Kiru Valley Complexity
-A case study over consequences of and causes to conflicts over irrigation water in Tanzania-
Abstract

Inequalities among different power groups are getting obvious in Kiru Valley, Tanzania mainly due to water scarcity. This paper aims to examine, by a case study, the increasing competition over irrigation water among Kiru Valley farmers in relation to socio-economic stratification. It is possible to divide the examined parts of Kiru Valley farmers into three different power groups corresponding to their access to irrigation water. First, large-scale sugar cane farmers owned by Tanzanians with Indian origin located on strategic positions near the main rivers. Second, upstream small-scale rice cultivators receiving water from the IFAD (International Found for Agricultural Development) irrigation system and, third, downstream small-scale farmers cultivating rice in the Mapea wetland. To achieve the objectives in this study, Rapid Rural Appraisal (RRA) techniques have been used and especially wealth rankings to measure the socio-economic stratification.

The wealth rankings demonstrate differences among Kiru Valley farmers. Those farmers connected to the IFAD irrigation system and the large-scale farmers have in higher amount a steady access to irrigation water than farmers cultivating the Mapea wetland. Consequently Mapea farmers are forced to rely on left over water from upstream IFAD farmers and surrounding large-scale farmers, leading to unfair distribution patterns and tensions among Kiru Valley farmers. Finally, it has further been found that access to irrigation water is reflected in household economy. Mapea farmers have less capital goods and households properties compared to both IFAD-irrigators and large-scale farmers.

Key words: International Fund for Agricultural Development (IFAD), irrigation system, water scarcity, Babati District, wealth rankings, Africa
List of abbreviations

IFAD    International Found for Agricultural Development
JICA    Japan International Cooperation
TSH     Tanzanian shilling
SIDA    Swedish International Development Cooperation Agency
RRA     Rapid Appraisal Rural Appraisal
NAFCO   National Food Corporation
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1 Background

Kiru Valley is located in the Rift Valley south of Lake Manyara, in Babati District, Manyara Region in Tanzania. In the early 20th century the vegetation of the area was invaded by tsetse flies and an epidemic of sleeping sickness entered the Valley. Many of the villages in Kiru Valley were settled during the villagisation programme in the 1970s when the tse-tse threat had been reduced through clear felling of trees. At the same time settlers, mainly pastoralists, from Mbulu-, Babati-, Hanang- and Monduli districts moved to the valley because of drought in their home areas. As more people and farmers settled in the area the demand for land, grazing and water rights increased and tensions between the large-scale farmers, who had been allocated vast cultivation areas during colonial times and the new inhabitants increased (Juma, 2004).

Until the 1970s Kiru Valley had no schools, no local government administration and was rather isolated with few indigenous peasants. By the 1970s, most of the white farmers, who originally leased the large-scale farms, had left and the farms were taken over by NAFCO (National Food Corporation), a government authority. In the beginning of the 1980s several of the leaseholds (farms) where bought by Tanzanians of Indian origin. Today there are 22 large-scale farms in Kiru Valley with an average of 3000 ha of land, which are under a 99-year lease since colonial times (Ubwani, 2002).

Kiru Valley has three different cultivation areas. Firstly the large-scale farmers that mainly cultivate sugar cane in Kiru Ward and secondly the small-scale rice farmers connected to the IFAD (International Fund for Agricultural Development) irrigation system. The IFAD irrigation scheme replaced the old indigenous irrigation system, which was destroyed by heavy El Nino rains in 1998 and delivers water throughout the year (Said, 2006). Thirdly, the small-scale farms located further downstream in the lower parts of the Valley, in Magugu Ward, and are not receiving water from the IFAD irrigation system. They are strongly dependent on leftover water from the irrigation scheme and erratic rainfall for cultivation of rice, maize and other cash crops in the Mapea wetland (Babati District Profile, 2005).

The water that feeds Kiru Valley is a system of rivers flowing down from the Kiru escarpment that originates from the Nou forest (See figure 1). Babati, Mbulu and Monduli Districts are located in the catchment area. However, the water that flows through the study area passes the villages of Kiru Dick, Kiorome, Erri, feeds the large-scale farms in Kiru Ward and the Muungo irrigation scheme (IFAD intake 1), passes the wetland in Mapea village and surrounding large-scale farms. Additionally the water supports the Mkombozi irrigation scheme (IFAD intake 2) with water before it drains into Lake Manyara (ENC, 2001).
Nou Forest has been deforested. It is easy to find forest clearings on the top of the escarpment as well as in the escarpment walls. Since 2001 a joint government and a village forest management project supported by the NGO, Farm Africa, has been established in the 18 villages located close to Nou Forest (Farm Africa, 2008).

Figure 1. Transect over Kiru Valley
Source: The author
1.1 Research problem

Conflicts over natural resources strongly affect the rural poor both in the context of vulnerability as well as in recovery. It is argued that poor people or households in developing countries are totally dependent on natural resources found in their local region (Homer-Dixon, 1999, Bauman, 2002). At the same time a majority of these poor people live in areas that are defined as ecologically marginalized. However, access to natural resources has generally been studied in the context of poverty reduction and in particular in questions regarding water issues (Bauman, 2002,). It has been found that sustainable water management is an important factor for developing countries to improve their standard of living (Falkenmark, 1990). Therefore, donor agencies worldwide have favoured irrigation systems, especially in Sub-Saharan Africa, to ensure agricultural production and particularly to obtain food security. But at the same time, the implementation of irrigation systems has been followed by increasing tensions between different power groups (Adams et al., 2004) involving different ethnic groups, unequal allocation and unfair distribution patterns (Ohlsson, 1999). These kinds of tensions are found also in Kiru Valley, Tanzania.

The most pronounced problem in the Valley is the complex access over irrigation water, involving three different power groups interacting in different patterns. The escalating social and economic inequalities among Kiru Valley farmers can be traced back to 2002, when IFAD, a subsided UN institution specialized in rural development, decided to construct a new irrigation system in the Valley. Their aim was to promote poverty reduction among small-scale rice cultivators in Mawemairo and Matufa. It has been found on the one hand that the IFAD irrigation scheme has reduced poverty in the concerned villages mainly due to effective use of irrigation water diverted from Dodumera River. Ironically, Kiru Valley farmers further downstream are on the other hand arguing that the construction of the IFAD irrigation system is the roots of complex disputes over irrigation water due to changed distribution patterns, and is de facto pushing Mapea wetland farmers to ecological and economical marginalisation. As a paradox, this takes place in an area that is famous for high-quality natural preconditions for rice production (KIVREP, 2007).
1.2 Objectives of the study

This study has two research objectives. The first objective is to explain the contributing causes to the increased competition over water for irrigation among different power groups. The second objective is to explain how differences in access to irrigation water among Kiru Valley farmers is reflected as social stratification.

1.3 Research questions

To examine Kiru Valley complexity this study will answer the two following questions:

1. How has the construction of IFAD irrigation scheme affected Kiru Valley farmers access to irrigation water?

2. How has the construction of IFAD irrigation scheme affected Kiru Valley farmers household economy?

The study defines large-scale farmers, farmers cultivating Mapea wetland and villagers in Mawemairo connected to IFAD intake 1 by Kiru Valley farmers.

1.4 Literature review

The research field dealing with the environmental conflict nexus emerged during the 1980s after the end of the Cold War. As a result of the Brundtland report in 1987 an increased awareness of the general negative effects of global environmental degradation and in particular the situation in the developing countries was highlighted. A majority of the studies within the field focused on the links between environmental scarcity and domestic conflicts in the context of degradation of renewable natural resources (Ellingsen et. al, 1998). Though the research field is still developing various scholars have showed that population pressure on natural resources contributes to conflicts (Maxwell, 2000, Homer-Dixon, 1995, Bächler 1998). There is, however, no real consensus on the matter and some researchers have opposed these findings (Levy, 1995).

There are three research groups that work in the frontline within this field. The Toronto group with Thomas Homer-Dixon, the Swiss Environment and Conflicts Project (ENCOP) with Günther Bächler and Kurt Spillman and the International Peace Research Institute (PRIO) in Norway (Homer-Dixon, 1995). This study will use the framework of the Toronto
group and is therefore not discussed at any length here. Bächler and his group have identified different types of concerns that trigger environmental conflicts i.e. in the words of Bächler. “Demographically caused migration conflicts”, this happens when there is an increased population pressure on environmentally weak regions or “ethno-political conflicts” when two or more ethnic groups have to share the same natural recourse (Bächler, 1998). The work of Bächler is based on 40 case studies and the approach is quite similar to the approach emphasized by the Toronto group. The differences are that Bächler incorporates the concept of modernization and maldevelopment (under-and overdevelopment) as further causes to conflicts over natural resources (Ibid).

Some PRIO researchers have questioned increased population pressure as important causes to environmental conflicts. These researchers oppose fundamental neo-Malthusian theories explaining that population growth and increased pressure on agricultural land will lead to conflicts (Gleditsch, 1998, Urdal, 2005). Henrik Urdal has developed models that show that countries with high population growth tend not to fall into conflicts as often as regions with low population increase (Urdal, 2005). Gleditsch (1998) argues that economic factors such as inequalities in access to belongings are important factors when discussing causes to civil war, which are seldom included in research on the subject. Moreover, political factors e.g. colonial influence and power asymmetries are often not considered when analyzing the environmental conflict nexus (Urdal, 2005, Bryant, 1998).

The significance of this study is that it assists in understanding the causes to environmental conflicts in developing countries. Environmental conflicts are complex and are not explained by addressing a single factor or perspective on a present problem. Combining theoretical arguments from the Toronto group with the main findings from the concept of political ecology provides, therefore, the opportunity to draw attention to formerly absent variables in environmental conflict research such as certain socio-economic factors, such as unequal power relations, unfair access to natural resources and surviving colonial influences.
2 Theoretical overview

This study will mainly use the approach of Thomas Homer-Dixon to examine the relationship between natural resource scarcity and conflict. The main features of the theoretical framework of political ecology will be used, in particular “the chain of explanation” developed by Piers Blaikie and Harold Brookfield (Blaikie & Brookfield, 1987).

2.1 The approach of Homer-Dixon

Water scarcity is not a new phenomenon in developing countries. Due to population growth as well as climate changes, conflicts over water resources are very likely to increase in the near future. Conflicts over water resources also exist between countries, but are more pronounced within countries involving, for example, different ethnic groups, unequal allocation of water between different power groups as well as unfair distribution patterns (Ohlsson, 1999). According to Homer-Dixon conflicts concerning renewable natural resources have complex causes. During the 1990s Homer-Dixon and the Toronto group carried out research on the relationship between resource scarcity and conflicts and have developed their own models on how conflicts over natural resources occur (Ellingsen, 1998).

The core of the theoretical framework is environmental scarcity and its effects. According to Homer-Dixon and his group, environmental scarcity is triggered by three types of variables (scarcities) important in understanding the context of environmental conflicts; a) supply-induced scarcity, b) demand-induced scarcity and c) structural scarcity (Ohlsson, 1999). Supply-induced scarcity is when natural resources are in decline due to pollution, degradation or when the resources are limited. It could be rivers that are drying out due to much water withdrawals from agriculture or lowered ground water tables etc. Demand-induced scarcity exists when population growth and changes in development patterns (e.g. increased welfare) contribute to a higher demand and each individual has less access to the resources as a result. For example, conflicts over irrigation water tend to increase in near future. Hence, irrigation schemes tend to attract people into an area due to increased rate of return compared to rain-fed agriculture and rising value of land. This kind of development pattern, including increased water withdrawals from the irrigation system as well as from other water sources (Cotula, 2006, Gleick, 1993) can increase the risk of water scarcity and environmental stress in arid regions. Structural scarcity is when some, often rich, actors have greater access to the natural resources than in particular the less wealthy. Structural scarcity exists when it is possible for some actors to prevent other members of the society to get further access to the natural recourse. This type of scarcity has often been inherited from former colonial structures. With
the help of these colonial tenure and management arrangement remnants power and wealth may still be accumulated (Homer-Dixon, 1999, Bryant, 1998).

It is argued here that the types of scarcities presented above may interact and create resource capture and ecological marginalization. Resource capture exists when a resource decreases due to a population increase. When the resource declines, strong actors in society may capture the resources and use their power and their self-interest to influence institutions responsible for the resources to gain increased access. As a result poorer groups in society become more (ecologically) marginalized due to unfair allocation of the resources and are forced to migrate and cultivate areas that are ecologically fragile and, therefore additional resource degradation are created (Homer-Dixon, 1994). For example, in eastern Kenya increasing competition for agricultural land in the Kikuyu reserves among powerful and poor farmers, led to migration of poor farmers into arid areas resulting in population pressure on cultivation land. Piers Blaikie, one of the pioneers and advocates of political ecology, defines the concept of marginalization as “to lose the ability to control their own lives”. This will affect which kinds of crops that are cultivated and also the opportunity to work on their own land (Blaikie, 1987).

When environmental scarcities interact in various patterns, societies in developing countries tend to change and these changes in turn may increase the risk of environmental conflict and stress. Homer-Dixon have recognized five social effects connected to resource scarcities:” (1) Constrained agricultural productivity, often in ecologically marginal regions, (2) constrained economic productivity, mainly affecting people dependent who are highly dependent on natural resources and who are ecologically and economically marginal, (3) segmentation of society, usually along existing ethnic cleavages, (4) disruption of institutions, especially the state and finally, (5), mitigation of these affected in search for better lives” (Homer-Dixon, p80,1999). The social effects mentioned above can be linked individually or combined with each other and result in further stress in society (Homer-Dixon,1991).
This paper will use the Homer-Dixon model in the context of Kiru Valley. Since the specific features of the Valley do not include all stages in the model only some of them are used. Therefore ethnic conflicts, coups d’etat, migration, social segmentation and weakened institutions have not been covered. However, figure 2 demonstrates that decrease in quantity and quality of renewable resources (supply-induced scarcity), boost in population growth (demand-induced scarcity) and unfair distribution patterns (structural scarcity) increase environmental scarcity. As a result constrained economic productivity will be the outcome if farmers are forced to cultivate in ecologically marginal areas that in turn will contribute to stress on household welfare. This can lead to insurgencies even known as deprivation conflicts (Homer-Dixon, 1994). Relative-deprivation conflicts are defined as process by which households in developing countries generate less wealth due to environmental degradation. Less wealthy strata in society are the most affected group and will be further economically marginalized; and more well-of power groups will use their influence and status to keep or increase their household welfare. This inequity can be followed by social stress that in turn can create conflicts in society when poorer groups show their disapproval versus the elite (Homer-Dixon, 1991).
2.2 The “chain of explanation” in political ecology

The political ecology approach stresses the interaction between human-environment relations and how it can be linked to environmental degradation. To understand the causes of environmental problems, investigations of the political, social and economic dimensions of the problem are essential (Bryant et al., 1997). Scholars of political ecology stress that three types of marginality; economic, ecological and politico-economic are linked to land degradation (Blaikie & Brookfield, 1987). For example, farmers can be politico-economically marginalized due to taxation and other surplus factors. Depending on how farmers deal with the changing cultivation pressure, it can affect the yield of their land. On one hand these changes can create more innovations, which become to increases the rate of return of the land. The land could instead, on the other hand, turn economically and ecologically marginalized due to lack of labour, negligence of maintenance (e.g. cleaning of feeder channels in an irrigation scheme) and additional future sustainable investments related to the natural resource. The problem arising from this is that these farmers, owing to their low economical and political status, tend to cultivate areas that are identified as ecologically marginal. Effects of these phenomena are that those farmers will affect their land further with collapsed harvest as a result (Bryant et al., 1997, Adams, 1990).

Piers Blaikie and Harold Brookfield have developed the “chain of explanation”. The chain stresses the causes of land degradation that are based on how farmers use their land and how society, national policies and the world economy are linked and how these linkages affect the local land users decision-making. This provides the researcher the opportunity to holistically understand Kiru Valley complicity. To clarify, the chain starts with (A) physical changes and (B) related economical symptoms at a specific place. These symptoms are additionally linked to (C) how peasants in a given area practise farming. It could be, for example, forest clearance or diversion of too much of irrigation water according to rules and regulations, which also reflects individual agricultural inputs (D) and the structure of society (E). Finally, the end of the chain explains how the state (F) and the international economy (G) are linked to the environmental problems (Bryant, 1998).
2.3 Synthesis of chosen theoretical frameworks

Two theoretical approaches are chosen to further understand Kiru Valley complexity. In Homer-Dixon theory, three main components, *demand-induced scarcity*, *structural-scarcity* and *supply-induced scarcity* are important in understanding environmental conflict nexus. These scarcities have three important functions in this paper. First, they work as a pre-made tool applied on the study area to help the researcher to mark off the Valley. Second, and even more important these scarcities are used to pinpoint significant factors such as power relation, population growth and type of agricultural productivity. Third, the scarcities are also demonstrated in Homer-Dixon model (figure 2) showing the effects and sources of environmental conflicts. Additional in-depth analyses of above scarcities give opportunity to put Kiru Valley specific features into a context.
By combining Homer-Dixon approach with main findings from the theoretical framework of political ecology a broad theoretical base is provided. The purpose of incorporating “the chain of explanation” is the possibility to highlight several environmental perspectives on Kiru Valley area. The main weakness of the Homer-Dixon approach is the tendency to advocate neo-Malthusian phenomena for causes to environmental conflicts. To overcome these issues, “the chain of explanation” is brought into a synthesis. Since the chain emphasizes the linkage between national policies, socio-economic factors and how farmers use their land, it offers the researcher a possibility to analyze Kiru Valley complexity through local, regional, national and international perspectives and even more importantly: to “move” between the different scales. This gives an opportunity to e.g. understand contributory causes for population pressure and how changes in agricultural productivity affect Kiru Valley farmers.

It is important to observe that “the chain of explanation” is incorporated into the reasoning of Homer-Dixon, therefore, not treated separately in the analysis section.
3 Methodology

3.1 Primary sources

To gather empirical material in Kiru Valley, multidisciplinary general Rapid Rural Appraisal (RRA) techniques were used. During the 1980s the RRA concept was developed and first used by researchers studying agrarian societies in the South. It was found that RRA techniques were more cost and time effective, reliable as well as flexible compared to other methods of studies of rural life in developing countries (McCracken et al., 1988).

This study uses both primary and secondary sources. I have not been using any secondary or primary quantitative data. The majority of the data in this study comes from primary sources, from 44 interviews and four wealth rankings, gathered during eight weeks of fieldwork in Kiru Valley. The study was completed in April 2007.

The majority of the interviews were semi-structured. This means that some questions are predetermined but gives opportunities to follow-up questions to get more in detail answers. In-depth interviews with both large- and small-scale farmers as well as officials were carried out. My earlier work in Kiru Valley helped me to identify more informants as well as in the District administration. The head of Participatory Irrigation Development Programme responsible for irrigation activities in Babati District and the Extension Livestock keeper in Babati Town who was, however, involved in the implementation of the IFAD irrigation scheme in 2002, were interviewed. This gave me basic knowledge over the IFAD-irrigation scheme.

In-depth interviews with members of water management institutions provided information on how these institutions prevent conflicts as well as their structure and function. Through transect walks in Kiru Valley, farmers; especially those connected to the IFAD irrigation system, and the rice cultivators cultivating Mapea wetland were interviewed about their perception of the water scarcity problem. This gave me an opportunity to contextualize my problem formulation and to identify locations and informants that were important for further interviews. To validate the findings, triangulation of the data was performed when necessary strengthening the validity of the study (Yin, 1993).

Additionally some of the interviews were group interviews. One benefit of this was to achieve different perspectives on the studied problem. After each field day, the whole group that interviewed the same persons, sat down and discussed the results of the interviews and sorted out any misunderstandings.
During some of the interviews I used a field assistant/interpreter. This may have contributed to some misunderstandings. After each interview with an interpreter a meeting was held to clear out any discrepancies. Moreover, the field assistant/interpreter might put his values and preconceived opinions into the interview situation. It is rather difficult to avoid such kinds of bias. But since the field assistant/interpreter had previous experiences of fieldwork through participation in yearly three-week excursions to Babati District with the Environment and Development programme at Södertörns Högskola, his assessment was considered to be safe enough to relay on.

The small and large farmers interviewed have not been referred by names in the text as well as in the reference list due to the sensitiveness (conflict) of the research subject.

3.1.1 Wealth rankings

To examine the social stratification among Kiru Valley farmers wealth rankings were used to quickly put my research problem into a context. One of the benefits of using wealth rankings is that the poorest households in an area are well covered compared to traditional socio-economic methods (Loiske, 1995). Another strength is its capacity to adapt to local conditions in the context of wealth, power and status between different power groups in a limited time frame (Adams et al., 1997). It was because these salient features that wealth ranking as a technique was chosen.

Wealth rankings were used to gather information about the social stratification of the Kiru Valley farmers. This gives a general idea on the power situation in the Valley. Using the village household registers all the selected households in Mawemairo and Mapea were written down on a piece of paper. Due to my time constraints only two sub villages from each village were examined, Mawemairo A, Mawemairo B, Mapea A and Mapea B in order to get usable working data. In Mawemairo a total of 187 households were randomly selected and all of these, according to the irrigation register committee, had access to IFAD irrigation water. Since the farmers in Mapea rely on traditional rice cultivation without any help from external authorities, no available household register was available that covered those households that have access to wetland cultivation. In Mapea village 180 households were selected randomly. With the help of existing contacts it was possible to identify as well as to contact large-scale farmers in Kiru Valley. Three large-scale farmers have been included in the study.

With the assistance of the village executive officer in Mapea and the irrigation scheme facilitator in Mawemairo who both have good knowledge about the two villages the informants could be identified. To avoid a biased data population the selection of informants was based on gender, social status and age. All the households in the two villages were recorded. The
wealth rankers, (three for each ranking), were then asked to cluster the households according to the local meaning of wealth (*uwezo*, in Swahili).

No minimum or maximum numbers of groups were predetermined to get as open context as possible. After each wealth ranking the informants were interviewed on how they had categorized the households and why. The informants categorized totally 4-19 different wealth groups. To get equally numbers of wealth groups corresponding to the *uwezo* (wealth) of examined farmers, the produced wealth groups were clustered together through in-depth analysis by looking for similar patterns e.g. size of cultivation land and household properties. The analysed data produced totally four wealth groups covering both the large-scale and small-scale farmers in Kiru Valley. The above rankings have been used to sample interviewees so that the interviews reflect the perception of the various power groups in the Valley (McCracken el al., 1988).

The informants managed to recognize the majority of the households in the examined villages. In Mawemairo 6.96 percent or 13 households were not identified. The informants did not distinguish two additional households concerning access to IFAD irrigation water and those were not considered. All the households on Mapea were identified.

### 3.2 Secondary sources

The secondary sources in this study contains a variety of written information covering, published scientific articles, documents, reports, books, Internet and local unpublished material in Babati, Tanzania. Scientific articles and books have in generally been used to mainly gather relevant information for the two chosen theoretical frameworks and in particularly to put my research problem into a context. The benefit of using scientific articles is that many of them are up to date and are targeted at one problem and therefore easier to sort out irrelevant information. To complement the approach of Homer-Dixon and the Toronto group, main findings from the concept of political ecology and in particular “the chain of explanation” model developed by Piers Blaikie and Harold Brookfield (Blaikie & Brookfield, 1987) were used. Of the different stages in the model, all does not have the same importance, therefore, not used as much as other.

Concerning the Internet sources, well-documented websites have been used but on some occasion it has not been possible because of complications to find relevant information on the research subject. Some of documents and reports used might not to be seen as reviewed as scientific articles but have been referred to in this study due to its judge importencess. It has also been difficult to deal with statistics that have the tendency to change between different sources.
Local unpublicised material was found in Babati Town. Background information about Babati District and Kiru Valley are obtained through the *Initial Environmental Examination For Mkombozi, Mwungano and Endamajeki irrigation schemes (ENC, 2001)*, which was very helpful and a source of important information, due to lack of previous existing survey over the study area. With assistance from the Land and Management (LAMP) office also in Babati Town, paper copies of some of the aerial photos that were taken in 1991 by the Swedish donor agency (SIDA) proved to be supportive in the process of framing the study area. Moreover, it was luckily easy to find the households register containing names of the households used in this study, from the villages of Mawemairo and Matufa. Though these registers were not exactly up to date it was still surprising to not the accuracy in named register.

### 3.3 Validity and Reliability

Validity is defined as the researchers successes in actually measure what he/she intended to measure (Thurén, 2003). This paper aims to measure socio-economic stratification among Kiru Valley farmers and how this variation in stratification contributes to the increasing competition over irrigation water. The strength in this study is the use of RRA techniques and in particularly wealth rankings developed specifically for measuring socio-economic stratification in developing countries. Another strength is that triangulation of many results from the wealth rankings were carried out to obtain a high degree of validity. Of course this study have certain limitations. In the concerned case study bias might has affected the results from the wealth rankings. During analysis work of the wealth rankings some of the households might be unintentionally placed in wrong wealth groups and therefore may affect the results form the wealth rankings. To avoid this bias predetermined numbers of wealth groups could be used but this could be counter productive to aim of having an open context, hence, to avoid stressed situation during the interview this approach was excluded. Another limitation of using wealth rankings is the design work of different wealth groups. The analyzed information obtained from the informants reflects the socio-economic stratification in the examined area, but due to researchers interpretation it perhaps not necessary fully accurate (Loiske, 1995).

Reliability is explained if the same results and conclusions can be repeated several times by later researchers using the same methods and case study (Yin, 1994). Since Kiru Valley area has not been well researched this paper could be seen as a pilot study for future research. However, two aspects in this research argue for verification in reliability. Firstly, previous research in the area clearly indicated rising conflicts caused by the increasing competition over irrigation water and this study confirmed those tensions, conducted by using similar methods (Said, 2006). All the material used has been critically read by fellow researchers and
supervisor. Secondly, as mentioned before three different informants for each wealth ranking in respective villages, who knew the villages well, were assigned to cluster the same households according to the local meaning of wealth. The majority of times all the informants grouped the households into similar wealth groups and have therefore obtained verification in reliability. One way to achieve improved reliability is to replicate the process several times with different informants. Due to the limited time to conduct fieldwork this was not achievable. Moreover, if all the households in Mapea, and in Mawemairo as well as all large-scale farmers were included in the wealth rankings it might have affected the reliability.

4 Survey of irrigation farming in Africa

To put irrigation farming into an environmental context, the first part of the result section examines the relationship between irrigation and agriculture in Africa. It is followed by a short description of irrigation systems in Tanzania. Finally, a case study that deals with increasing competition over irrigation water in Kiru Valley is given.

4.1 Irrigation systems and agriculture in Africa

The number of irrigation systems in Africa is generally quite modest, with the exceptions of Egypt and Sudan when compared to other countries in the world. In Asia 32.4 percent of the total cropland is under irrigation and in Africa it is only 6.1 percent (Schoengold et al., 2005). In Sub-Saharan Africa the percentage is even lower showing that 3.5 percent of the total cropland is under irrigation (McLean et al., 2006). To keep up with population growth, agriculture in developing countries needs to produce more crops per litre of water (FAO, 1997) and is, therefore, one of the reasons why donor agencies favour irrigation systems constructions there (Schoengold et al., 2005). One of the benefits of irrigation is that farmers have the possibility to decide when they need the water in their cultivation instead of depending on rainfall. Another benefit that is well documented is that irrigated land increases agricultural productivity. Irrigated areas are up to 2.5 times more productive compared to traditionally rain-fed agricultural areas (Stockle, 2001). For example, in Asia the yields have increased between 100-400 percent after constructing irrigation systems (Schoengold et al., 2005).

About 85 percent of the total water withdrawals in Africa are used by the agricultural sector. In semi-arid regions the percentage is somewhat higher and represents a major part of the water resources (FAO, 1997). For example in Tanzania, the total water withdrawals are estimated to be 5142 million m$^3$ and the agriculture sector uses 4624 million m$^3$ of which 4417 m$^3$ are used for irrigation. The livestock sector consumes 207 million m$^3$ and, finally, the do-
mestic sector uses 493 million m$^3$ (ICID, 2006). In developing countries many irrigation systems are, however, inefficient and lose about 60 percent of the water that is transported (United Nations, 2002). Some researchers argue that traditional furrows lose up to 80 percent of the water through leakage and evaporation, before it reaches the field (Huggins, 2000).

The International Water Management Institute (IWMI) argues that during an average year of rainfall, rain-fed agriculture evaporate 20 percent of the rainwater, compared to 3-6 percent in irrigated lands. This is because rain-fed agriculture needs larger cultivation areas and therefore need more water and that rainwater instead of infiltrating into the soils forming a water storage much of the rainwater flows into the rivers as runoff. Rain-fed agriculture is the most common type of agriculture in Sub-Saharan Africa and makes up 95 percent of the total cereal production (Rijsberman, 2001).

4.1.1 The use of irrigation systems in Tanzania

Irrigation in Tanzania goes back to the Iron Age. There is evidence that between 1700 and 1890 irrigation was practised in Arusha, Kilimanjaro, Tanga and Mwanza Regions in Tanzania. These indigenous irrigation systems were normally small in size and managed by local communities. Present day irrigation is more large-scale and normally under government control as well as management (ESRF, 1997). According to the National Irrigation Master Plan (NIMP), the irrigation potential in mainland Tanzania is about 2.1 million ha. NIMP catalogued 1428 irrigation schemes, of which 1328 were small-scale irrigation systems, 85 of them were privately owned and 15 under government control (ICID, 2006).

The majority of the irrigation systems in Tanzania divert water from rivers, streams and springs. Gravity-fed irrigation systems make up over 99 percent of the irrigated area and only 0.2 percent of the irrigated areas use groundwater. Water storage reservoirs are not common. Advanced sprinkler irrigation is not widespread due its expensiveness (ICID, 2006). In the semi-arid parts of the country water harvesting and other basic techniques are used to control rainfall runoff. The most common crops under irrigation are rice, but irrigation is also used for maize, sugar cane and vegetables e.g. tomatoes (FAO, 1995)

Three different types of irrigation systems are found in Tanzania:

1. Modern irrigation systems (35847 ha) with full irrigation facilities, managed by the government and other external authorities.

2. Traditional irrigation systems (122630 ha): They mainly consist of traditional furrows and are maintained by the farmers themselves.
3. Improved traditional irrigation systems (25511 ha): Rebuilt and constructed by external authorities such as donor agencies.

(FAO, 2005)

5 Case study

The first part of the case study presents the general features of Babati District. Later sections deal more specifically with differences among Kiru Valley farmers due to their access in irrigation water.

5.1 The context

The research area selected is Kiru Valley, located in Babati District, Tanzania, along the Rift Valley, south of Lake Manyara. On the west side of the Valley, the majestic Mbulu plateau rises and its escarpments feeding the Valley with water. The features of the valley are rather special. Until the 1970s the valley had no school and no local governments and was quite isolated from indigenous farmers (Said, 2006). The large farms owned by the Indian minority were the only actor that controlled and had the monopoly of the water in the valley until 2002, when IFAD decided to build an irrigation system in the villages of Matufa and Mawemairo.

The area has not yet been satisfactorily studied. Before the construction of the IFAD irrigation system a rather vague environmental impact assessment (EIA) was carried through (ENC, 2001). Basic statistics, such as demographic data from the 2002 (consensus) is available as well as local District plans and some simple maps of the large-scale farms. In 1991 the Swedish donor agency, SIDA, funded aerial photographing of the area.

5.2 Babati District

Babati district is located in north-central Tanzania in East Africa. It is one of the four administrative districts of Manyara Region and is located south of Lake Manyara. The district itself has four divisions (Babati, Bashnet, Gorowa and Mbugwe), 21 wards and 81 villages. The total area of Babati district is 6,069 km², with a population of 302,523 inhabitants (National Website of the United Republic of Tanzania, 2006) according to the 2002 census. Altitudes range between 1000-2300 meters above sea level (ENC, 2001).
5.2.1 Climate and Rainfall

The area has a tropical savannah climate. It is typical in this type of climate for there to differences between the rainy and dry seasons. Before the rainy season the temperature is 35-40 degrees Celsius while during the rainy periods the temperature falls (Christiansson, 1988). The rainy season is divided into two periods. The short rain is known as “vuli” and generally falls from November to January. The long rain, “masika”, begins in February and ends in May. The rainfall is sometimes very intensive and may increase the risk of damaging soil structures and increase the risk of erosion (Sandström, 1995). The precipitation in tropical savannah climates is quite irregular and varies between 800 mm to 1000 mm on an annual basis (ENC, 2001).

5.2.2 Irrigation and agriculture in Babati District

Agriculture is the main economic activity of the district. About 180.000 ha of land is appropriate for cultivation, 30 percent of the district area and the majority of the agriculture is dependent of rainfall. Irrigation potential is 12000 ha and about 17 percent of it is utilised. Kiru Valley farmers agricultural technology varies, from simple hand hoes to modern tractors (ENC, 2001).

Kiru Valley has three different cultivation areas. Firstly the large-scale farmers that mainly cultivate sugar cane in Kiru Ward and secondly the small-scale rice farmers connected to the IFAD irrigation system. The irrigation IFAD irrigation scheme replaced the old indigenous irrigation system, which was destroyed by heavy El Nino, rains in 1998 (Said, 2006) and delivers water throughout the year. And thirdly, the small-scale farms located further downstream in the lower parts of the Valley, in Magugu Ward, are not receiving water from the IFAD irrigation system, but are strongly dependent on leftover water for cultivation of rice, maize and other cash crops in the Mapea wetland and erratic rainfall (Babati District Profile, 2005 KIVREP, 2007).

Kiru Valley farmers use two different types of rice seed. Traditionally Super is cultivated in Mapea wetland. Super needs less water to grow and is; therefore, better to use in drier areas. IFAD rice cultivators also farm Super but intercrop it with Saro. It is quite common to utilize several different types of rice due to variations in soils, location of rice plots and rainfall patterns (Meertens, et al., 1999).
5.3 Tensions among Kiru Valley farmers

As a consequence of the diminishing water supplies conflicts over irrigation water are getting increasingly obvious. The most pronounced problem is the water conflict between large-scale Indian owned farms, local indigenous small-scale farmers in Mapea village and farmers utilizing the IFAD irrigation scheme. Small-scale farmers utilizing the IFAD irrigation system accuse each other of taking more water than contracted. The IFAD farmers claim that the large-scale farms divert water from the main rivers before it reaches the IFAD irrigation system due to self-interest. The large-scale farmers in turn argue that deforestation of the escarpments; cultivation on riverbanks, irregular rainfall, population growth, the IFAD irrigation system and climate change causes the decline of irrigation water. Farmers in Mapea wetland accuse the upstream IFAD farmers, the large-scale farmers in Kiru Ward as well as large-scale farmers in Magugu Ward for taking more water than agreed.

The large-scale farmers in Kiru Valley have at several occasions demonstrated their disapproval against IFAD irrigation schemes. According to IFAD irrigators, large-scale farmers from Kiru Ward have held meetings with farmers in Mapea to gather opposition against the IFAD irrigation scheme. Before the construction of the Mkombozi irrigation scheme (intake 2) connected to Gichameda village one large-scale farmer refused to give up land that was close too the riverbank according to the rules. The case was handed over to the District Commissioner who found that the large-scale farmer was wrong. Only after mediation between the large scale farmer and the IFAD authorities construction work of the Mkombozi intake could begin. Similar events have also happened in the Muugano irrigation scheme (IFAD intake1). The small-scale farmers wanted to build a watchtower to get a better view of the main intake as well as better protection against water snatchers. But the large-scale that have land close to the intake refused to rent out land. After discussions with IFAD authorities the watchtower was built. It was to found that the same large-scale farmer had to demolish one of his groundwater wells since rules and regulations does not allow any cultivation and constructions work 60-100 meters from the riverbank (Said, 2006).

5.4 Water management in the Valley

The studied parts of Kiru Valley have three different water management areas corresponding to their geographical location. In Kiru Ward both large-scale and small-scale farmers from Mawemairo and Matufa are represented in a River committee. The committee consists of 12 members and is made up equally of large and small-scale farmers. The villages of Mawemairo
and Matufa connected to the IFAD irrigation system are assigned six representatives. Four seats belong to large-scale farmers in upper parts of Kiru Ward and finally, two seats are assigned to large-scale farmers in the lower parts of the Ward. The River committee has meetings at least once a month and more frequently during periods of water scarcity.

Due to periods of water scarcity a water distribution committee has been established through the initiative of small-scale farmers in Mapea village and the surrounding large-scale farmers. The water distribution committee is responsible for irrigation water distribution to the small-scale farms in Mapea wetland and to the nearby large-scale farms. The water committee also handles general grievances concerning irrigation water and water disputes between upstream IFAD farmers and the farmers in Mapea village. The small-scale farmers in Mapea and the surrounding large-scale farmers have a rotation scheme where they are allowed to use irrigation water for one week each.

Farmers connected to the IFAD irrigation system also have their own irrigation committee. The irrigation committee has two subgroups, the executive committee and the mediating committee. The members are democratically elected by the 472 members of the irrigation scheme. The executive committee is responsible for issues regarding finance and planning, operation and maintenance, security and distribution. Meanwhile, the mediating committee deals with water-associated conflicts. The IFAD Muungano irrigation scheme covers both the villages of Mawemairo and Matufa. The irrigation scheme belongs to Manyara Irrigation zone with headquarters in Babati Town, and deals with irrigation activities in the district.

Babati District belongs to the central irrigation zone located in Singida, 222 km south west of Babati Town, where water rights and other water related issues are administered. The two villages, Mawemairo and Matufa, share the same irrigation intake. The intake is constructed so that no more than 600L/sek of irrigation water can be diverted. The rest of the water flows in a southerly direction to Mapea village (see figure 1). The water is transported by gravitation into the irrigation intake via the Kiru escarpment supplying 19 feeder channels and 913 acres of land for irrigation farming in Mawemairo village. Through a rotation scheme Mawemairo obtain water four days a week and the remaining three days are assigned to Matufa village. Within the irrigation scheme the maintenance work is divided between the farmers. One farmer is responsible for supervising the irrigation system from the main intake to the central channel. As mentioned before, the water in the central channel is dispersed into 19 feeder channels and each channel has one responsible person who oversees any water related question. The responsible person does not own land in the irrigated section and is also elected by farmers in the irrigated section. It is compulsory for all members of the scheme to clean the irrigation channels from sediment etc. The villages pay 1328 000 TSH (2007) to the Zonal office in Singida for their water rights.
The water rights determine the amount of water that can be used for irrigation farming. Both villages share the same water right. Between the 1-15th of each month the villages of Mawemairo and Matufa are allowed to extract water for the purpose of irrigation and from 16-30th Mapea village are authorized to obtain water.

5.5 Social stratification in Kiru Valley

Social stratification is explained by hierarchic structure of citizens in a society in different strata (Loiske, 1995). It is argued that stratification represent the unfair distribution of rights and obligations within a community. Consequently societies tend to categorise people based on wealth, status, power and ethnicity to reflect their social status (Stavenhagen, 1974).

This section examines the social stratification among Kiru Valley farmers corresponding to their access to irrigation water. The scope of this study includes the villages of Mawemairo, Mapea and surrounding large-scale farmers. Mapea village is divided into three different sub villagers, A, B and Mazibas with a population of 1847 inhabitants (2002 consensus) distributed into 414 households. Sub villages A and B have been examined and are called Mapea here. According to the 2002 (census) Mawemairo had a population of 2707 people in 661 households in it’s four sub villages, Mlimani, Bulkeri, Mawemairo A and Mawemairo B. Mawemairo A and Mawemairo B have been studied and are, therefore, called Mawemairo (ENC, 2001).

Diagram 1. Percentage of households in wealth groups in Mawemairo and Mapea

Wealth group one represents the well-off farmers and is the smallest group in the examined villages. In Mawemairo this group constitutes 12.9 percent (24) of the households and 9.4 percent (51) of the households in Mapea. All the large-scale farmers are found in wealth group one. The poorest households are found in wealth group four, and are fairly of the same
proportional size in the two villages. In Mawemairo 23.6 percent (44) of the households and in Mapea 20.9 percent or 37 households are found in wealth group four. As the diagram indicates the majority of the households in both villages’ are found in the third wealth group, with just over 50 percent (93) of the households in Mapea village and 37.5 percent, (70) households in Mawemairo. The differences between the two villages are quite interesting. During the implementation (2002) of the IFAD irrigation scheme each household allotted a rice plot of a fixed size (five acres) due to IFAD rules and regulations therefore the pronounced differences and less poor households in Mawemairo. By allotting rice plots to several household members many households could bend the rules to access larger areas.

5.5.1 Access to wetland cultivation in Mapea

The village of Mapea receives water for rice cultivation via the indigenous irrigation system when there is enough water in Dudumera River. The water is diverted into the channels by stones, sandbags and trees to finally reach the Mapea wetland. The quantity of irrigation water is not controlled or regulated, as there are no irrigation gates as in IFAD irrigation scheme. According to villagers in Mapea rice has been cultivated in the wetland as long as they can remember with traditional irrigation methods.

Since the construction of the IFAD irrigation scheme farmers in Mapea have regularly experienced periods of water scarcity. In 2005 farmers from Mapea went to the District Commissioner to complain over the untenable water situation. The case went through all legal channels including the Regional Commissioner and finally came to the Zonal office (responsible for water rights) in Singida. The Zonal office’s verdict was that all involved should have access to irrigation water, and that a conflict resolution mechanism should be established. Some farmers argue that the IFAD irrigation system upstream has created more poverty in Mapea and less water and refer to the periods of water shortage in 2006, when farmers in some places in Mapea had to abandon rice cultivation in favour of the less income generating maize. Also some large-scale farmers were affected by the water scarcity. One large farm was not able to cultivate sugar cane due to the water scarcity that year. All the interviewed farmers in Mapea expressed their anxiety about the diminishing water availability.
Diagram 2. Access to wetland cultivation in the village of Mapea in percent of households

All large-scale farmers have access to irrigation water due to their strategic locations near the main rivers or at the water sources. They are all found in wealth group one. As the diagram indicates all households in wealth group one have access to wetland cultivation. While the majority of the poor farmers, 74 percent, have no access to wetland cultivation. This corresponds when interviews of the households covered by wealth rankings were carried out. The last 8-10 years there have been concerns in the village regarding land and water use due to a relatively high in-migration. This has resulted in dramatic increase in prices of farms in the wetland. According to farmers in Mapea, four years ago the value of an acre of cultivation land for rice was 50,000 TSH. In 2007 the price for the same acre was between 150,000-400,000 TSH depending on the distance to the water channel. More marginalised households stressed the difficulty to obtaining access to wetland cultivation. The diagram also shows differences between wealth groups regarding renting of land. Farmers in wealth group one and two does not need to rent land as they have capital to purchase land. Households in wealth group four are too poor to rent land. The biggest problem in the indigenous irrigation system occurs during periods of water scarcity. The small-scale farmers in Mapea village accuse surrounding large-scale farmers of not using monitoring equipment and of taking more water than is contracted. According to wetland farmers, large-scale farmers exceed their scheduled irrigation time regularly and irrigate for one and half week instead of the contracted one week. Mapea farmers also accuse large-scale farmers for dividing the irrigation water between themselves before it reaches the wetland where the small-scale farmers cultivate rice. As consequence Mapea farmers are not receiving irrigation water at agreed time and increased risk for damaged rice harvest. This led to that farmers from Mapea village illegally destroyed a large-scale farmer’s irrigation intake during dry seasons when less water is available. Another
problem is the different positions of the rice plots vis-à-vis the furrows in the wetland. According to rice cultivators in Mapea village, farmers that have rice plots close to the main intake can easily irrigate more then they are allowed, affecting farmers with rice plots further downstream negatively. Some farmers also illegally take irrigation water during the night. The water distribution committee is the institution responsible for issues related water within the wetland. According to the small-scale farmers the water distribution committee has difficulties to solving the above mentioned problems.

5.5.2 Household property in Mapea village

Table 3 clearly shows there are no significant differences between well-off farmers and the lower strata when comparing access to expensive items e.g. cars, tractors and oxen ploughs. The main distinction between the wealth groups, except a noted difference in standard of housing is that the well-off farmers have invested in milling machines that are rented out to other farmers during harvest. The milling machines are used after harvest to process the rice, by peeling the tiny shells off the rice for a ready product. However, the well-off farmers also tend to have larger cultivation areas compared to the less wealthy households and they also employ labourers. All wealth groups have access to bicycles, also the day labourers who need to move to their workplaces.

![Table 3]

The well-off farmers have access to resources outside Mapea. One farmer has access to three acres in Gitchameda, where IFAD intake number two is located and three acres in the IFAD Irrigation system in Mawemairo. Another, well-off farmer cultivates rice also in Kisan-
ganji wetland. The lower strata of the households in Mapea have access only to cultivation in the village. As mentioned before, 74 percent of the households in wealth group four do not have access to wetland cultivation and are, therefore, strictly dependent on dry land cultivation. In the same wealth group socially marginalized e.g. disabled, sick and poor people are found and these groups generally have few belongings. For instance one farmer stressed the frustration of renting or purchasing land in the wetland but due to lack of capital it was not possible. The family has lived in the village for three years and a total of five people live in the household. The salary of the son, who has been working as a tailor in Magugu, supports his mother and three children who he has to take care of since their mothers’ death. The household only cultivates one acre of maize and rent a small simple house for 3000 TSH/months.

“IFAD has created more poverty in the village of Mapea. We are forced to abandon rice cultivation because of less water” (Small-scale farmer in Mapea, 2007)

According to the Sub village chairman in Mapea (A) and other informants in the lower strata, the most important problem for households is lack of capital and they have as a consequence no access to land in the wetland. Instead they cultivate maize or other cash crops on dry land and work as day labourers.

Various housing standards in Mapea village were noted as before mentioned. Households in wealth group one and two were characterised by modern cement houses, with tin roofs, painted walls and generally in good condition. Households in wealth group three had simpler houses with brick walls with thatched or tin roofs. The poorest households lived in simple huts with mud walls and thatched roofs, or lived together with relatives.

5.5.3 Access to irrigation water in Mawemairo

As mentioned before, the heavy el Niño rains in 1998 destroyed the old indigenous irrigation system. The old irrigation system was badly planned and a lot of water was wasted through evaporation. IFAD, therefore, decided to build a new irrigation scheme in Mawemairo and Matufa villages in 2002 and managed the irrigation scheme until 2005. As diagram 3 indicates, the majority of households in Mawemairo have access to irrigated land. Some of the well-of farmers in wealth group one did not practice farming in the village. Instead the main activity was breeding livestock for commercial purposes.
The differences between the wealth groups here are not as pronounced as in Mapea village except that 48 percent of the households in wealth group four do not have access to irrigation water. It is a bit surprising; since, according to the IFAD irrigation register all of the households should have access to irrigation water. The fact that the IFAD scheme was implemented in 2002 and five years later 50 percent are without land in the irrigation system indicates that the lower strata have become marginalized. As in Mapea village farmers in Mawemairo have been affected during periods of water scarcity. The primary problem in the irrigation scheme is that of distributing an equal amount of water among the rice plots. Farmers that have rice plots at the end of the irrigation system argues that farmers that have rice fields close to the feeder channels take more water than contracted because rules are not followed. According to members of the irrigation committee, farmers with larger rice plots generally have more income has occasionally bribed watchmen to open irrigation gates when it is not allowed.

According to IFAD authorities and rice cultivators in Mawemairo the market prices of land in the IFAD scheme has increased extremely quickly. Since the construction of the scheme, the cost of an acre of land connected to irrigation water has risen from 125,000 TSH in 2002 to 1,000,000 TSH in 2007. The secretary of the water committee explained that well-off people in Babati have bought land in the irrigation scheme for future investment. The Regional Commissioner (four acres), the IFAD manager (one acre), the District Executive Director (one acre) and TAN Road Director (two acres) all have rice fields in the irrigation scheme.
5.5.4 Household property among villagers of Mawemairo

Prior to the establishment of the irrigation scheme farmers in Mawemairo relied on dry land cultivation, water from the indigenous irrigation system and by working as day labourers at large-scale farmers sugar cane factories under hush conditions. Land and agriculture inputs such as tractors were rented and were expensive.

Table 1 clearly shows that wealth group one and two have a lot of property e.g. cars, tractors, motorbikes, cell phones, milling machines etc, compared to the lower strata. They generally have larger cultivated land situated in a good position in the irrigation scheme and even carry through dry land cultivation. One of the more well-off farmers has his own bank account that contained five million TSH and also has due to his *uwezo* (wealth) a gun for protection. Generally the tractor and the milling machine are rented out to other farmers when not used by the owners.

<table>
<thead>
<tr>
<th>W.G</th>
<th>Cars</th>
<th>Tractors</th>
<th>Milling machine</th>
<th>Oxen plough</th>
<th>Motor bike</th>
<th>Cell phone</th>
<th>Cycles</th>
<th>Video &amp; TV</th>
<th>Live-stock</th>
<th>Day labour</th>
<th>Cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5-50</td>
<td>5-20 acres. Some also have land outside the village</td>
</tr>
<tr>
<td>3-4</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Few</td>
<td>No</td>
<td>Few</td>
<td>Yes</td>
<td>Few</td>
<td>Yes, but few</td>
<td>Work as day labourers as well as owns land</td>
<td>0-3 acres</td>
</tr>
</tbody>
</table>

*Table 2. Characteristic wealth indicators for the village of Mawemairo per wealth group*

The well-off farmers, wealth group one and two, also have more access to property outside the village. One farmer has access to irrigation land in the village of Gichameda where IFAD intake number two is located and owns a small shop in the neighbouring village of Matufa. Another farmer possesses 25 acres of rice fields in Ngorongoro region also in an irrigation system. All wealth groups own livestock but the more well-of farmers own bigger numbers.
Some farmers in wealth group one have livestock for commercial purposes and sells to the market in Arusha.

During interviews’ comments on various housing standards also among Mawemairo farmers was noted. Households in wealth group one and two owned modern well kept cement houses with tin roofs and painted walls. Households in wealth group three had simpler houses with brick walls with tatch or tin roofs. The poorest households owned simple mud huts with thatched roofs.

Many of the interviewed households in the lower strata had migrated from other parts of Tanzania to Mawemairo. The most important problem for poorer household is the high prices of renting and purchasing land in the IFAD irrigation scheme. It is possible for these farmers to obtain a quarter of an acre in the irrigation scheme if working as a bird watcher. Just before harvest birds have a tendency to damage the rice crop and has to be protected. Everyday life of the households has become better since the establishment of the irrigation scheme, because now family members can work as day labourers and generate income to the family.

5.5.5 Large-scale farmers in the Valley

As mentioned before, Indians born and raised in Tanzania now own a majority of the large-scale farms. The farms were taken over from government authorities (NAFCO) in the 1980s. The main crops are sugar cane, banana and exotic fruits that demand a lot of water. Several of the farms in Kiru and Magugu Ward are located in strategic positions along the big rivers so they can be easily irrigated. The majority of the large-scale farms have irrigation systems (some of them are up to 25 km long) that were built during the German colonial rule.

<table>
<thead>
<tr>
<th>W.G Large Scale farmers</th>
<th>Cars</th>
<th>Tractors</th>
<th>Milling machine</th>
<th>Oxen plough</th>
<th>Motor bike</th>
<th>Cell phone</th>
<th>Cycles</th>
<th>Video &amp; TV</th>
<th>Livestock</th>
<th>Day labourers</th>
<th>Cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes, several</td>
<td>Yes, several</td>
<td>Yes</td>
<td>No information</td>
<td>No information</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Employees just about 150 workers</td>
<td>Average of 3000 acres</td>
</tr>
</tbody>
</table>

Table 3. Wealth indicators for large-scale farmers

Table 2 above clearly indicates that the large scale-farmers in Kiru Valley have more cars, tractors and property compared to small-scale farmers in Mawemairo and Mapea. The owner of one large-scale farm, located close to Mapea village, recently purchased a neighbouring estate, and the households agriculture is supported by 24 tractors worth 100,000 US dollar apiece. The same large-scale farmers children are university educated in the United Kingdom.
where the family also owns a house. In addition to the agricultural activities the household operate a transport company based in Arusha, where another family house is located. The transport company covers an area including the whole of Tanzania and neighbouring countries Kenya and Uganda, with 20 semi-trailed Scania lorries. All of the interviewed large-scale farmers have drilled their own groundwater wells due to periods of water scarcity. One groundwater well has the capacity to deliver water for 30-40 acres for agricultural activities. Each well costs approximately 130 dollar a meter depending on geological features.

Two of the large-scale farms located in Magugu Ward, close to Mapea village, have 500 acres of rice fields in Mapea wetland, of which the estate uses 100 acres and the rest is leased to small-scale farmers in the area. Large-scale farmers have been assigned contract cultivation by the government of Tanzania, (see following chapter). Another large-scale owner, located in Kiru Ward, has started to abandon sugar cane production for broiler breeding and has already started construction work for future breeding. The same large-scale farmer is politically active in the ruling party and owns several tractors as well as expensive cars.

5.6 Differences in cultivation among Kiru Valley farmers

A majority of the interviewed farmers in Mawemairo and Mapea has drawn attention to exhausted soils. Their perception is that the yields of rice are have been decreasing from 30-40 bags of rice per acre 10-15 years ago compared with today’s 20 bags/acre for the same rice plot. Farmers in Mapea, who have land connected to the IFAD irrigation system in both Mawemairo and Gichameda, says that there are differences in yields, transplanting methods and access to irrigation water. IFAD and the Japan International Cooperation Agency (JICA) have since its construction, supported farmers that have land connected to the IFAD irrigation scheme. During transplanting each rice seed is planted with a fixed gap of 10, 20, 30 centimetres between seeds. In Mapea the rice crops are planted randomly and the available land area is, therefore, not used at the maximum. With the help of a particular tractor or ox plough the bottom of the rice fields are levelled off for a steady level of water, which is one of the most important aspects in rice cultivation, besides the steady flow of water that the IFAD scheme delivers throughout the rice fields. In Mapea wetland it is difficult to have a steady flow of water into the rice fields since the irrigation water is diverted into the wetland with stones, sandbags and trees.

The small-scale farmers that have rice plots in both Mapea wetland and in the IFAD irrigation system stated that the factors presented above have contributed to five bags extra rice per acre compared to production in Mapea wetland. Farmers linked to the IFAD irrigation system also use more fertilizer. Many of those interviewed stated that around 50-60 percent of the
farmers, mainly the well-off ones, used fertilizers. Two types of fertilizers are used: manure from livestock, which is utilised by 20-30 percent of the farmers and chemical fertilizers, which are used by 30-40 percent of the farmers. The latter is used to a larger extent and must be added on a regular basis. Manure from livestock is kept in the soil for a longer period, therefore, not added annually. In Mapea wetland fertilizers are not used to the same extent, since the soil is believed to have a higher water holding capacity, due to wetland features and also due to the extra expenses linked to fertilizers.

The large-scale farmers cultivation is more commercial to a higher extent compared to the small-scale farmers in the area. Except of the majority of the sugar cane production that is used to produce gongo, a type of illegal unrefined liquor, which is often related to alcoholic diseases and misuses (KIVREP, 2007). The government of Tanzania has assigned the interviewed large-scale farmers a contract for the cultivation of maize and sorghum. This means that environmental inspections by government authorities are carried out at the farms, to control the agricultural methods (e.g. measurement of soil quality) used since vegetables are exported to countries such as Kenya. Benefits of contract cultivation are the difference in generated income. According to the large-scale farmers, contract cultivation generates three times more income than traditional maize cultivation. The Tanzanian government pays 60,000 TSH (2007) for an acre of contracted maize compared to 15,000 TSH for one acre traditionally cultivated maize.

Kiru Valley farmers receive the same price for rice when traders come to Magugu. The small-scale farmers tend to sell their rice immediately after harvest. Due to the large-scale farms strong economical situation they do not need to sell at fixed prices. They can store the rice yield and then sell when the demand for rice is higher, usually some month’s after the main harvest. Moreover, the large-scale farmers have other ways of gaining access to the rice market. Since they have their own lorries, transports to Arusha are easily done and, therefore, they have the chance to sell at better prices.
6 Analysis

This paper will argue that Homer-Dixon's three scarcities exist in Kiru Valley and further analysis of these scarcities put Kiru Valley complexity into a perspective. Moreover, general findings from the "chain of explanation" are incorporated to examine Kiru Valley farmers human-environment relations.

6.1 Kiru Valley complicity

By returning back to the model (see figure 1) that demonstrates effects and source of environmental scarcity helps us to analyse the differences among Kiru Valley farmers.

Starting with demand-induced scarcity. It is possible to argue three main reasons for population growth in the Valley stimulated both from local, national and international oriented factors. Internationally, the high market price of rice in Sub-Saharan Africa is caused by the increased demand due to population growth in urban regions during the last 10-20 years (Meertens et al., 1999). Between 1995-2001 the rice consumption in sub-Saharan Africa increased by 5.3 % but the production increased by only 2% (Futoshi, 2007). Nationally, the Poverty Reduction Strategy Paper (PRSP) of Tanzania aims dramatically to reduce poverty by 2010 through economic development. Mwakalila and Noe (2004), researchers from Research on Poverty Alleviation (REPOA), argue that the constructions of irrigation systems is important in order to achieve the goals of the PRSP due to the high rate of return compared to rain-fed agriculture and therefore stimulate migration to those areas, as in Kiru Valley. Locally, the examined areas have been experiencing a high immigration during the last 8-10 years. People that had been moving away from the Valley, to Arusha, Babati and other parts of Tanzania are now returning search for better economic opportunities due to the high market price of rice in combination with relatively secure water access delivered by IFAD irrigation scheme that was constructed in 2002. Consequently prices of purchasing and renting land in the wetland as well as in the IFAD-irrigation system have increased dramatically. Above factors have also contributed to changes in development patterns and in improved welfare, resulting in an increased water abstraction from the Dodumera River. This development has in general affected the lower strata among Kiru Valley farmers negatively in the context of wealth and power. Particularly affected farmers are those cultivating Mapea wetland, demonstrating dramatically less capital goods (see figure 1 and 3) e.g. cars, tractors, motorbikes, video and TVs compared to households in Mawemairo. Different households in respective villages also confirmed differences in household living standard that corresponded to farmers access to irrigation water, not to mention the large-scale farmers that are seen as elite in Kiru Valley.
Supply-induced scarcity. The causes of declining amount of water in the Valley are complicated. Since 1984 Kiru Valley farmers have reviled periods of water scarcity and it is feasible to argue 4 different types of causes for water shortage in the valley; (1) the construction of the IFAD irrigation system. For example, Lankford (2004) found when examining 4 indigenous irrigation intakes in Tanzania that had been rebuilt, as in Mawemairo that social conflicts tend to emerge due to drying up of rivers and unfair distribution patterns. The most important problem is that improved irrigation intakes captures more water then naturally shared therefore contributing to a more pronounced competition among different actors especially during dry periods (Lankford, 2002). Moreover, Lankford (2004) argues that donor agencies do not consider entire river systems when building irrigation system and instead the focus lies on the single irrigation system rather than a wider environmental context. However, (2) deforestation on the escarpments as well as the escarpments walls, and (3) forest clearance in the Nou Forest. It is a widely recognized fact that deforestation causes decreased levels of water in rivers and lakes and this could be one of many factors for water decline in the Kiru Valley area (Sandström, 1995). Finally (4) lack of functioning monitoring equipment over the amount of water extracted by the large-scale farmers in the Valley.

Structural-scarcity. Differences in accesses to irrigation water are found among Kiru Valley farmers. The building of the upstream IFAD irrigation system has contributed to unfair access to irrigation between the villages of Mawemairo and Mapea, resulting in affected power relations. Farmers in Mawemairo have legally been assigned water rights and they have a legal right to water used in irrigation farming as the large-scale farmers in the Valley. Explicitly this means, that Mapea farmers do not have the possibility to claim the authorized right over irrigation water because they are not allocated water rights. Consequently, the implementation of the IFAD irrigation system is a contributory cause of water capture by small-scale farmers in Mawemairo from farmers cultivating Mapea wetland. And according to obtained filed-data households in Mawemairo village generally have more access to irrigation water than to Mapea village. The most pronounced differences are found among poor peasants (see diagram 1 and 2).

At the same time the construction of the IFAD irrigation system has enforced the establishment of water management institutions in the Valley and even more importantly the assignment of water rights, as mentioned before, to Mawemairo farmers. This has, on the one hand, lead to less pronounced differences in the context of, wealth, status and power among large-scale farmers in Kiru Valley and small-scale farmers in Mawemairo receiving water from the IFAD irrigation scheme. The large-scale farmers are at present forced to negotiate in the river committee about water related issues and this could be one of several causes for their disapproval against the IFAD irrigation scheme. However, on the other hand farmers cultivating
Mapea wetland are more often found to be further ecologically and economically marginalized since they are forced to rely on leftover water from the surrounding large-scale farmers and upstream constructed IFAD irrigation system. As a paradox, this is taking place in an area that is famous for its existence of fertilized soils and high-quality natural preconditions for rice productions (KIVREP, 2007).

Before the construction of the IFAD irrigation system, the large-scale farmers were the only actor who had the only commercial interest for the irrigation water in the Valley. Kiru Valley had until 1970s had no schools and no government administration and was rather isolated from local peasants. Many of the large-scale farmers are economically powerful and have a strong political influence in the region (Said, 2006). However, their water rights where determined during the former (German) colonial government and is still under utility. At that time the environment was likely in a better condition, with less deforestation and cultivation on Kiru escarpments, less people in the Valley and probably more available water.

**Constrained economic productivity.** Applying the “chain of explanation” to the Kiru Valley complexity addresses important aspects of land and water use in the area. In Kiru Valley periods of water scarcity have been seen since 1984-1985 at a five-year time intervals in combination with high immigration into the Valley. At the same time the rice yield been decreasing and farmers have been experiencing exhausted soils as result. This has resulted in constrained economic productivity in general among Kiru Valley farmers and has particularly affected small-scale farmers cultivating Mapea wetland. Consequently farmers in Mapea have been forced to abandon rice cultivation due to periods of water scarcity. The differences are tremendous in the context of generated income. According to small-scale rice cultivators, one acre of maize is sold for 15000 TSH at harvest while one acres of rice generate 600000 TSH. These are the first “economic symptoms at a specific place”, as defined by Blaikie and Brookfield (1987). Evidently differ in socio-economic stratification is found showing less well-off farmers and a higher degree of poor farmers in Mapea compared to the village of Mawemairo, with the most pronounced differences in wealth groups 1-3. This could be explained by more utilized rice cultivation in Mawemairo contributing in higher rice yields due to a steady access to irrigation water and technical education as well as agricultural support on methods for rice cultivation from external authorities such as IFAD and JICA. Additionally, IFAD rules and regulations were designed to limit each farmer to five acres of land in the irrigations system to promote fair distribution patterns.

Due to all occupied farming land in the Mapea wetland and in the IFAD irrigation system new settlers and poor farmers are because lack of capital forced to rely on dry land cultivation (e.g. maize). As a consequence farmers cultivate areas that are not appropriate for farming such as close to riverbanks. It is possible to argue that those farmers and especially farmers
cultivating Mapea wetland are *ecologically and economically marginalised* as a unit. As mentioned before farmers in Mapea have predominantly been affected in the context of access to irrigation water due to their dependency on leftover irrigation water from upstream IFAD-farmers and surrounding large-scale farmers for rice production. If Mapea peasants do not receive irrigation water on a regular basis they are more likely to have difficulties obtaining a good rice harvest. As an outcome falling yields are continuing to stress household welfare and contributing to further push into *marginalisation*. Mwalalila and Now (2004) founded similar results when examining irrigation systems role in poverty reduction in Mbarali District, Tanzania. The most affected households were those that were not receiving irrigation water on a regular basis as in Mapea wetland.

Some of the large-scale farmers who are located in the lower parts of Magugu ward (close to Mapea village) have also been affected of the water scarcity, especially during the drought of 2006 with constrained economic productivity as a result. Since the large-scale farmers are economically strong they have the opportunity to overcome water shortage due to digging ground water wells. They are therefore not affected to the same extent as the small-scale farmers during periods of water scarcity.

**Insurgencies.** The environmental scarcities mentioned above have contributed to an understanding of the causes for conflicts over irrigation water between Kiru Valley farmers. Homer-Dixon and the Toronto group argue due to environmental scarcity, poor households are becoming further marginalised because of unfair distribution patterns and as an outcome more well-off power groups gain more. Consequently poorer groups are finding ways to demonstrate their frustration (Homer-Dixon, 1991). This has occurred in Kiru Valley, as the Mapea farmers experienced powerlessness against IFAD rice cultivators and surrounding large-scale farmers. In 2005 Mapea farmers went to the District Commissioner and complained about the unsustainable water situation that emerged after the construction of IFAD irrigation scheme. Moreover wetland peasants have damaged one large-scale farmer irrigation intake and not to mention the daily disappointment growing among Mapea villagers. Similar situation have developed in the Mkoji catchments, Tanzania, between rice irrigators in the middle and the lower zones of the catchments area. The conflicts erupt during transplanting season and farmers have occasionally destroyed irrigation furrows, under violent circumstances, to divert irrigation water into their own farms (FAO, 2006). Farmers connected to the IFAD irrigation system have also been shown their disapproval, especially during the 2006 water scarcity, when large-scale farmers in Kiru Ward were accused of diverting non-contracted irrigation water into their farms before it reached the IFAD-irrigation system, (Said, 2006).
7 Conclusions

The three analyzed Homer-Dixon environmental scarcities exits in Kiru Valley and answers the research question asked in this study: *How has the construction of IFAD irrigation scheme affected Kiru Valley farmers access to irrigation water?* The large-scale farmers were, until the construction of the IFAD irrigation scheme in Mawemairo, the only actors that had merely access to irrigation water in the Valley. But are now due to establishment of water management institutions forced to negotiate for their water withdrawals in the river committee. The building of the upstream IFAD irrigation system has also contributed to unfair distribution patterns affecting some farmers more than others. In Mawemairo village 48 % of the households in wealth group four, 10 % in wealth group two and 18 % in wealth group three do not have access to irrigation water. While in Mapea village a majority, (74 %) of the households in wealth group four and one third of the farmers in wealth group two and three do not have access to irrigation water. IFAD irrigators have also been assigned water rights as the large-scale farmers, meaning that they have the legal right to divert irrigation water.

These differences in accesses to irrigation water have lead to pronounced socio-economic differences among Kiru Valley farmers, and thereby answers the second research question of this study: *How has the construction of IFAD irrigation scheme affected Kiru Valley farmers household economy?* Consequently Mapea wetland farmers have become strongly dependent of IFAD leftover water and water from surrounding large-scale farmers, pushing Mapea households into economical and ecological marginalization. Evidently, Mawemairo farmers can obtain irrigation water on steady basis due to the building of IFAD irrigation system. This in combination with their differences in transplanting methods have contributed to more utilized rice cultivation resulting in higher rice yields and generated income. As a result households connected to IFAD irrigation scheme have significantly more capital goods such as cars, tractors, motorbikes video and TVs compared to households cultivating Mapea wetland. The examined large-scale farmers could be seen as economically elite. They have not been affected as other Kiru Valley farmers due to drilling of own groundwater wells, larger cultivation areas, diverse entrepreneurship and historical background.

This study has drawn attention to the missing socio-economic factors in the environmental conflict nexus. It should be useful to further in-depth socio-economic research in the examined area to find the roots of the increasing competition over irrigation water in Kiru Valley.
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Appendix

Appendix I. Map over Mawemairo village. The wetland of Mapea is located east from Mагugu.

Map 2. Babati District - Administrative Divisions

LEGEND

- Regional boundaries
- District boundaries
- Divisional boundaries
- National Park boundary
- Irrigation Scheme project
- Water body
- National Forest Reserves
- Major roads

Source: ENC, 2001