25.00
	Some conflicts	45.66	53.85	42.86	52.94	50.00
	Frequent conflicts	41.30	12.31	0.00	29.41	25.00

Source: Author's fieldwork 2011

### 7.5.3 Ethnic Group

Another significant relation was found between the variable ethnicity and the opinion of people about conflict was found. Of the Samburu people interviewed 77.3% stated that water was used without conflicts, while only 12.7% of the Kikuyu did state the same. There is thus a big difference in opinion between these two ethnic groups.

**Table 7.9:** Relation between ethnic group and opinion about conflicts

		Ethnic group			
		Kikuyu	Masaai	Meru	Samburu
Opinion about conflicts					
	Without conflicts	12.7	50.0	13.9	77.3
	Some conflicts	52.4	50.0	61.1	22.7
	Frequent conflicts	24.9	0.0	25.0	0.0

Source: Author's fieldwork 2011

### 7.5.4 Main location

There is a significant relationship between the location where people live and their opinions about conflicts in the area.

**Table 7.10 :** Relation between main location and opinion about conflicts

		Main location			
		Mid ewaso Ng'iro	Nanyuki	Ngusishi	Sirimon
Opinion about conflicts					
	Without conflicts	63.4	25.8	7.1	14.3
	Some conflicts	43.1	61.3	50.0	53.6
	Frequent conflicts	2.4	12.9	42.9	32.1

Source: Author's fieldwork 2011

63.4% people living in the mid-Ewaso Ng'iro sub catchment state that water is used without any conflicts. Also in the Ngusishi sub-catchment a relatively high percentage of the people (42.9%) state that the conflicts are related to the use of the natural resource water. In the Nanyuki sub-catchment this percentage is significantly lower with 25.8%.



### 7.5.5 Member of a WRUA

It was expected that there would be a positive relationship between WRUA membership and the opinions of people about conflicts in the area. Since WRUAs are organizations set-up to manage the water resources and reduce the number of conflicts about this natural resource.

**Table 7.11:** Relation between member of a WRUA and opinion about conflicts

		Member of a WRUA	
		Yes	No
Opinion about conflicts			
	Without conflicts	29.3	70.7
	Some conflicts	56.9	43.1
	Frequent conflicts	48.6	51.4

Source: Author's fieldwork 2011

Table 7.11, Shows that people who are not a member of a WRUA tend to state far more often that there is no conflict within the catchment than people who are a member. This, however, does not mean that the hypothesis as set in the former paragraph is automatically right. It can also be the case that people who are a member of a WRUA are better informed about the conflicts in the area. Since they are more active in conflict prevention, resolution and management of water and therefore state that there are more conflicts.

### 7.5.6 Test between subjects

Creation of a multinomial regression model to control the variables for each other is not possible because of separation in the data. Therefore the assumption is made that the dependent variable *Opinion about conflicts* is an interval variable. This means that Anova test between subject analyses can be used to control the effect of variables for each other.

**Table 7.12:** factors that link with Opinion about conflicts

Variable	P-value	Significant relationship
Main occupation	0.367	-
Main Location	0.682	-
Member of WRUA	0.245	-
Water availability for human household consumption	0.277	-
Water availability for household economic activities	0.044	+
Ethnicity	0.875	-
Wealth class	0.397	-

Source: Author's fieldwork 2011

Controlled for all other variables, the effect of the variable water available for household economic consumption (Q33.a.Recoded) is the only variable that still has a significant influence on the opinion of people about conflict. One can thus conclude that the amount of water available for household economic activities is linked with the opinion of people about conflicts in the area. People with large amounts of water available tend to state there are more conflicts within the area than people with small amounts of water available. Various possible explanations can be given for this relation. Firstly, People with large amounts of water available are often the wealthier people. In general in this area the wealthier people are the more educated people. These people often know more about the area, thus also know more about conflicts in the area. Secondly, people who have a large amount of water available are confronted by poor people to share water. People with large amounts of water available like large scale horticultural farmers and large scale private ranchers are confronted by this fact. Often not only by poor people but also by various NGOs

### **7.6 Trend in conflict**

If we look at the trend in water related conflicts, 42.4% of the people see a general increase in water conflicts within the catchment. 28.3% believes the number of conflicts did not change in recent years and 27.9% of the people saw a decrease in the number of conflicts in recent years.

**Table 7.13:** Trend in conflict over past ten years

<b>Trend in conflict in %</b>				
	Increase	same	decrease	Don't know
General	42.2	28.3	28.0	1.5

Source: Author's fieldwork 2011

Studying the different types of conflicts, one can conclude that a large part of the community (42%) believes there was an increase of all types of conflict about water in the area.

**Table 7.14** :Trend in conflict over last ten years

Increase/decrease in recent years in %						
	Strong increase	Increase	Same	decrease	Strong decrease	Don't know
Intra-group	22.3	19.8	25.6	14.9	15.7	1.7
Inter-group	21.2	22.9	22.0	17.8	14.4	1.7
Group government	13.8	23.6	34.0	13.8	13.0	1.6
Group-private business	17.9	29.1	29.9	12.0	10.3	0.9
Human-wildlife	13.0	27.6	30.1	14.6	13.0	1.6

Source: Author's fieldwork 2011

Looking at the opinion about the trends in conflicts in the region, clear differences can be seen between the regions. In the Ngusishi catchment 30.5% of people believes that there was a strong increase in conflicts about water within the catchment in recent years. In the other catchments this number is significantly lower.

**Table 7.15:** Trend in conflict over last ten years in different sub-basins

Increase/decrease in recent years	strong increase	increase	same	decrease	strong decrease	Don't know
Mid Ewaso Ng'iro	10.9	31.3	29.7	20.8	7.3	0.0
Nanyuki	4.6	43.7	17.2	16.1	0.0	18.4
Ngusishi	30.5	15.2	14.2	9.1	28.9	2.0
Sirimon	12.2	11.3	52.2	6.1	7.0	11.4

Source: Author's fieldwork 2011

People were also asked about their view of conflicts in the near future. 38.7% of the people believed there would be an increase in the numbers of conflicts about water in the near future, 26.0% of the people felt the situation would stay the same and 24.5% of people felt that there would be a decrease of conflicts in the near future.

**Table 7.16** : Trend in conflict over next ten years

Trend in the near future in %	increase	same	decrease	don't know
	46.8	26.2	24.5	2.5

Source: Author's fieldwork 2011

Looking at the different types of conflict, one can see that the community in general believes that there will be an increase in all types of conflicts about water within the area. The most common explanation given is that people believe that the availability of water will decrease in the coming years. They believe that because of climate change there will be longer periods of droughts and a rise

in temperature. The community also believes there will be a growing demand because of population growth and a growing number of people that use irrigation. They argue that this growing demand and decreasing supply will lead to more conflicts in the future.

**Table 7.17:** Trend in different types of conflicts over the coming ten years

Increase/decrease in the near future in %						
	Strong increase	Increase	Same	decrease	Strong decrease	Don't know
Intra-group	28.1	19.8	23.1	15.7	10.7	2.5
Inter-group	28.6	20.2	25.2	16.0	7.6	2.8
Group government	18.5	21.0	29.8	14.5	13.7	2.4
Group-private business	24.6	25.4	28.0	13.6	5.9	2.5
Human-wildlife	23.4	24.2	25.0	16.9	8.1	2.4

Source: Author's fieldwork 2011

Again there can be seen large differences between the sub-catchments.

**Table 7.18:** Trend in conflicts in the different sub-basins over next ten years

Next ten years	strong increase	increase	same	decrease	strong decrease	Don't know
Mid ewaso Ng'iro	7.6	28.3	27.2	23.9	10.3	2.7
Nanyuki	2.7	32.2	28.7	29.7	0.0	5.4
Ngusishi	17.8	15.7	23.6	13.1	29.8	0.0
Sirimon	13.1	4.8	71.4	4.8	0.0	6.0

Source: Author's fieldwork 2011

## **7.7 Actions most helpful to prevent conflict**

To gain insight in the best actions available to prevent conflict in the Upper Ewaso Ng'iro basin, People were asked to react on six statements (see Table 7.19). The action that is believed to be most helpful to prevent water conflicts, is to increase the number of shallow wells. People argue that if the number of shallow wells rises water scarcity will decrease and there will be less conflict. Another measure that is believed to be very helpful is to enhance watershed management by reducing run-off water. The community believes that a lot of water is wasted by run-off. If water is better managed and retained there will be less runoff and thus more water available which will lead to less conflict. Also the increased use of water harvesting and the increase of number of boreholes will provide more water. The control of upstream extraction of water is seen as the fifth most helpful solution to reduce conflict. People downstream did very much agree on this notion, but people living upstream often mentioned that this would lead to more conflict. The least effective way to prevent water conflict was to control upstream river water pollution. People do not see the pollution of water as a big problem and therefore cleaning the water would not help much to prevent conflict.

**Table 7.19:** Actions most helpful to prevent water conflict

<b>Actions most helpful to prevent water conflict<sup>3</sup></b>	<b>Score</b>
1. Increase number of shallow wells	207
2. Enhance watershed man. by reducing run-off water	163
3. Increase use of roof water harvesting	158
4. Increase number of boreholes	149
5. Control upstream river water extraction	124
6. Control upstream river water pollution	112

Source: Author's fieldwork 2011

## **7.8 Conclusion**

What can we conclude after looking at the conflicts about water in the Upper Ewaso Ng'iro catchment? First, only a small (27.5%) part of the community believes the natural resource water is used without conflict.

Second, these conflicts about water exist in different forms. According to the community, the conflicts that are most severe are the conflicts between the government and the community.

Third, there are certain factors that influence the fact if people have experienced conflicts in the last year. These variables are; the fact if people are a member of a WRUA and the level of water scarcity experienced for economic activities by the household. However, controlling for the variables that are expected to have an influence on the experience of conflict by using a regression model, it seems that no variable has a significant influence on the fact if people did experience conflict. As a result no decisive cause could be pointed at explaining why people experienced water conflicts.

Fourth, there are some factors that influence the opinion of people about water conflicts in the region. The variables, main occupation, main location of the household, being a member of a WRUA, the amount of water available for household economic activities, the ethnicity and the wealth of the household have an influence on the opinion people have about conflicts over water in the area. However, after creating a model which controls these variables for each other only the variable water available for household economic activities still has a significant influence. Analysing this

---

<sup>3</sup> There were five response categories, ++ which meant that they thought the action was very helpful in preventing conflicts about water, + which meant that they thought the actions was helpful to prevent conflicts about water in the catchment, +- which meant the action would not influence, - which meant that they thought actions not be helpful to prevent conflict, -- which meant they thought the action would not at all be helpful to prevent conflicts about water within the catchments. These response categories were recoded, ++=2, +=1, +=0, -=1, --=-2. Then the total scores on the variable are calculated, by adding the scores of each respondent on the variable together. The numbers under score in the table represent these total scores. These numbers can be interpreted as followed, a score higher than 0 means that in total people think the action is actually helpful to prevent conflict, a score below zero means that people in total do not think the action is helpful to prevent conflict. The higher the score the more people think action will help to prevent conflict.

relation one can conclude that People that have very much water available for their economic activities, state that conflicts are more common than people who have very little water available.

Fifth, there is a clear trend in conflict according to the community. People believe that conflicts are on the rise the past ten years and will be on the rise for the next ten years. There are, however, huge differences in the opinion of people in the different sub regions. A clear explanation for these differences, however, is not found.

Sixth, the actions that are most helpful to prevent conflict are all related to the improvement of the amount of water available within the region.

# 8 ORGANIZATIONAL FEATURES OF WATER RESOURCE USER ASSOCIATIONS

## 8.1 Introduction

In this chapter the organizational features of the WRUAs will be discussed. Attention will be devoted to their structure, problems and potentials. Furthermore, the opinion of the WRUA officials, the community, researchers, NGO employees and people from WRMA about the functioning of WRUAs will be presented.

## 8.2 Formation process of the WRUA

### 8.2.1 Year of foundation

WRUAs were formed between 1998 and 2010. Although the current Water Act was only put in place in 2002, already some years earlier people had taken initiatives to set up community based management organizations. Table 8.1 shows which year the WRUAs were formed.

**Table 8.1:** Formation of the WRUAs

Name of the WRUA	Year founded	Initiative to start WRUA	Trigger event
Sirimon	1998	Community	Conflict
Ngusishi	1998	Community	Conflict
Nanyuki	2001	Community	water scarcity
Upper-Ewaso Ng'iro	2001	Community	Change of the law
Likii	2002	Community	water scarcity
Burguret	2003	Community	water scarcity
Timau	2005	government	Conflict
Naro Moru	2007	Community and the government	water scarcity
Ontulilli	2008	government	water scarcity
Mid-ewaso Ng'iro	2010	Community	water scarcity

Source: Author's fieldwork 2011

### 8.2.2 Who's idea was it to form a WRUA

In Most cases (six out of ten) it was the community who initiated the process of forming a WRUA. However, in two cases WRUAs were entirely initiated by the government. One WRUA results from a collaborative process between the community and the government and one WRUA was founded by the community together with a large scale farmer. Table 8.1 provides more specific information about the individual WRUAs.



### *8.2.3 Trigger events that led to the formation of the WRUA*

Several trigger events for starting a WRUA were mentioned by the WRUA officials. There are, however, three categories of trigger events that can be distinguished. The first category of events is the emergence of conflicts. Three of the ten WRUA officials stated that one of the trigger events that led to formation of their WRUA was the emergence of conflict. Mostly they spoke of conflicts between upstream and downstream water users. They stated that upstream water users used too much water so downstream people were not able to get water which led to conflicts. But also conflicts that arise from illegal abstractions and uncontrolled water use were mentioned.

The second category of trigger events concerns the water scarcity within the catchment. Six WRUAs were formed because there was water scarcity within the catchment. People saw the river dry up and wanted to stop this.

The last category of trigger events is of a legal nature, i.e., the change in the 2002 Water Act. Table 8.1 provides more detailed information about the individual WRUAs.

### *8.2.4 Support in development phase*

Although the process of setting up a WRUA was mostly started by the community, many were not able to set up the WRUAs by themselves. Nine out of ten WRUAs were assisted by NGOs in this process. The help of these NGOs can be subdivided in two categories: capacity building and funding.

Many WRUAs were assisted in the development phase by NGOs. The Laikipia wildlife forum, Rural Focus, SNV and CETRAD all gave support in capacity building of the among WRUA members. NGOs helped to organize seminars, to form a constitution and prepare sub-catchment management plans for the catchments. They organized seminars for committee members on water management and assisted on the ground by teaching the local farmers on how to use water efficiently under drought conditions.

Besides capacity building, the NGOs also funded the WRUAs, for example, for an office or specific projects.

Besides the NGOs also some large scale farmers helped the community to set up the WRUA. Seven WRUAs received assistance from large scale farmers on capacity building and funding of the WRUAs.

**Table 8.2:** Support of WRUAs in development phase

Name of the WRUA	Support in development phase			
	NGOs		Large scale farmers	
	Funding	Capacity	Funding	Capacity
Sirimon	yes	yes	yes	no
Ngusishi	no	yes	yes	no
Nanyuki	yes	yes	no	yes
Upper Ewaso Ng'iro	no	yes	yes	no
Likii	no	yes	yes	no
Burguret	no	yes	yes	no
Timau	no	yes	yes	no
Naro Moru	no	yes	no	no
Ontulilli	no	no	no	no
Mid-Ewaso Ng'iro	no	yes	no	no

Source: Author's fieldwork 2011

#### 8.2.5 Initial objectives

It is interesting to look at the initial ideas with which the WRUAs were formed. What did the community have in mind when the WRUA was formed, which task and objectives were initially intended for the WRUA.

All WRUAs were formed with the objective of water management in mind. Seven WRUAs saw a role for them in the resolution and prevention of conflicts. Four WRUAs also wanted to undertake action to prevent degradation or enable rehabilitation of the catchment.

The objectives of the WRUAs have changed over the years. Most WRUA officials still agree that their most important task is managing the water and making sure that every member gets an equal share. Nevertheless, the education of the members on efficient water use and the consequences of their action are now mentioned as an important task for the WRUA.

**Table 8.3:** Initial objectives of the WRUAs

Initial objectives										
	Sirimon	Ngusishi	Nanyuki	Upper Ewaso Ng'iro	Likii	Burguret	Timau	Naro Moru	Ontulili	Mid Ewaso-Ng'iro
Conflict prevention		X	X	X	X	X	X	X		
Conservation				X		X	X	X	X	X
Water management	X	X				X		X	X	
Capacity building	x	x	x		X	x		X		X
Collect revenue										X
Comply with the law				X						

Source: Author's fieldwork 2011

### **8.3 Organizational structure of the WRUA**

As explained earlier a WRUA has to be registered legally to be considered for recognition by WRMA. A WRUA can, according to Rule 10 of the rules accompanying the 2002 Water Act, be registered as 'an organization, corporate body or person that has legal status' (GOK, 2002). In practice most WRUAs (eight) were registered as an association. Only two were registered as a society. Although some of them started as community based organizations or self-help groups, they all completed the sometimes lengthy process to suffice with the conditions of becoming an association. At the time of the interview they all had a constitution in place, albeit all in a very standardized form.

The WRUA is managed by a management committee which in most cases consists of 15 members representing different groups of water users and different areas in which the WRUA is present. From this management committee a chairman, secretary and treasurer are appointed. They are appointed via elections. These elections are held every year, although some WRUAs held elections every two years and others even after five years.

In contrast to the rather homogenous constitutions and management structure of the WRUAs, there are big differences in the professionalism of the running of the WRUAs. The extent to which WRUAs can hire professional staff differs greatly. Only four of the WRUAs had a fulltime professional manager. Three WRUAs did not have staff at all and are dependent on volunteers for the management of the WRUA. Other WRUAs have staff in the form of river scouts who monitor the catchment. Furthermore there are differences in the housing opportunities of the WRUAs. Not all the WRUAs have a permanent office, two lacked a permanent office. The key reason given for this lack of staff and office space is in most cases the absence to finances. Indeed, nine WRUAs are

financially constraint. Five WRUAs have such severe financial constraints that they do not have a permanent office or staff employed.

**Table 8.4:** Features of the WRUAs

Name of the WRUA	Fulltime Manager	Permanent Office	River scouts	Registered	Financial Constrains
Sirimon	no	yes	no	Society	Yes
Ngusishi	yes	yes	yes	Association	No
Nanyuki	no	yes	yes	Association	Yes
Upper Ewaso Ng'iro	no	yes	yes	Association	Yes
Likii	Yes	yes	yes	Association	Yes
Burguret	Yes	yes	yes	Society	Yes
Timau	no	yes	yes	Association	Yes
Naro Moru	yes	yes	yes	Association	Yes
Ontulilli	no	no	no	Association	Yes
Mid-Ewaso Ng'iro	no	no	no	Association	Yes

Source: Author's fieldwork 2011

Looking into the financial situation of the WRUAs it is interesting to provide an insight in the actual incomes and expenses of the WRUAs. The main income of the WRUAs exists of annual membership fees and registration fees for new members. Two WRUAs also charge their members for their water use and receive some income from this. Three WRUAs started income generating activities such as agro-forestry, Tree necessities or honey production to generate extra income. Next to this self-generated income there is the Water Service Trust Fund (WSTF), an organization connected to the government which funds some WRUAs. Furthermore, WRUAs often receive support from NGOs to start bigger projects.

The main expenses of the WRUAs can be subdivided into two categories, first the running of the WRUA and second, implementing projects. The costs that result from running the WRUA are, rent for the office, fuel and maintenance of vehicles and payment of salaries and allowances of the committees. The expenses should in theory be covered by the income the WRUA generates. However, this is not always the case. Expenditures for the running of projects are mostly covered by funding from NGOs, the WSTF or other donors.

The NGOs are the most important partner for the implementation of projects. Three WRUAs even depend on NGOs for their very existence. The officials from these WRUAs stated that without the support of NGOs the WRUA would not be able to exist. NGOs and the WSTF are however not the only organizations that support the WRUAs. Also some large scale farmers in the sub catchment support WRUAs in the running of their daily affairs. Five WRUAs are funded by the large scale farms, and two even dependent on large farmers' support for their survival.

**Tabel 8.5:** Income of the WRUAs

<b>Income</b>	Sirimon	Ngusishi	Nanyuki	Upper Ewaso Ng'iro	Likii	Burguret	Timau	Naro Moru	Ontulili	Mid-Ewaso-Ng'iro
Charge water use		x		x						
Membership Fee	x	x	x	x	x	x	x	x	x	x
Income generating activities		x	x	x				x		
NGOs	x	x				x	x	x	x	x
Government	x		x			x				x
Large scale farmers		x			x	x	x	x	x	

Source: Author's fieldwork 2011

**Table 8.6:** Professionalism of the WRUA

<b>Name of the WRUA</b>	<b>Support in development phase</b>							
	<b>Ngo</b>		<b>Large scale farmers</b>		<b>Successful function without NGOs</b>	<b>Exist without NGOs</b>	<b>Successful function without large scale farmers</b>	<b>Able to exist without large scale farmers</b>
	<b>Money</b>	<b>capacity</b>	<b>Money</b>	<b>capacity</b>				
Sirimon	yes	yes	yes	no	no	yes	Yes	yes
Ngusishi	no	yes	yes	no	yes	yes	Yes	yes
Nanyuki	yes	yes	no	yes	no	yes	Yes	yes
Upper Ewaso Ng'iro	no	yes	yes	no	yes	yes	n.a.	n.a.
Likii	no	yes	yes	no	no	yes	No	yes
Burguret	no	yes	yes	no	yes	yes	Yes	yes
Timau	no	yes	yes	no	no	no	Yes	yes
Naro Moru	no	yes	no	no	no	yes	No	no
Ontulilli	no	no	no	no	no	no	No	no
Mid-Ewaso Ng'iro	no	yes	no	no	no	no	n.a	n.a.

Source: Author's fieldwork 2011

However, this does not mean that large scale farmers have a big influence on the WRUAs. Only 22% of the officials believe large scale farmers were dominant in the WRUA. Table 8.7 provides more specific information concerning the individual WRUAs.

**Table 8.7:** Influence of large scale farmers

Name of the WRUA	Influence large scale farmers
Sirimon	comparable to others
Ngusishi	Weak
Nanyuki	Weak
Upper Ewaso Ng'iro	n.a.
Likii	dominant
Burguret	very weak
Timau	comparable to others
Naro Moru	very weak
Ontulilli	very weak
Mid-Ewaso Ng'iro	n.a.

Source: Author's fieldwork 2011

#### **8.4 Activities**

Sub-catchment management plans describe five areas of development for the WRUAs. First, a better water allocation; second, resource protection; third, catchment protection; fourth, institutional development and fifth, infrastructural development. Although not mentioned as such in the sub-catchment management plans, research shows that there is a sixth area in which WRUAs are very active, namely conflict resolution.

#### **8.5 Best achievements**

The opinion of the WRUA officials about their best achievements are as diverse as the WRUAs objectives and professionalism. Some WRUA officials are very proud of the fact that the WRUA is registered, while others point to the fact that all members have piped clean water. Two WRUAs point to the fact that the WRUA is now actually running as their best achievement. They talk about the registration of the WRUA, the mobilization of people to run the WRUA and the acceptance of the WRUA in the community. They point to the fact they created a sub-catchment management plan which gives them a focus and time frame for their future activities. Others are proud they were able to set up a full-time office.

However, some WRUAs seem to be in a further stage of development. They addressed the issue of water management more seriously. Still, within the field of water management big differences can be witnessed. One WRUA (Ngusishi) created a common intake, via which they

provided piped water to all their members, put in place meters to monitor their water use and regulate water in all seasons. Other WRUAs did not reach this stage yet. They started managing the water and constructed water through pipes for some of their users and regulate the water during the dry spells.

Some WRUAs reduced conflict, because of better management, less scarcity so less conflict or via other routes like providing all the members with a voice and the WRUA acting as a platform of discussion in which conflicts are solved before they explode. It seems that irrespective of the development phase of the WRUA, all of them are already able to fulfil this role to some extent. All WRUAs are proud of the fact that they are educating the community and are building the capacity of their members in this respect.

### **8.6 Main potentials**

Asking WRUA officials about the main potentials of the WRUAs that have not yet been fully exploited, a clear difference in professionalism of the WRUAs can be seen. The less professional WRUAs are talking about the establishment of a permanent office and putting in place a fulltime manager as a potential. The more professional WRUAs talk about rehabilitation of the catchment area. All officials agree that further implementation of the water projects as described in the sub-catchment management plans, is the next step forward.

### **8.7 Differences between the WRUAs**

Clear differences exist between the WRUAs. To compare the WRUAs in general, a professionalism ranking is created<sup>4</sup>. This ranking is shown in table 8.9. There is a large difference. The Ngusishi WRUA scores 40 points, while the Mid-Ewaso-Ng'iro WRUA scores 4 points only. How can these differences be explained? Various explanations can be given for these differences.

A first thought was that the older WRUAs would be more professional than the younger WRUAs. The argument underlying this statement is based on the presumption older WRUAs have had more time to develop. However, this hypothesis does not seem to hold. Although the oldest WRUA, Ngusishi, is the most professional, the Upper Ewaso Ng'iro WRUA, already established in

---

<sup>4</sup> Based on 15 indicators a ranking of the professionalism of the WRUA is created. The indicators used are: Number of conflicts addressed, all cases successfully addressed, Piped water to all users, Full-time manager, permanent office, local sanctioning system, written guidelines for conflict resolution, website, river scouts, financial constraints, successfully function without NGOs, Exist without NGOs, Successfully function without help from large scale farmers, Exist Without large scale farmers, On each indicator a WRUA could score 3 points. The higher the score of the WRUA on the ranking the more professional a WRUA is.



2001, is one of the least professional WRUAs. In contrast, the Naro Moru WRUA, only established in 2007, is already in the top half of the ranking.

A second argument would be that WRUAs who were helped in the development phase by large scale farmers, would become more professional. Large scale farmers can provide the money and the knowledge to the WRUAs which would make it a better running WRUA, is the idea. There is some proof for this hypotheses. The two less professional WRUAs were not helped in the development phase by large scale farmers. Where all the others who are ranked higher, except for the Naro Moru WRUA, did receive help from large scale farmers in their development phase. However, a big difference exists between for example the Upper Ewaso Ng'iro WRUA and the Ngusishi WRUA, even though they were both helped in the development phase by large scale farmers.

A third argument is that WRUAs are more professional if supported by NGOs in the development phase. These NGOs, like the large scale farmers, will be able to provide money and knowledge which helps to build a professional WRUA. However, all WRUAs except for one are helped by NGO in their development phase. Therefore it is hard to draw any conclusions based on this indicator.

A fourth and the most convincing argument is that WRUAs who have a full-time manager in place are able to be the most professional. A professional full-time manager has the knowledge, skills and time to put in the WRUA to make it function well, where other WRUAs depend mostly on unskilled volunteers. Also in table 8.9 this difference can be seen. The four most professional WRUAs do have a fulltime manager where the others do not have such a person. Some remarks here can be made however, since a WRUA should have some sort of finances to put in place a full-time manager, which requires some sort of a solid financial base. Still however the argument holds, that putting in place a full-time manager would add a lot of opportunities to a WRUA.

**Table 8.8:** Best achievements of the WRUAs

<b>Best achievements</b>										
	Sirimon	Ngusishi	Nanyuki	Upper Ewaso Ng'iro	Likii	Burguret	Timau	Naro Moru	Ontulili	Mid-Ewaso-Ng'iro
Capacity building	X	x			x					x
Environment									x	
Running WRUA					x					x
Water management		x	x	x		x	x	X		

Source: Author's fieldwork 2011

**Table 8.9:** Professionalism of the WRUA

Name of the WRUA	Points	Year of foundation	large scale farmers help set up WRUA	Large scale farmers Help running affairs	NGOs help to set up WRUA	NGOs help running affairs	full-time manager
Ngusishi	40	1998	yes	no	yes	yes	yes
Burguret	28	2003	yes	no	yes	yes	yes
Likii	25	2002	yes	no	yes	yes	yes
Naro Moru	23	2007	no	no	yes	yes	yes
Sirimon	23	1998	yes	no	yes	yes	no
Timau	22	2005	yes	no	yes	yes	no
Nanyuki	19	2001	yes	yes	yes	yes	no
Upper Ewaso Ng'iro	16	2001	yes	yes	yes	yes	no
Ontulili	9	2008	no	no	no	yes	no
Mid-Ewaso Ng'iro	4	2010	no	yes	yes	yes	no

Source: Author's fieldwork 2011

**Table 8.10:** Main potentials of the WRUAs

Main potentials										
	Sirimon	Ngusishi	Nanyuki	Upper Ewaso Ng'iro	Likii	Burguret	Timau	Naro Moru	Ontulili	Mid-Ewaso-Ng'iro
Capacity building		x		x						x
Water projects	x	x		x	x	x	x	x	x	x
Income			x							
Rehabilitation	x		x	x				x		
Water management										
Employ staff									x	
Office										x
Solve conflict								x		

Source: Author's fieldwork 2011

## **8.8 Opinion of the community**

In the preceding paragraphs the organizational structures of the WRUAs and opinions of the WRUA officials are discussed. In the following paragraph insides will be provided in the opinion of the community concerning WRUAs.

### *8.8.1 Membership of the WRUAs*

Looking at the knowledge of the community about WRUAs some interesting conclusion can be drawn. 66.9% of the community does know what a WRUA is, which leaves 33.1% not knowing. In other words, one in three members of the adult population in the community does not know anything about WRUAs. Looking at membership data we learn that only 47% of the households in the community is a member of a WRUA.

However, numbers do differ significantly between the sub catchments. In the Ngusishi sub catchment (75.6%) and the Nanyuki sub catchment (61.3%) the membership rate is much higher than in the Sirimon (35.7%) and Mid-Ewaso-Ng'iro (13.4%) sub catchments.

**Table 8.11:** WRUA membership in sub-basins

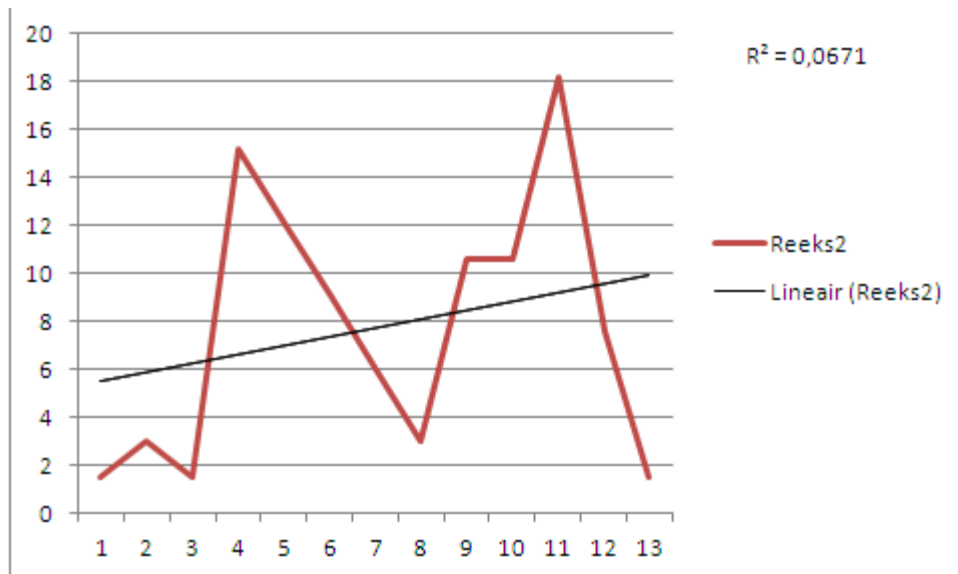
Member of a WRUA		Mid Ewaso Ng'iro	Nanyuki	Ngusishi	Sirimon
	yes	14.3	61.3	75.6	35.7
	no	85.7	38.7	24.4	64.3

Source: Author's fieldwork 2011

Table 8.12 and figure 8.1 show the year in which a member joined the WRUA. From this graph can be seen that there is no clear trend in people joining the WRUA.

**Table 8.12** : Year became a member Figure 8.1: Trend in WRUA membership

Year	%
1998	1.5
1999	3
2000	1.5
2001	15.2
2002	12.1
2003	9.1
2004	6.1
2005	3
2006	10.6
2008	10.6
2009	18.2
2010	7.6
2011	1.5



Source: Author's fieldwork 2011

### 8.8.2 Reasons for people to join the WRUA

Table 8.13 displays the reasons why people joined the WRUA. A total of 22.2% joined because they needed water. They believed joining the WRUA would give access to more and clean water. Some 20.6% became a member by default because their water project joined the WRUA. 17.5% of the WRUA felt they needed to comply with the 2002 Water Act. They were aware that the 2002 Water Act made it mandatory that every river should have a WRUA. They wanted to comply with the law by joining the WRUA. A smaller part of the community, 11.1%, became a member because they assumed becoming a member would help solving water conflicts. They believed the WRUAs would act as platforms for conflict resolution. With the help of these settings conflict would be solved more easily.

**Table 8.13:** Reasons why people became a member

Reasons	%
Because i need water	22.2
Because the project is a member	20.6
Because of the water act	17.5
Because of conflicts	11.1
Because it is cheap and well organised	7.9
Because i am a water users	4.8
Because of water shortage	4.8
Because they promised me water	3.2
To help them when they have a problem	3.2
Because they control the users	1.6
So all projects can cooperate better	1.6
To benefit from the WRUA	1.6

Source: Author's fieldwork 2011

The people were also questioned about the main activities of a WRUA. does undertake. A total of 54.9% of the community believes the WRUAs main activities are related to the regulation and provision of water. Examples of activities are, handing out water permits, monitoring the water and rationing water in the dry season. 19.6% of the community claimed that the main activities of the WRUAs are mainly geared towards the conservation of the catchment, by preventing pollution, planting trees and prohibiting people to cultivate near the riverbank. 13.7% mentioned capacity building activities as the main activities of the WRUA. Only 4% pointed at big water projects such as constructing dams, as the main activities the WRUA does undertake.

**Table 8.14:** Main activities of the WRUAs

Main activities of the WRUA	%
Water regulation/provision	54.9
Conservation	19.6
Reduce conflict	7.8
Capacity building	13.7
Water projects	4.0

Source: Author's fieldwork 2011

### 8.8.3 Water availability

A fairly large part of the community (47%) is of the opinion that WRUAs have a positive effect on the amount of water available in the catchment. Most people (67%) believe the WRUA is managing and controlling the water which in general leads to more water available. Other reasons mentioned for the fact that there is more water available are; the WRUA is educating people on efficient water use, the WRUA is conserving the catchment, the WRUA is cleaning the water and the WRUA makes

members cooperate to make sure everybody gets their share of water. 3.5% of the community believes the WRUAs have no effect on the amount of water available. And only 1.4% of the people see a negative effect of the WRUA on the amount of water available. Some people believe conflict is caused by the rationing programmes the WRUAs puts. Finally, 47.5% of the people do not know if the WRUA has an effect on the amount of water available. This high percentage can be explained by the fact that 33.1% of the community does not know what a WRUA is and 53% of the community is not a member of the WRUA

**Table 8.15:** Influence of the WRUA on water availability

Opinion	%
very positive	25.2
positive	22.4
no effect	3.5
negative	1.4
very negative	0.0
don't know	47.5

Source: Author's fieldwork 2011

#### *8.8.4 Impact on cooperation*

A large part of the community (47.7%) states that there is more cooperation about water resources since the arrival of the WRUA. However, they give different explanations for this increased cooperation. Some (34.7%) people point to the fact WRUAs organize meetings for members to create awareness as the most important explanation for the increased cooperation. Others (32.7%) believe water is now managed, and therefore people are more eager to cooperate. Others believe water projects are now working together. Lastly a small part of the community point to catchment protecting and conflict prevention as reasons for more cooperation over water within the catchment.

1.4% of the people is of the opinion that the WRUA has no impact on the cooperation over water resources, They state people do not understand what a WRUA is and that they see water as God given. So they believe you can use the share of water given to you by the river (God).

However, 0.7% claims that people are collaborating less since the WRUA exists. These people did not give a clear explanation for the fact they believed there was less cooperation since the WRUA exists.

Again a relatively high % of the people (50.4%) did not know if the WRUA had an impact on the cooperation over water resource in the catchment. This high percentage can be explained by the same reasons as done earlier, a lot of people do not know what a WRUA is and if they know what a WRUA is, still a lot of them are not a member.

**Table 8.16:** Influence of WRUAs on cooperation

<b>Opinion</b>	<b>%</b>
Much more	26.6
More	20.9
same	1.4
Less	0.7
Much less	0
Don't know	50.4

Source: Author's fieldwork 2011

## **8.9 Researchers and NGO employees on WRUA and effectiveness**

### *8.9.1 Introduction*

In the following paragraphs the views and opinions of researchers, NGOs employees and people from WRMA working with the WRUAs will be discussed.

### *8.9.2 Influence on the availability of water resource in the area*

According to people from WRMA, NGOs and researchers working with the WRUAs, the WRUAs do have a positive influence on the availability of water resources in the area. WRMA officials believe WRUAs are very active in supporting small scale household water conservation projects and promote the efficient use of water on a small scale. These two activities ensure that there is more water available on a household level.

NGOs employees tend to focus on the increased awareness of people. People use the water more efficiently and cooperate more over water so everybody has their share. Also some WRUAs have provided water storage tanks and systems for roof catchments and the construction of common intakes.

Researchers point to the fact that the WRUAs effectively implement the water rationing schemes in the dry season. Before the existence of WRUAs, WRMA had difficulties putting in place water rationing schemes. Therefore WRMA would take other measures to make the river flowing like blocking the intake. This resulted in a situation where people would not have water for a certain amount of time. Researchers argue that the WRUA are able to put in place water rationing schemes, working together with the community. Although water rationing is still not done in the best way, because of a lack of communication, researchers reported an improvement, however, in the water availability, especially in the dry season.



### *8.9.3 Influence on cooperation*

On the topic of cooperation about water resources, people from WRMA, NGOs and researchers working with WRUAs state that WRUAs have a positive influence.

According to WRMA officials, WRUAs are very active in the creation of awareness among the community. This awareness makes sure people understand the reasons for the measures which are taken to manage the water. Therefore people are more willing to cooperate when these measures are put in place.

People working for NGOs also point to the fact of a greater awareness. For example, during the 2009 drought WRUAs were able to ration water in a way that every user at least had access to water during some hours of the day.

Researchers tend to focus on the WRUAs as forums for conflict resolution. They believe WRUAs have a positive impact on cooperation because the WRUAs; they provide a platform to discuss the problems over water. Therefore, people are less likely to use violence. WRUAs brought communities together. However, some remarks were made on these statements. In the end it all depends on the capacity of the WRUA. If WRUAs have not enough capacity to provide information about rationing and do not monitor the water rationing, they will not be able to change the situation.

### *8.9.4 Management structure*

The biggest problem concerning the management structure of the WRUA is that it is done on a voluntary basis. People managing the WRUA (the volunteers) do not have sufficient skills or enough time to run the WRUA successfully. Moreover, people are not willing to work on a voluntary basis for a long period of time. Therefore, new people keep coming in which slows down the practical progress of the WRUAs. The government agencies that are in charge of setting up the WRUA are supposed to take care of these issues. Unfortunately, these agencies do not have the time, will, power or money to solve this problem. However, in some cases WRUAs were able to overcome these problems. Especially when there was involvement from NGOs, WRUAs are now functioning better. NGOs were able to support the WRUAs in capacity building. They helped to train people who manage the WRUAs. However, to make sure a WRUA is managed in a professional and structural way, researchers agree hiring of full-time staff, such as a manager is the best solution. Yet, there are some problems concerning the appointment of staff. Funding from most NGOs and the government through the WSTF cannot be used for hiring staff. This funding can only be used for the implementation of projects. Another comment on this statement given by certain researchers, is that although you can see that WRUAs with fulltime professional managers have evolved faster, the causal link that seems to be in place can be questioned. One could argue that it is because the community pays the managers themselves, they demand more from them. The argument raised, is that the community is

more involved when they pay the salary of the manager. In such a case the community wants to see that their money is spend in a good way. So just giving WRUAs funding for fulltime managers would maybe not be the best solution after all.

#### *8.9.5 Power issues within the management of the WRUA*

There are some issues concerning the distribution of power in the WRUA and in the management committee in particular. A first issue that can be seen as is the influential position of the chairman. The chairman is often a person with knowledge and money. Combined with the fact that people often do not understand the rules and meaning of their functions, there can arise a problem. A situation that is regularly seen is that the chairman thinks he owns the WRUA and needs to make all the decisions. In this case the chairman has a disproportionate level of influence on the WRUA. Unfortunately, this problem is not easily solved. The chairman needs to have a lot of knowledge and some money because, all committee members are volunteers and when things have to be done and there are deadlines the chairman has to carry the biggest burden.

Researchers from Rural focus and CETRAD point to the role of the large scale farmers in some WRUAs which can be problematic. They believe, members of the WRUAs expect the large scale farmers to fund the WRUA or even own the WRUA. Normal members expect too much from the large scale farmers and some large scale farmers are already cooperating too much. If they fund the WRUA and put a certain amount of time in the WRUA, they want something in return. It is not that large scale farms receive more water from the WRUA, but it becomes hard to correct them if they do not follow the rules. Also this problem is a delicate one, large scale farmers can be very useful in the beginning because they usually have the financial resources and knowledge to help set up the WRUA. Most of the time, they are willing to contribute but they do not want to be involved in management. As long as they have a constant flow of water they do not care. Also large scale farmers are very careful because they do not want any negative publicity, they do not want to be seen as the ones that run the WRUA.

The last and main power issue within the WRUA is the role of the water projects. Researchers believe water projects have a disproportionate influence. The management committee of a WRUA should have 15 members, in a lot of cases ten of them are chairmen of water projects .Therefore they have more influence than individual members and other groups of members, which are not represented in the management committee.

#### *8.9.6 Legal framework*

Some researchers believe the lack of a solid legal base of the WRUA is an issue. The 2002 Water Act subscribes that becoming a member of a WRUA is voluntary. Therefore WRUAs have no legal base to force people to become a member. However, WRUAs can only exert influence on people that are a member. Therefore a situation can exist where people are not cooperating with the WRUA and the WRUA has no means to force them. However, this does not have to be a problem because there are other ways to pressure people to become a member of the WRUA. For example when you want a water permit from WRMA you need a letter of recommendation from your WRUA. Otherwise WRMA will not issue a permit. In most cases WRUAs do not provide a letter of recommendations to people who are not a member, thereby forcing people to become a member. Another example is when your pump is confiscated by WRMA because you abstracted water illegally. Then WRMA will only give you back the pump if you have a letter from the WRUA. The WRUA can choose not to issue such a letter if you are not a member.

Other researchers go further by stating that WRUAs should not have a bigger mandate. They raise questions about the capacity of the community. Therefore they argue you should not give the community too much power if they do not have the capacity to handle it.

#### *8.9.7 Finances*

Researchers have diverse views on the financial aspects of the WRUAs. Some researchers claim there are serious problems with the financial situation of the WRUAs. They believe WRUAs do not have enough funds to employ full time managers. Even if WRUA has the money available in form of external funds, they are not entitled to spend this on a manager.

Other researchers see different issues. They argue the main problem is that most WRUAs only have donor funding as source of income. Furthermore, other WRUAs do not even have access to donor funding because they do not have the expertise to write proposals for funding.

Others state that the availability of the money is not so much of a problem. They argue that WRUAs can get funding from NGOs and the WSTF. According to these researchers, the main problem is that WRUAs are not able to spend or use the money in the proper way. They do not have the capacity to manage the money, they do not have the knowledge to spend it in a responsible way and report back on where they spend the money on. Also the conditions under which the money is made available is a problem. The rules are put in place by accountants and demands some accounting knowledge to know how to get money and report back. The WRUA management committee does not have such knowledge, because they do not have a training in accountancy.

Researchers working with the Laikipia wildlife forum (LWF), argue WRUAs are able to get external funds but that problems arise when the funds are disposed. They argue, when WRUAs have

written a proposal for a certain funding, they write a very nice proposal with a good budget. The actual problem arises when the money comes in. When the money comes in, a lot of people all the sudden want to do different things with the money. When people see the money everybody wants to have a share and the projects carried out with the money tend to end up in the backyard of committee members or friends of committee members.

Researchers from Rural focus state that, WRUAs do not work hard enough to raise funds within the community. If they would show the community what they do and why they are important and why they need the money they would probably get enough funding from the community. But the problem is that the management does not tend to include the community enough. The money tends to end up with management committee members and their friends.

#### *8.9.8 Corruption*

Researchers believe there is a problem with corruption within the WRUAs. People pay an annual membership fee, yet often it is not known where the money is used for. The problem is that the finances of the WRUA are not transparent in their financial policy. This leads to rumours of corruption.

### **8.10 Conclusion**

The community as well as the experts working with the WRUA agree that the WRUAs manage the available water resources in a good way and improve the water availability in the catchment. However, there are some problems concerning the WRUAs. Like issues concerning the management of the WRUAs and their financial situation. Furthermore, there are big differences between the WRUAs. Where some WRUAs function very well and are very professional, others are not able to accomplish almost anything. The reasons for these problems and differences are discussed in the preceding paragraph, but what would be the way forward?

The main conclusion that can be drawn from this chapter is that the main problem of the WRUAs is their lack of implementing capacity. To solve this problem I would like to suggest some solutions.

First, a different way of capacity building. Instead of training some members of the community for three days a different approach should be taken. Not only the committee but also community members should be trained. Take them (the people, committee members) to training and hold their hand for a while. You cannot train people in three days, it should be a continuous process over a longer period of time. Also when you train only the chairman, treasurer and secretary you only train three people. You can assume they will train the rest of the community but in practice this is not the case. Committees do not always reach out to the communities. Often there is a lack of

communication with the community so you should also inform/train the community.

Second, a community will not be able to run a WRUA themselves. The community should be the base of the organization but a full-time manager should be appointed. Examples from this study show that a full-time manager is a valuable addition to the management committee. An education manager, has the time and the skills to help the WRUA in a professional way. The combination of local knowledge from the community combined with the expertise of a skilled manager makes a WRUA more effective.

# 9

## ROLE OF WRUAS IN CONFLICT AND COOPERATION

### **9.1 Introduction**

in this chapter we will discuss the role of WRUAs in conflict resolution. As stated earlier, in the WRUA sub-catchment management plans no specific attention is devoted to the role of the WRUAs in conflict resolution. Some WRUA activities are mentioned that touch upon it in a side way. However, the government of Kenya had earmarked an important role for the WRUA in conflict resolution. In section 15 (5) of the 2002 Water Act it is stated that ‘these associations will act as forums for conflict resolution and cooperative management of water resources’ (GOK, 2002). In the following we will provide some insights in the activities performed by the WRUAs related to the resolution of conflicts and their effectiveness.

### **9.2 Conflict resolution**

According to the Laikipia District WRUA officials, there are two main causes which can lead to water related conflicts. The first cause is actual water scarcity (for domestic and/or productive consumption). The second cause is the distribution of the available water among different resource users. The water related conflicts addressed by the WRUAs are mostly conflicts between different water users, conflicts with individual users over illegal abstractions or conflicts between WRUAs and individual members about water use and payment.

There is a wide variety in the number and frequency of conflicts the different WRUAs have addressed. One WRUA has dealt with one case only since its formation while another was involved in solving a total of 52 cases. Furthermore there is a variety in the number of conflicts the WRUAs were not able to solve and are still present today. It is hard to explain why some WRUAs already addressed 52 cases and another just a single case. A relation between the number of conflicts and the age of the WRUA was expected. Such a relation, however, is not present as is shown in table 9.1. The youngest WRUA, the mid-Ewaso Ng’iro WRUA addressed the most conflicts. Another link that was expected was the link between professionalism and the number of conflicts addressed. The reasoning is that if a WRUA is more professional it is able to solve more conflicts. As indicators of professionalism in this study we used numerous criteria. The presence of a fulltime manager, a permanent office, river scouts, a local sanctioning system and written guidelines for conflict resolution. Yet, a relationship between the professionalism of the WRUA and the number of conflicts can not be found. The WRUA which addressed the most conflicts, the Mid-Ewaso Ng’iro WRUA, is

definitely not the most professional WRUA according to our criteria. As they have no fulltime manager, permanent office or river scouts. Looking closer into the Mid-Ewaso-Ng'iro WRUA, however, a possible explanation for the high number of conflicts addressed can be found. The mid-Ewaso-Ng'iro WRUA is located in the most downstream area of all the WRUAs studied, where the water scarcity is most severe. Also the Mid-Ewaso-Ng'iro WRUA is located in an area where a lot of Maasai pastoralist reside. These pastoralists mainly live on group ranches and share the grazing land and water sources with the present wildlife. Furthermore, the Mid-Ewaso-Ng'iro sub catchment is the most densely populated with wildlife. Therefore when in 2010 there was a big drought, a lot of conflicts arose between humans and wildlife. These conflicts were addressed by the WRUA. Still, a general explanation for the differences in the number of cases WRUAs have dealt with is not easily found.

**Table 9.1:** Number of conflicts addressed by the WRUAs

Name of the WRUA	Year of foundation	Number of conflicts addressed	Number of cases that still exist
Sirimon	1998	10	5
Ngusishi	1998	5	2
Nanyuki	2001	5	1
Upper Ewaso Ng'iro	2001	4	2
Likii	2002	1	1
Burguret	2003	3	1
Timau	2005	5	3
Naro Moru	2007	10	2
Ontulilli	2008	6	1
Mid-Ewaso Ng'iro	2010	52	1

Source: author's fieldwork 2011

**Table 9.2:** Professionalism of the WRUA 2

Name of the WRUA	Fulltime Manager	Permanent Office	River scouts	Local sanctioning system	Written guidelines conflict resolution
Sirimon	no	yes	no	yes	yes
Ngusishi	yes	yes	yes	yes	Yes
Nanyuki	no	yes	yes	yes	No
Upper Ewaso Ng'iro	no	yes	yes	yes	No
Likii	Yes	yes	yes	yes	Yes
Burguret	Yes	yes	yes	yes	No
Timau	no	yes	yes	yes	Yes
Naro moru	yes	yes	yes	yes	Yes
Ontulilli	no	no	no	yes	No
Mid-Ewaso Ng'iro	no	no	no	yes	Yes

Source: Author's fieldwork 2011

The initiative for involvement of the WRUA in conflict resolution is mixed. In 50% of the cases the issues were brought to the WRUA by the community and in 50% the WRUA officials themselves located the conflict. Six WRUAs have official written-down guidelines for conflict resolution. The WRUA committee together with the members defined these rules. However, the most effective way according to the WRUA officials to solve a conflict is still true through dialogue with the various parties involved.

None of the WRUAs have been successful in solving each and every water related conflict they encountered. Thus, some conflicts brought to the WRUA still exist up till the present day. The reason for this failure varies. Some officials point to the fact that in certain cases the interest of the various groups involved were so far apart that the WRUA did not have the time and capacity to solve these conflicts. Others point to the fact that the WRUAs have a lack of power to implement the agreed upon solutions. Besides power, meager financial resources of the WRUA also interferes with a full implementation of a lasting solution. The WRUAs have financial limitations and are therefore not able to put in place enough river scouts who can control if people are complying with the proposed solutions. Another financial constraint can be seen when technological solutions are proposed. WRUAs often do not have the resources to put in place a system of common water intakes and pipes to deliver water equally to the community. Therefore some conflicts are not resolved. In a few cases, however, the conflict is still in court which explained why the dispute was not yet solved.

In conclusion, WRUAs play a role in conflict resolution and they are in most cases able to solve conflicts. However, financial constraints and the lack of power to implement agreements undermines a 100% success score. It is also interesting, to look at the opinion of the community about the WRUAs impact on conflict.

### **9.3 Impact on conflicts**

A total of 43% of the community is of the opinion that there is less conflict within the area since the WRUA came into being. The majority of this 43% believes there is less conflict because the WRUA is very active and effective in conflict resolution. Others (24%) point to the fact that the WRUA undertakes special activities to prevent conflict such as meetings to create awareness. 13% of the community mentions there is less conflict in the area because the WRUA manages the water in a good way.

However, a small part of the community (4%) believes that the WRUA did not have an effect on the number of conflicts that are present in the catchment. They argue that the WRUA is not powerful enough to solve conflicts. They state that the WRUA does propose solutions but that they



are not able to put these in place. They believe the WRUA lacks the legal base to influence non-members of the WRUA and therefore these people are not inclined to change their behavior.

3% of the people even believe that there are more conflicts in the catchment since the WRUA was established. They give several reasons for their opinion why the formation of the WRUA has led to more conflicts. Several people state there is a bias within the WRUAs. Which results in some members being favored by the WRUA officials because they know these officials. In case of the Mid-Ewaso Ng'iro WRUA this dissatisfaction was regularly expressed. Community members who were not active in the management of the WRUA felt that the WRUA was only undertaking action in certain places. These places happen to be inhabited by people managing the WRUA. A part of the people interviewed was not convinced this was a coincidence. Therefore they had their doubts whether the WRUA was doing the right thing. Hence, their opinion about the WRUA was not very positive. Another reason for claiming that the formation of the WRUAs led to more conflict is that initially, especially upstream water users, do not understand the water rationing. Some of them did not experience severe water scarcity. Therefore they did not understand why they can not use water uncontrolled anymore. As the WRUA tells them they can not use water uncontrolled, conflict arises between these users and the WRUA.

Unfortunately, a database with conflicts about water for the last 20 years, to objectively determine if the formation of the WRUA led to more or less conflict, is not available. In my opinion, however, WRUAs do have a positive influence on the number of conflicts that arise and the intensity and the duration of the conflicts. This opinion is based on the fact that WRUAs provide a forum for conflict resolution. In the past downstream people who did not have water went upstream to destroy upstream irrigation systems. Now people have the option to go to a WRUA official. This official organizes a meeting where people can discuss the problem instead of immediately reacting with violence. This is not only theoretically possible but does also regularly happen in practice as is shown in the interviews held with the community. Also in case of duration of the conflict the WRUAs have an influence. A good example is the conflict between large scale ranchers and pastoralists about water and land. Pastoralists tend to invade the land of large scale ranchers when there is a scarcity of water resources or grazing land. Through the WRUAs some large scale ranchers made agreements with pastoralist which cover this problem.

A relatively high percentage of the people (49%) did not know if the WRUA had an impact on the cooperation over water resources in the catchment. This high percentage can be explained by the fact that a lot of people do not know what a WRUA is.

**Table 9.3:** Influence of WRUAs on conflicts

<b>Opinion</b>	<b>%</b>
Much less	18
Less	25
Same	4
More	2
much more	1
don't know	49

Source: Author's fieldwork 2011

#### **9.4 New types of conflict**

In the former paragraph it became clear some people believe that the existence of the WRUA could also lead to more conflicts in the area. In this paragraph more insight will be provided in the kind of new conflicts the WRUA produces. Also specific information was sought among the respondents whether they agreed with this claim, namely if the WRUA caused new types of conflicts.

Only 6% of the people states the WRUA created new types of conflicts. In particular, conflicts concerning water rationing. Initially people looked at the WRUA as a negative phenomenon. As communities feel that the water belongs to them and is God given. If outsiders tell them they need to share water they do not agree. This occurs mainly in the dry season, when people are not permitted to abstract water from the river. This situation can create conflict. Another new type of conflict mentioned is that some WRUAs now force people to pay for water. People are not used to this and therefore some of them are not willing to pay. When the WRUA does force people to pay, conflict arises.

**Table 9.4:** Influence of WRUAs on new conflicts

<b>Opinion</b>	<b>%</b>
Yes	6
No	45
Don't know	49

Source: Author's fieldwork 2011

#### **9.5 Interviews experts**

All in all when comparing opinions aired by researchers, people from NGOs and people from WRMA working with the WRUA. It becomes clear they all agree that the establishment of the WRUAs has reduced the occurrence of conflicts within the catchment.

WRMA officials point to the fact that less conflicts arise nowadays because the WRUAs manage the water resources in the right way together with the community. Researchers from Rural Focus point to the fact that there are now less conflicts within the catchment because WRUAs

provide a platform for discussion when there are issues between the different users. Therefore, people are less likely to react with violence as was common in the past. Researchers from the AWF do agree on this notion and point out that especially downstream people now have a place to go and put a complain in trying to correct a detrimental situation. Researchers working for the US Peace Corps believe WRUAs have a positive effect and they are helping to a certain extent. They state that WRUAs created a place where people can come together and talk about the water resource. Which resulted in communities being brought together. In addition, WRUAs have implemented water rationing schemes so that every user at least has water a certain time per day/week. This decreased the numbers of violent conflicts in the catchment.

However, all experts do also see new types of conflicts since the WRUAs are established. Some focus on the issue of funding which has led to new forms of conflicts. The moment financial means arrive quarrels might erupt among its members about which groups will benefit from these funds. Other researchers and the WRMA have raised another interesting issue. The law rules that every river should have a WRUA and if a WRUA is established this WRUA can write proposals for funding. Populist members of parliament tell people to form more then one WRUA to get more funding. People thus start registering WRUAs for the upper or lower parts of the river, to get funding. WRMA, however, states that in most cases only one WRUA per river is allowed. There are some exceptions. For big rivers such as the Ewaso Ng'iro river, WRMA allows the existence of more than one WRUA if they cover different areas, since WRMA is aware that it is impossible for one WRUA to cover such a large catchment. Still, Populist members of parliament do not restrict their advice to large rivers. This leads to conflicts between WRMA and people who have established the WRUA. A good example in this case is the Nanyuki river. There are two WRUAs established for the Nanyuki river following advice of local members of parliament. However, only one WRUA is officially recognized by WRMA and therefore able to get funding. The other WRUA is not able to function because of lack of funding. Hence, people connected to this WRUA are in conflict with WRMA. The role of politics in projects like this should not be underestimated. Especially local members of parliament make promises to the community to win votes for their parliamentary bid. These promises are often in contrast with the law.

A third issue which can lead to new types of conflict because of the establishment of WRUAs arises when a single WRUA covers more than one district. Some NGOs and other types of support restrict their operations to one specific district. There are, however, rivers that cover more than one district. In this case only a part of the WRUA will receive support. This leads to inequality between people in the same WRUA which can lead to conflicts.

## **9.6 Conclusion**

What can we conclude about the relation between conflicts and WRUAs? In general the population agrees that there is less conflict because WRUAs exist. The community also states that there is now more conflict than 10 years ago, when WRUAs did not exist. This is at least remarkable. Yet, this can also mean that although there is now more conflict than 10 years ago, without the WRUAs there would even be more conflict. Therefore, WRUAs can still be seen as very helpful organization in the prevention and resolution of conflict. Experts such as people from NGOs, researchers working with WRUAs and people working for WRMA, do agree on the notion of the community that WRUAs have reduced the occurrence of conflicts within the catchment.

After studying the WRUAs in the catchment I agree with the notion of the experts and the community that WRUAs have reduced the occurrence of conflict within the catchment. Fieldwork shows that a lot of conflicts are solved by the WRUAs. There are in my opinion three main reason for this reduction of conflict. Firstly, the WRUAs act as forums for conflict resolution. The WRUAs provide an accessible platform for discussion when there are issues between the different users. WRUA officials are in many cases able to solve these discussions. So instead of the use of violence a lot of issues are solved trough dialogue. The fact that these officials are members of the community, which makes them easily approachable for the community, is an important reason for the success of these discussions.

Secondly, WRUAs are able to provide more water for the community. WRUAs prevent the occurrence of conflict by making more water available. In some cases WRUAs were able to put in place working water rationing schemes. WRMA was earlier not able to put in place working rationing schemes. This led to uneven access to water between different users. From this uneven distribution conflict was likely to arise. Some WRUAs are able to put in place functioning water rationing schemes. Therefore, in these cases everybody has access to water for at least a part of the day or week. This and the fact that the community themselves created these water rationing schemes, makes the acceptance of these schemes easier.

Finally, the WRUAs created awareness among the upstream members and the downstream members of the community. In case of the upstream members, the WRUAs promotes efficient water use and water storage. In addition the upstream community is now aware that the amount of water they use directly influences the amount of water available for the downstream community. This combination of strategies has led to an increasing availability of water. Among the downstream community awareness on efficient water use and storage is created, so that more water is available. Therefore there is less reason for conflict. Furthermore, they make the downstream community aware that, if there is no water, attacking the upstream of community is not wise.

However, a lot of work still needs to be done. The reasons for the reduction of conflict are not in place in all WRUAs. As stated earlier there are huge differences between WRUAs and a lot of WRUAs are still very unprofessional. This is also the case in conflict prevention and resolution of conflicts by the WRUAs.

# 10 DISCUSSION

## **10.1 Introduction**

Which conclusions can we draw about the changing rural water situation in the Upper Ewaso Ng'iro Basin and the influence of the Water Resource User Associations on cooperation and conflict over this dwindling water resource? In the following we will reflect the findings to the theoretical framework and main hypotheses.

## **10.2 Falkenmark's water stress indicator**

Application of Falkenmark's water stress indicator would make us conclude that there is no such thing as water scarcity within the whole of the Ewaso Ng'iro North catchment area, since in the basin there is an annual availability of more<sup>5</sup> than 10,000 cubic meters per capita. In such a situation Falkenmark would argue that there are no or just minor problems. However, scholars like Notter (2007), Mutiga(2010), and Kiteme & Gikonyo (2002) prove that water is scarce and becoming even scarcer in the near future in the Upper Ewaso Ng'iro river catchment. They show a drying up of the river in the downstream areas for the dry season. This increasing scarcity is also evidenced by the perception of the community inhabiting the catchment area. A total of 75% of the people interviewed experience water scarcity for their household economic activities. Therefore in this case the Falkenmark water stress indicator proved not to be a good tool to indicate the level of water scarcity. This finding supports the critique by Donkers (1995) that Falkenmark is wrong to assume that a region or country is a homogenous entity. Local differences within countries or regions should be taken into account. For example, in the Ewaso Ng'iro there is a huge difference in water availability between the upstream and downstream areas. Another critique that I would like to add is that besides a geographical also a time perspective should be taken into account. In the Ewaso Ng'iro basin there is a big difference in the presence of water in the rainy season and in the dry season. Where in the rain season there is a surplus, and some of it is even lost due to untrapped run off, in the dry season there is scarcity. The water stress indicator of Falkenmark does not take these spatial and time difference into account.

---

<sup>5</sup> In 2011 around 2.1 million people were predicted to live in the catchment. The total amount of water available in the catchment was estimated to be 37.2 km<sup>3</sup> in 2011 (ILRI, 2011). This means that 17740 m<sup>3</sup> of water per annum is available per person.

### **10.3 Conflict and environment nexus**

As discussed in the theoretical chapter, there are a lot of different theories about the relation between the environment and conflict. After studying the Upper Ewaso Ng'iro catchment what can we say about the relation between the environment and conflict in the region?

Water scarcity within the catchment is present and so are conflicts within the catchment. But is there also a direct link between these two observations? As discussed earlier (chapter 7) there are five main types of conflicts. The relation between the environment and conflict is different for each of these types of conflicts and therefore will be discussed individually. The first type of conflict, the intergroup conflict, is the conflict within the community water projects. The reason for conflict within these projects arises in dry season when water is relatively scarce. In this situation some people have more water available than others. Although this conflict arises in dry season, the conflict is merely about the uneven distribution and rules covering this distribution then about the actual scarcity. The conflict concerns the distributional issue of the available water. However, this distributional issue would not be in place if there was an abundance of water. Thus in this case a direct relationship between environment and conflict is not found, but scarcity of water does play a role in conflict because without scarcity there would not be a distributional issue.

The second type of conflict in the catchment is the intra-group conflict. These conflicts are merely between upstream and downstream users. Downstream users moving upstream in dry season to destroy irrigation systems upstream, so the water will flow downstream again. Although these conflicts merely arise in the dry season, the conflicts are mostly related to the uneven distribution of water and inefficient water use. Upstream users using large amounts of water in an inefficient way create a scarcity of water. Users getting in conflict with each other because upstream users do have water, and use it wastefully, downstream users do not have water. Thus again scarcity does play a role in conflicts but a direct link between scarcity and conflict is not found.

The third type of conflict is the conflict between groups of water users and the government. This type of conflict is mostly associated with the problem of illegal water use. The government gets into conflict with users who illegally abstract water. Again this type of conflict mainly takes place in the dry season. Once more there is no direct link between scarcity and conflict. People do abstract water illegally for various reasons. Some water users abstract water illegally because their water permit doesn't allow to abstract enough water. However, most users abstract illegally not because water is scarce but because they do not have a water permit. They do not have a water permit because of a lack of knowledge on how to apply for a permit. Therefore this type of conflict is not directly linked to scarcity.

The fourth type of conflict is between private businesses and groups of water users. The most severe conflicts are the conflicts between pastoralists and large scale ranchers and the conflicts

between large scale horticultural farmers and small scale water users. The first conflict is also not a direct relation between water scarcity and conflict. Pastoralist in desperate need for natural resources as grass and water invade the territory of large scale ranchers where these natural resources are available abundantly which leads to conflict; once more a distribution issue rather than an actual scarcity. In the case of conflicts between small scale water users and horticultural farmers, Small scale water users argue that large scale farmers take too much water and that therefore no water is left for them. However, in reality the small scale water abstractors all together use far more water than the few large scale farmers. In this case one can argue there is scarcity of water because too much people and enterprises want to use the area for farming which requires a large amount of water.

The fifth and last type of water related conflict in the Upper Ewaso Ng'iro catchment is the conflict between humans and wildlife over water. This type of conflict can be seen as the clearest example of the scarcity causes violence paradigm. In other situations people have discussion or fight because of an uneven distribution of water because of a lack of management. Humans and wildlife do not have an easy way to manage the resource together. Therefore, Humans and wildlife getting in conflict with each other because they use the same scarce natural resources. Therefore a more direct link exists in this case than in other cases.

Can we conclude that in this case the theory of Homer-Dixon (1999), Peluso & Watts (2001) and Baechler (1998) stating that environmental scarcities lead to violent conflict, is right? Would we come to this conclusion, the critique of Agmann (2005) and Lind & Sturman (2002), that research on the "ecologic sources of conflict" has been characterized by a one-sided fixation on causality, would be in place. Because there is conflict within the catchment and there is scarcity, but a direct link or causality between these two can not be found in most cases. The argument of McKay (1996), that communication, trust, the anticipation of future interactions, and the ability to build agreements and rules sometimes control behaviour well enough to prevent a tragedy, seems to be in place. Although there is conflict within the catchment, violent as well as non violent, there is certainly no tragedy because of the management of the environment takes into account the arguments raised by McKay.

The notion of Homer-Dixon (1999), however, that violence that results from competition over scarce resources would be triggered by failures in governance such as unequal access to resources and free riding problems, is an interesting argument in this case. Most conflicts that arise in the catchment, arise because of unequal access to the natural resource water as we have seen in the former paragraphs.

So, what I would like to argue is that a direct relation between scarcity and conflicts in the Upper Ewaso Ng'iro in most cases does not exist. With which it does not mean to say scarcity does not have an influence on conflict. However there seems to be an intervening variable, distribution of water. In case of the human wildlife conflict one could argue that conflicts are there because of



scarcity, but this an exception. In all other cases there is the intervening variable 'distribution of the water' which has influence on the fact if conflict will arise or not. This distribution of the water is connected to the way the water source is managed.

#### **10.4 Community based water management**

The WRUAs established in the Upper Ewaso Ng'iro catchment are a clear example of an attempt to introduce community based resource management, from a situation whereby planning, policy formulation, and regulation is conducted primarily by centralized government agencies, towards a bottom-up approach, which involves all relevant parties, especially local communities, in the process of environmental management and decision making (Merkhofer et al., 1997; Moote et al., 1997; Vasseur et al., 1997; Smith et al., 1997). The central issues in the theory of community based water management are cooperation, collaboration, conflict resolution, and social negotiation. The existence of the WRUAs is justified by the government on the arguments given by Blaikie (2006) that communities, defined by their tight spatial boundaries of jurisdiction and responsibilities, by their distinct and integrated social structure and common interests, can manage their natural resources in an efficient, equitable, and sustainable way.

After studying the WRUAs we can argue that some of the WRUAs are able to manage the resource in an efficient, equitable and sustainable way indeed. Especially the most professional WRUA, the Ngusishi WRUA is able to manage the water in such a way, via their system of pipes and common intakes. However, many WRUAs are not (yet) able to manage the water resources in their area in a sustainable way.. Bradshaw (2003) argues that, communities must display a genuine desire to steward local resources in the interests of all stakeholders—including future generations and non-locals. This scholar's claim that moreover local communities also need sufficient capacity to manage the resource base, is very applicable to the WRUAs. In the Ngusishi catchment where the water is managed according to the three principles, i.e., efficient, equitable and sustainable, 74% of the people is a member. In other catchments where a significantly lower percentage of the people is a member the water is managed not in such a good way. This underlines Bradshaw's statement that the community must display a genuine desire to manage the resource. When the community is not even a member one could say the community does not desire to manage the resource.

The second argument of Bradshaw (2003), the lack of capacity can also be traced back to the less performing WRUAs. In chapter 7 it is stated that WRUAs that do have a skilled full-time manager in place are performing better than WRUAs that do not have such personnel. The manager brings in the necessary capacity to manage the resource, which is missing in the less professional WRUAs.

Another point of critique on CBNRM is raised by Crance & Draper (1996), Maser (1995) and Selin & Chavez (1995). These scholars they argue that not only the community should be involved but

also scientific and technical experts. This point is consistent with the previous criticism about the lack of capacity. The best performing WRUAs all have a skilled full-time manager in place. Therefore in these cases there is a good combination of local and professional knowledge which leads to efficient and good management of the resource.

A last point I would like to discuss is the issue raised by Blaikie (2006) that the attractiveness of CBNRM rides on a heterogeneous set of theories and sentiments but has been increasingly criticized from within the academy and in some professional evaluations. He argues that monitoring the outcomes of CBNRM programmes has been very rare, and non-existent and evaluations of CBNRM by the communities themselves have been conspicuously absent, so that their voices have not been articulated and heard. This thesis, as sort of an evaluation study about WRUAs, can raise an interesting counter argument. In the case of the Upper Ewaso Ng'iro basin, especially the community is very enthusiast about the existence of the WRUAs. Where experts are asking some critical questions, the communities in the Ewaso Ng'iro North basin reply overwhelmingly positive (90%) to the question How do you see the existence of the WRUA?. And on the question, How the WRUA can be improved? the regular answer is 'The WRUA is already doing a very good job now'.

### **10.5 Central hypothesis**

The central hypothesis of the thesis is that 'Water Resource User Associations which are formed under the 2002 Water Act, positively affect cooperation over water resources and these organizations will help to avoid conflict between the different water users in the changing rural water situation in the Upper Ewaso Ng'iro River Basin in Kenya.' Does the study confirm or deny this hypothesis?

As chapter 8 shows, WRUAs which are set up to manage the water resource and prevent and resolute conflicts are still in a development stage and are dealing with some severe problems. In contrast to this problems, a large part of the community believes that formation of the WRUAs has led to less conflict, more cooperation and less water scarcity in comparison to the situation ten years ago when the WRUAs did not exist. Also resource experts state that WRUAs are doing a good job on the resolution and prevention of conflict.

The community, however, also states there is more scarcity and that there are more conflicts now than ten years ago. They also claim that in the near future there will be even more scarcity and more conflicts. There is thus a clear contradiction between these data. Although people believe the WRUAs have a positive influence on water availability and conflict, they also state that there is now more scarcity and conflict then before the WRUAs existed.

A possible explanation is that factors as presented by Ojwang & Wargute (2009) related to increasing human pressure, unsustainable land use practices, declining size of wildlife areas, climate change, droughts and declining river flows have led to more conflict in the area. That although there

are now more conflicts in absolute numbers than ten years ago, without the WRUAs this increase would be even bigger.

# 11 REFERENCES

- Achterhuis, H.J. (1990) Filosofie van groei en schaarste.  
Retrieved from: <http://igitur-archive.library.uu.nl/sg/2007-1115-201017/1-filosofie.pdf>
- Agrawal, A. (2002). *Environmentality: Technologies of Government and the Making of Subjects*. Durham, NC: Duke University Press.
- Alker, H. R. , Gurr, R. T. & Rupesinghe, K. (2001) (eds.), *"Journeys through conflict. Narratives and lessons"*, Lanham.
- Axt, H.J. (2006) Conflict- a literature review.
- Baechler, G. (1998) Why environmental transformation causes violence: A synthesis. *Environmental change and security project report*, Issue 4, spring.
- Baland J.M. & Platteau J.P. (1996). *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Oxford, UK: Clarend.
- Ballentine, K. (2004) *Program on Economic Agendas in Civil War: Principal Research Findings and Policy Recommendations*. New York: International Peace Academy.
- Black, M. & King, J. (2009). *The Atlas of Water*. Brighton: Earthscan Publication.
- Berkes, F. (1989). *Common Property Recourses: Ecology and Community-based Sustainable Development*. London: Belhaven Press.
- Blaikie, P. (2006) Is Small Really Beautiful? Community-based Natural Resource Management in Malawi and Botswana. *World Development*, Vol. 34, No. 11, pp. 1942–1957.
- Bradsawh, B. (2003) Questioning the credibility and capacity of community-based resource management. *the Canadian Geographer*, Volume 47, issue 2 .
- Brahm, E. (2003). *"Conflict stages"*, in Guy Burgess/Heidi Burgess (eds.), *Beyond intractability*, Boulder.  
Retrieved from: [http://www.beyondintractability.org/m/conflict\\_stages.jsp](http://www.beyondintractability.org/m/conflict_stages.jsp)
- Bromley, D. (1992). The commons, common property and environmental policy. *Environmental and resource economics* 2 (1): 1-18.
- Choucri, N. & North r. (1975) *Nations in Conflict: National Growth and International Violence*. San Francisco: Freeman.
- CoCoon, (2010) Research proposal Ewaso Ng'iro North River Basin.

Collier, P. (2000). Rebellion as a Quasi-Criminal Activity. *Journal of Conflict Resolution*. 44, pp. 839-53.

Collier, P. & Hoeffler, A. (1998) On the Economic Causes of Civil War. *Oxford Economic Papers*. 50, pp. 563-73.

Crance, C. & Draper, D. (1996). Socially cooperative choices: An approach to achieving resources sustainability in the coastal zone. *Environmental Management* 20:175–184.

Derman B. & Hellum A. (2007). Livelihood rights perspective on water reform: Reflections on rural Zimbabwe. *Land Use Policy*, Volume 24, Issue 4, , Pages 664–673.

Deutsch, M. (1973), *“The resolution of conflict”*, Harvard press.

Deutsch, M (1991), “Subjective feature of conflict resolution: psychological, Bibliographysocial and cultural influences”, in Vayrynen (ed.), *New directions in conflict theory*, London, pp. 26-56.

Diehl, P.F. & Gleditsch, P. (N.D.) “Controversies and Questions”, In: *Environmental Conflict*.

Donkers, H. (1994.) *De witte olie: water, vrede en duurzame ontwikkeling in het Midden-Oosten*. 1e editie, Utrecht: Van Arkel.

Ericksen, P. , Said, M. , Leeuw, J. , Silvestri, S., Zaibet, L. , Kifugo, S. , Sijmons, K., Kinoti J., Ng’ang’a L. , Landsberg, F. , Stickler, M. (2011) *Mapping and valuing ecosystem services in the Ewaso Ng’iro Watershed*. Submitted to World Resources Institute (WRI) and DANIDA.

Fairhead, J. and Leach, M. (1996). Rethinking the Forest-Savannah Mosaic. In M. Leach, and R. Mearns (Eds.), *The Lie of the Land*. London: James Currey.

Faures, J. & Santini G. (2008). Water and the Rural Poor Interventions for improving livelihoods in sub-Saharan Africa. *FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS*.

Falkenmark, M. (1997) The Massive Water Scarcity Now Threatening Africa: Why Isn't It Being Addressed? *Ambio*, Vol. 18, No. 2 (1997), pp. 112-118.

Fearon, D. J. (1994), “Ethnic war as a commitment problem (Paper presented at the annual meeting of the American Political Science Association)”, New York.

Frerks, G. (2007) Linking Environment and Conflict Building Blocks for a Knowledge, Innovation and Research Strategy.

Gardner-Outlaw, T., and Engleman R. (1997). *Sustaining Water, Easing Scarcity: A Second Update: Revised Data for the Population Action International Report: Sustaining Water: Population and the Future of Renewable Water Supplies*. Washington, D.C.: Population Action International.

Georgiadis, N.J., Ihwagi, F., Olwero, J.G.N., Romanach, S.S. (2007). Savanna herbivore dynamics in a livestock-dominated landscape. II: Ecological, conservation, and management implications of predator restoration. *Biological Conservation*, 137, 473-483.

Gichuki, F., H. Liniger, L.C. MacMillan, G. Schwilch, J.K. Gikonyo. (1998). Scarce water: exploring resource availability, use and improved management. *Eastern and Southern Africa Geographical Journal* 8: 15-27.

Gichuki, F.N. (2001). Water Management Constraints and Opportunities: A Case Study for the Upper Ewaso Ngiro North Basin. In Ngana J.O 2001.(editor). *Water Resources Management in Pangani River Basin. Challenges and Opportunities*. Dar es Salaam University Press, Dar es Salaam.

Gleditsch, N. P. (2001). "Armed Conflict and the Environment," in Paul F. Diehl and Nils Petter Gleditsch (eds.), *Environmental Conflict*. Boulder, Colorado: Westview Press.

GOK, (1999). National population and housing census. Vol 1. Ministry of Planning and National Development, Central Bureau of Statistics.

GOK, (2002). The Water Bill, 2002. In *Kenya Gazette Supplement, Bills 2002*, Government Printer, Nairobi; 287-413.

GOK (2006). THE WATER RESOURCES MANAGEMENT RULES, In *Kenya Gazette Supplement*, Government Printer.

GOK, (2009). National population and housing census. Vol 1. Ministry of Planning and National Development, Central Bureau of Statistics.

Goodhand, J. & Hulme, D. (1999) 'From Wars to Complex Political Emergencies: Understanding Conflict and Peacebuilding in the New World Disorder'. *Third World Quarterly*. Vol. 20, no. 1, 13-26.

Hardin, G. (1968) The Tragedy of the Commons," *Science*, 162(1968):1243-1248.

Hauge, W. & Ellingsen, T. (1998). Beyond environmental scarcity: causal pathways to conflict. *Journal of peace research* Vol.35: 299-317.

Homer-Dixon, T. (1999), "Environment, scarcity, and violence", Princeton.

Homer-Dixon, T. (1997), "Environmental scarcities, state capacity and civil violence: the case of Bihar, India", Toronto.

Homer-Dixon, T.(2000). *The Ingenuity Gap*. New York: Alfred A. Knopf.

Homer-Dixon, T. (1998). *Ecoviolence: Links Among Environment, Population, and Security*. Oxford: Rowman and Littleald.

Huber, M. & C.J. Opondo. (1995) Land use change scenarios for subdivided ranches in Laikipia district, Kenya. *Laikipia-Mt. Kenya paper No.19*, LRP,Kenya.

Jayyousi, O.A. (2007) Water as a human right: towards civil society globalization. *International Journal of Water Resources Development*, 23:2, 329-339.

Kiteme,B.P. (2005) Understanding Development Priorities of Local Actors in the Upper Ewaso Ngiro Catchment.

Kiteme, B. P. , Gikonyo, J., (2002). Preventing and resolving water use conflicts in the Mount Kenya highland-lowland system through water users associations. *Mt Res Dev* 22(4):332–337.

Klem, B. (2003) *Dealing with scarcity and violent conflict*. A background paper. The Hague: Netherlands institute of international relations 'Clingendael'.

Kohler, T. (1987) Land use in transition: Aspects and problems of small scale farming in a new environment : the example of Laikipia District, Kenya.

Kronenburg, E. & Vlist, J. (2009) Schaarste en transitie, Kennisvragen voor toekomstig beleid. Retrieved from: [www.rijksoverheid.nl/bestanden/...en.../2009/11/01/.../w1329.pdf](http://www.rijksoverheid.nl/bestanden/...en.../2009/11/01/.../w1329.pdf)

Lind J., & Sturman k. (2002). eds. *Scarcity and Surfeit. The Ecology of Africa's Conflicts* (Pretoria: Institute for Security Studies.

Malthus T.R. (1798) . *An essay on the principle of population*, Oxford World's Classics reprint.

Maser, C. (1995). *Resolving environmental conflict: Towards sustainable community development*. St. Lucie Press, Delray Beach, Florida, 250 pp.

Maxwell, J. W. & Reuveny, R. (2000). Resource Scarcity and Conflict in Developing Countries. *Journal of Peace Research*, 37(3), 301-322.

Mckay, D. (1996) *rush to union: understanding the european federal bargain*. (Oxford/New York: Oxford university press.

Merkhofer, M. W., Conway R., & R. G. Anderson. (1997). Multiattribute utility analysis as a framework for public participation in siting a hazardous waste management facility. *Environmental Management* 21:831–839.

Moote, M. A., McClaran M.P. , & Chickering, D. K. (1997). Theory in practice: Applying participatory democracy theory to public land planning. *Environmental Management* 21:877– 889.

Mumma, A. (2007) Kenya's new water law: an Analysis of the implications of Kenya's water act, 2002, for the rural poor

Ngigi, M. (2005). The Case of Smallholder Dairying in Eastern Africa. *EPT Discussion Paper 131*, IFPRI, Washington D.C.

Niederer P. (2000): Classification and Multitemporal Analysis of Land Use and Land Cover in the Upper Ewaso Ng'iro Basin (Kenya) using Satellite Data and GIS. *MSc thesis*. Centre for Development and Environment, Institute of Geography, University of Berne.

Notter, Benedikt (2002): Water Balances in the Upper Ewaso Ng'iro Basin. *Research Practice Paper*. Centre for Development and Environment, Institute of Geography, University of Berne.

Notter, B., MacMillan, L., Viviroli, D., Weingartner, R., Liniger, H. P. (2007) Impacts of environmental change on water resources in the Mount Kenya region. *Journal of Hydrology* 343(3–4):266–278.

Ohlsson, L. (1995) *Hydropolitics, conflicts over water as a development constraint*, Zed books.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Ostrom, E. (2002). *Drama of the commons*. National Academy Press, Washington, DC.

Ostrom, E. & Dietz, T. (2003). *Water rights in the commons*.

Ojwang', G. O., and Wargute, P.W. (2009). The population trends and distribution of large herbivores in Laikipia district. Department of Resource Surveys and Remote Sensing, Nairobi.

Peluso, n. & Wats, p. (2001) *Violent environments*. Cornwall university press.

Perret, S. (2006) New paradigms, policies and governance in the water sector.

Perret, S., Farolfi, S., & Hassan, R. (2006) Water governance for sustainable development: Approaches and lessons from developing and transitional countries.

Pfetsch, F. R. (1994), *"Internationale Politik"*, Stuttgart.

Pfetsch, F. R. & Rohloff, C. (2000), *"National and international conflicts", 1945-1995: new empirical and theoretical approaches"*, London.

Platteau, J. (1996). The Evolutionary Theory of Land Rights and Applied to Sub-Saharan Africa: A Critical Assessment. *Development and Change*, 27, 29-86.

Postel, S. (1999). *Pillar of Sand: Can the Irrigation Miracle Last?* New York: Norton.

Rhoads, B.L. (2009), Empirical analysis of planform curvature–migration relation of meandering rivers, *Water Resources Research*, 45, W09424, doi:10.1029/2008.

Ross, M. (1999) The Political Economy of the Resource Curse. *World Politics* 51: 297–332.

Richards, P. (2005) 'New War, An Ethnographic Approach.' in P. Richards (ed.) *No Peace No War, An Anthropology of Contemporary Armed Conflict*. 1-21. Athens/Oxford: Ohio University Press.

Rural Focus (2006) Where is the water going to. Abstraction Surveys carried out in 2002 and 2004.

Rutten, M. (2012) How Natural is Natural? Seeking Conceptual Clarity over Natural Resources and Conflicts.

Sandole, D. (1998), "A comprehensive mapping of conflict and conflict resolution: a three pillar approach", in *Peace and Conflict Studies*, 5/2, <http://www.gmu.edu/academic/pcs/sandole.htm>



Selin, S., & Chavez, D. (1995). Developing a collaborative model for environmental planning and management. *Environmental Management* 19:189–195.

Singer, D. J. (1996), “Armed conflict in the former colonial regions: from classification to explanation”, in Luc van de Goor/Kumar Rupesinghe/Paul Sciarone (eds.), *Between development and destruction: an enquiry into the causes of conflict in post-colonial states*”, pp.35-49.

Smit, N. (1996). The production of nature. In *Future natural*, ed. G. Robertson, M. Mash, L. Tichner, J. Bird, B. Curtis, and T. Putnam, 35–54. London: Routledge.

Smith, L. G., Nell Y.C , & Prystupa, M.V. (1997). The converging dynamics of interest representation in resources management. *Environmental Management* 21:139–146.

Soysa, I. de (2002). Ecoviolence: Shrinking Pie, or Honey Pot? *Global Environmental Politics*, 2(4), 1-34.

Tiffen, M., Mortimore, M. & Gichuki, F. (1994). *More People, Less Erosion – Environmental Recovery in Kenya*. London: Wiley

UNHCHR (United Nations High Commissioner for Human Rights) (2003) Rights to Water: *High Commission’s Statement to 3rd World Water Forum*, Kyoto.

Retrieved from: <http://www.unhchr.ch/html/menu2/6/water/index.htm>

Vasseur, L., L. LaFrance, and C. Ansseau. 1997. Advisory committee: A powerful tool for helping decision makers in environmental issues. *Environmental Management* 21:359– 365.

Wade R. (1994). *Village Republics: Economic Conditions for Collective Action in South India*. Oakland: ICS Press.

Warner, J. (2004a) *Mind the GAP - Working with Buzan: the Illisu Dam as a Security Issue*. SOAS Water Issues Study Group, School of Oriental and African Studies / King's College - London (Occasional Paper 67).

Warner, J. (2004b) 'Water, Wine, Vinegar, Blood: on Politics, Participation, Violence and Conflict over the Hydrosocial Contract', *Proceedings of a conference on 'Water and Politics'*, World Water Council/IUCN, Montpellier, February 2004.

Watson, R. (2007) Water resource users associations around mount Kenya – Establishment, Operation and Potential for conflict prevention.

Weber, M. (1947), *“The Theory of social and economic organization”*, New York.

WHO (2003) The Right to Water. *Health and Human Rights Publication Series*; No. 3 (Geneva: WHO).

Witsenburg, K & Roba, A.W. (2007). “The Use and Management of Water Sources in Kenya's Drylands: Is there a Link Between Scarcity and Violent Conflicts

Wolf, A.T. (2001) *water conflict and cooperation in 2020 vision*. Washington DC: international food policy research institute.

Wolf, A., Yoffe S., & Giordano, M.( 2003). International Waters: Identifying Basins at Risk. *Water Policy* 5(1): 31-62.

Wolf, A. T. (2009). A Long Term View of Water and International Security. *Journal of Contemporary Water Research and Education*, 142, 1-9

World bank (2003) *Kand policies for growth and poverty reduction: A world bank Policy research report*. Oxford and washingtonL a co-publication of the world bank and oxford university press.

WRMA & WSTF,(2008) *Wrua development cycle*.

WWAP, (2006) *Water a shared responsibility*.

Retrieved from: <http://unesdoc.unesco.org/images/0014/001488/148866e.pdf>

WWAP (2012). *Managing Water under Uncertainty and Risk.The united nations world water development report 4*, Volume1.

Yoffee, S.B. ,Wolf A.T. & Giordano M. (2005). 'Conflict and Cooperation over International Freshwater Resources: Indicators of Basins at Risk', *Journal of the American Water Resources Association* 39(5): 1109–1126.