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The Last Will Be First: Water Transfers from Agriculture to Cities in the Pangani River Basin, Tanzania

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ABSTRACT: Water transfers to growing cities in sub-Sahara Africa, as elsewhere, seem inevitable. But absolute water entitlements in basins with variable supply may seriously affect many water users in times of water scarcity. This paper is based on research conducted in the Pangani river basin, Tanzania. Using a framework drawing from a theory of water right administration and transfer, the paper describes and analyses the appropriation of water from smallholder irrigators by cities. Here, farmers have over time created flexible allocation rules that are negotiated on a seasonal basis. More recently the basin water authority has been issuing formal water use rights that are based on average water availability. But actual flows are more often than not less than average. The issuing of state-based water use rights has been motivated on grounds of achieving economic efficiency and social equity. The emerging water conflicts between farmers and cities described in this paper have been driven by the fact that domestic use by city residents has, by law, priority over other types of use. The two cities described in this paper take the lion's share of the available water during the low-flow season, and at times over and above the permitted amounts, creating extreme water stress among the farmers. Rural communities try to defend their prior use claims through involving local leaders, prominent politicians and district and regional commissioners. Power inequality between the different actors (city authorities, basin water office, and smallholder farmers) played a critical role in the reallocation and hence the dynamics of water conflict. The paper proposes proportional allocation, whereby permitted abstractions are reduced in proportion to the expected shortfall in river flow, as an alternative by which limited water resources can be fairly allocated. The exact amounts (quantity or duration of use) by which individual user allocations are reduced would be negotiated by the users at the river level.

KEYWORDS: Inter-sectoral allocation, irrigation, priority allocation, urban water demand, water conflict, water right, water scarcity

INTRODUCTION

Urban centres are steadily growing and need more and more water. Transferring water from agriculture to cities is an obvious way of reallocating the uses and users of the available water in a catchment (Celio

et al., 2010). The main rationale is that in situations of water scarcity allocation should favour uses with the highest returns per unit of water (including basic human needs). In this discourse, agriculture is considered as a voracious user of water that mainly produces low-value output (Savenije and van der Zaag, 2002; Molle and Berkoff, 2006). In cases where the level of water development has reached its maximum and/or inter-sectoral reallocations do not suffice, interbasin transfers seem to be the preferred (supply-oriented) strategy (see Swyngedouw, 1997 on urbanisation of water; for an assessment of interbasin water transfers see Gupta and van der Zaag, 2008). Little attention is being paid to the fact that irrigation water may serve many other high-values uses (e.g. domestic, vegetable gardens, livestock, fishing, and construction).

In Tanzania, the ongoing state-led formalisation of water allocation may be considered a continuation of a process started by the British colonial power. As early as 1923, the British colonial administrators introduced a statutory water right system in mainland Tanzania (then Tanganyika), whereby the ownership of all water resources was vested in the King of England. Water rights were issued to users located in areas declared crown land, while areas under 'natives' were allowed to be governed by local customs and traditions.

Although the independent government of Tanzania was at first preoccupied with modernisation through irrigation development and the reorganisation of villages, it subsequently amended the colonial water law and policies, introducing water rights fees and volumetric charges for water used. The most recent attempt by the government to regulate water use is driven by increased scarcity, which among others is manifested by frequent electricity power cuts (Lankford et al., 2009). Nearly all Tanzania hydroelectric power plants are located downstream of other users and are, hence, very sensitive to water scarcity. Water shortages are attributed to uncoordinated planning of use, imperfect policies, inefficient use in the agricultural areas, and inadequate monitoring (World Bank, 1996). To solve this problem the water policies and laws were revised in 2002 and 2009, respectively. The National Water Policy of 2002 gives first priority to water for basic human needs (often interpreted as water for drinking only, not considering other domestic needs), second priority is given to water required to protect ecosystems, while all other uses are subject to social and economic criteria to be reviewed from time to time (URT, 2002). The policy recognises that "water is a public good of high value in all its competing uses, and requires careful conservation and sustainable utilization" (URT, 2002). It cites extensive irrigation during dry seasons and inefficiencies of many irrigation schemes as major causes for reduction in water availability (URT, 2002). This position is in line with generally held views that: (a) agriculture gets the lion’s share of all water diverted and yet generates low returns per unit water used; (b) agriculture incurs the largest wastage; (c) water productivity in the non-agriculture sector is much higher than in agriculture; and (d) cities are frequently water-short (Molle and Berkoff, 2009; Rosegrant et al., 2009). Thus it is believed that considerable gains can be achieved by improving irrigation efficiencies and, if that is not sufficient, through reallocating water to higher-value uses (Molle and Berkoff, 2009). In the Pangani basin irrigated agriculture is mainly practised by smallholder farmers. It is believed that these farmers utilise most of the available water but with very low efficiencies leading to water stress (Maganga et al., 2002; Kashaigili et al., 2003).

Implementation of the 2002 water policy, however, appears to generate conflicts in water allocation at the local level. Thirsty cities within a river basin refer to the water act, which gives priority to domestic needs, to claim water already in use by rural communities for small-scale irrigated agriculture. This leads to tensions and sometimes violent confrontations. This paper describes and analyses processes of water appropriation from smallholder irrigators by cities in the Pangani river basin and the ensuing conflicts. Using a framework of agriculture-to-city water transfers, it identifies shortcomings in the current water allocation system and proposes an alternative allocation mechanism that takes into account the variability in supply and also proposes alternative institutional arrangements for its enforcement.

The following section reviews the concept of water allocation focusing on water right administration and transfer and highlights the typology of transfer and mechanisms often used. Section 3 introduces the study area (Pangani river basin and study sites) and the research methods used. Section 4 presents two cases of city versus smallholder farmers' water allocation conflict. The next section (5) discusses the findings and by way of conclusion (section 6) the paper explores mechanisms by which limited water resources can be fairly allocated between cities and rural areas.

CONCEPTUAL REVIEW: WATER TRANSFER BETWEEN AGRICULTURAL AND URBAN USE

When water is scarce it has to be shared among competing interests and this requires putting in place criteria and procedures that clearly define who is entitled to what amount of water, at what time, for how long and in which place. In addition, proper institutional arrangements with means to monitor the enforcement of the water-related rules are required. Although the arrangement can also be developed by users, religious communities, non-governmental organisations and customary leaders, normally governments assume the role of the main regulator of water use in a catchment. State-led water management reforms have included the formalisation of water right[1] administration and the creation of basin management institutions. Water ownership is vested in the state and users are required to acquire permits to use water from a given source. These approaches are used to justify government's intervention in water allocation in terms of economic efficiency, social equity and sustainability of the water resource (Syme et al., 1999; Wang et al., 2003). These three principles, coupled with the notion of users' participation in the decision-making process, are integral components of the discourse on Integrated Water Resources Management (IWRM).

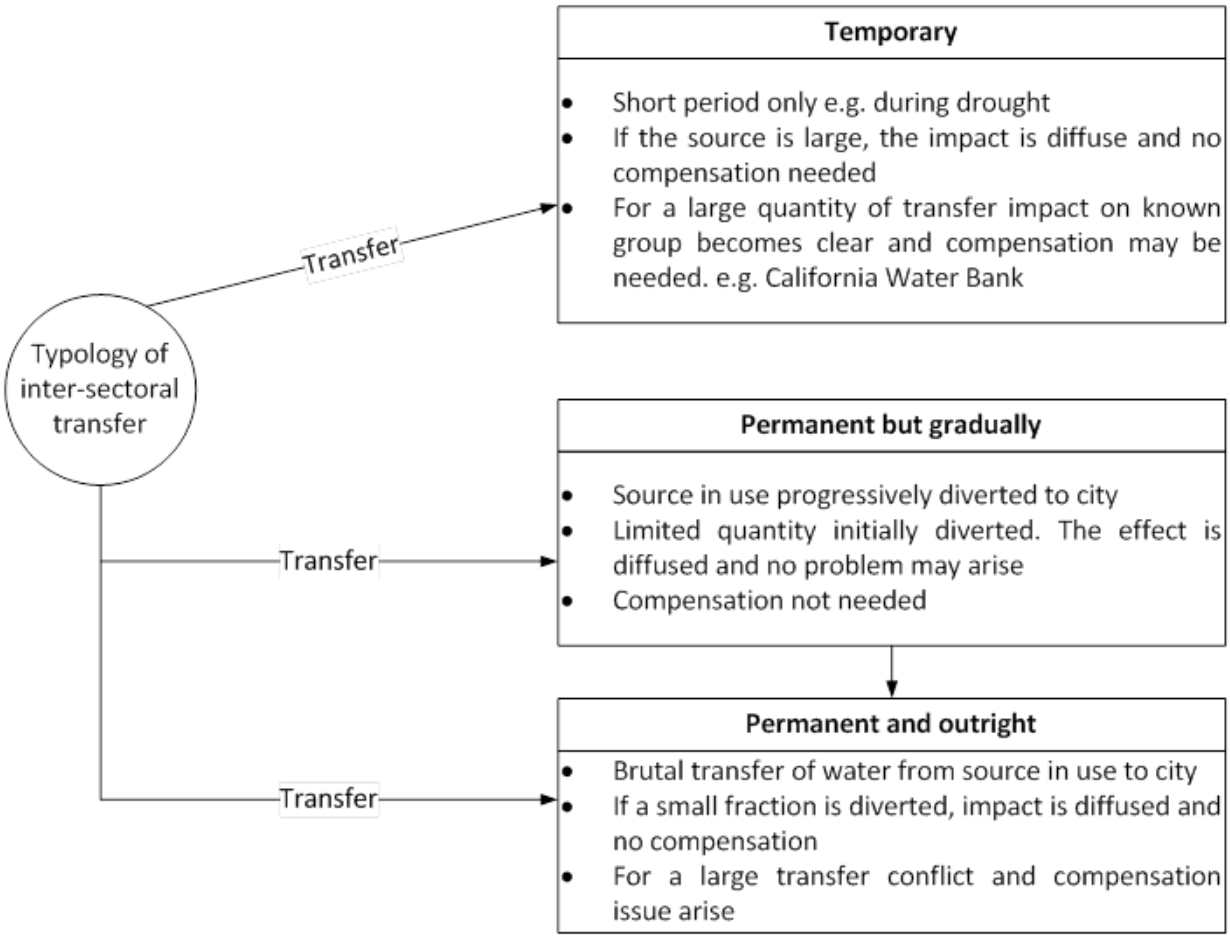
In places where water is over-allocated, reallocation and transfers between uses or sectors are the typical responses (other responses may include reuse of treated wastewater, improvement of irrigation efficiency, etc). The process of water transfers from agriculture to cities takes several forms and may include: temporary transfer; permanent but gradual transfer; and permanent and outright transfer (figure 1). Temporary transfers typically occur during periods of drought; the agriculture sector will be severely affected albeit for a limited period of time. The most quoted example of temporary water transfer is the California Drought Water Bank which arranges temporary water purchases from individual farmers for transfer to other users (Molle and Berkoff, 2006; Meinzen-Dick and Ringler, 2008). Permanent but gradual transfer is a case where a water source is progressively diverted to the city. Initially a limited quantity may be diverted, which diffuses its effect in the short term. Permanent and outright transfer, on the other hand, is a sudden and long-term reallocation; large transfers are often contested by the existing users.

To understand the impacts of transfer it is interesting to follow the mechanism (formal or informal) by which the three types of water transfer are implemented. Four mechanisms of transfers can be identified (Meinzen-Dick and Ringler, 2008; Molle and Berkoff, 2009). First, *market-based mechanisms* allow water to be sold either directly to buyers for non-agricultural uses or indirectly through transfers of land with a water right appurtenant to it. Second, *water right transfer through administrative decisions* follows a formal procedure which is spearheaded by a national government or basin management institution according to the functions assigned by law. Celio et al. (2010) highlight how water transfers from the Krishna and Manjira rivers to the city of Hyderabad in India were sanctioned through several government orders. Prior use rights are rarely recognised although indirect compensation may be given (Meinzen-Dick and Ringler, 2008). Farmers may protest against administrative transfers but are mostly unsuccessful against cities that appear to be more powerful. Third, *transfer through collective negotiations* with communities can be concluded between existing

[1] In this paper, a water use right and a water permit have the same meaning – both confer a time-bound right to beneficial use of the available water but not its ownership.

users and the state or between the users themselves. Collective negotiations aim at win-win solutions and may take into account other uses (Molle, 2004). Fourth, *transfer by stealth* is done unilaterally by the state, basin authority or other entity, without complying with formal procedures and/or legal requirements, and without consulting those potentially affected.

Figure 1. Typology of water transfer.



Source: Adapted from Molle and Berkoff, 2006; Meinzen-Dick and Ringler, 2008.

Although widely promoted, available literature on water transfers indicates that they often have negative impacts on irrigators, other uses linked to irrigation water, and the environment (Hearne, 2007; Molle and Berkoff, 2009; Celio et al., 2010; Movik, 2012; Perramond, 2012). Meinzen-Dick and Ringler (2008) present a case where water-exporting regions in California lost more in crop production than they were paid for the water. Market-based transfers, e.g. water sales by tankers' association from rural to middle-class residents, have been reported (Meinzen-Dick and Ringler, 2008), but water markets at larger spatial scales have been less frequent and often unsuccessful, partly because of the infrastructure needed to transfer water from one user to another (Molle and Berkoff, 2009). So far, positive experiences of market-based transfers are confined to countries with strong legal, institutional and regulatory backgrounds and relatively wealthy stakeholders (Hearne, 2007; Molle and Berkoff, 2009). Thus in countries characterised by data scarcity, where the requisite physical infrastructure for water control (e.g. storage reservoirs, canals) is lacking, and with weak monitoring and enforcement capacity, water transfers by market-based mechanisms are likely to be problematic.

Finally, in most African countries state law is not the only source of water rights but there are also customary rules backed by local authority and social norms that govern water access. Religious laws and development projects also define the condition for access to water. Hence, users may use different rules and rights to claim water access (Meinzen-Dick and Pradhan, 2002). The plurality of water laws may be a source of conflict when dealing with water reallocation.

STUDY AREA AND RESEARCH METHODS

Study area: Pangani river basin and location of research catchment

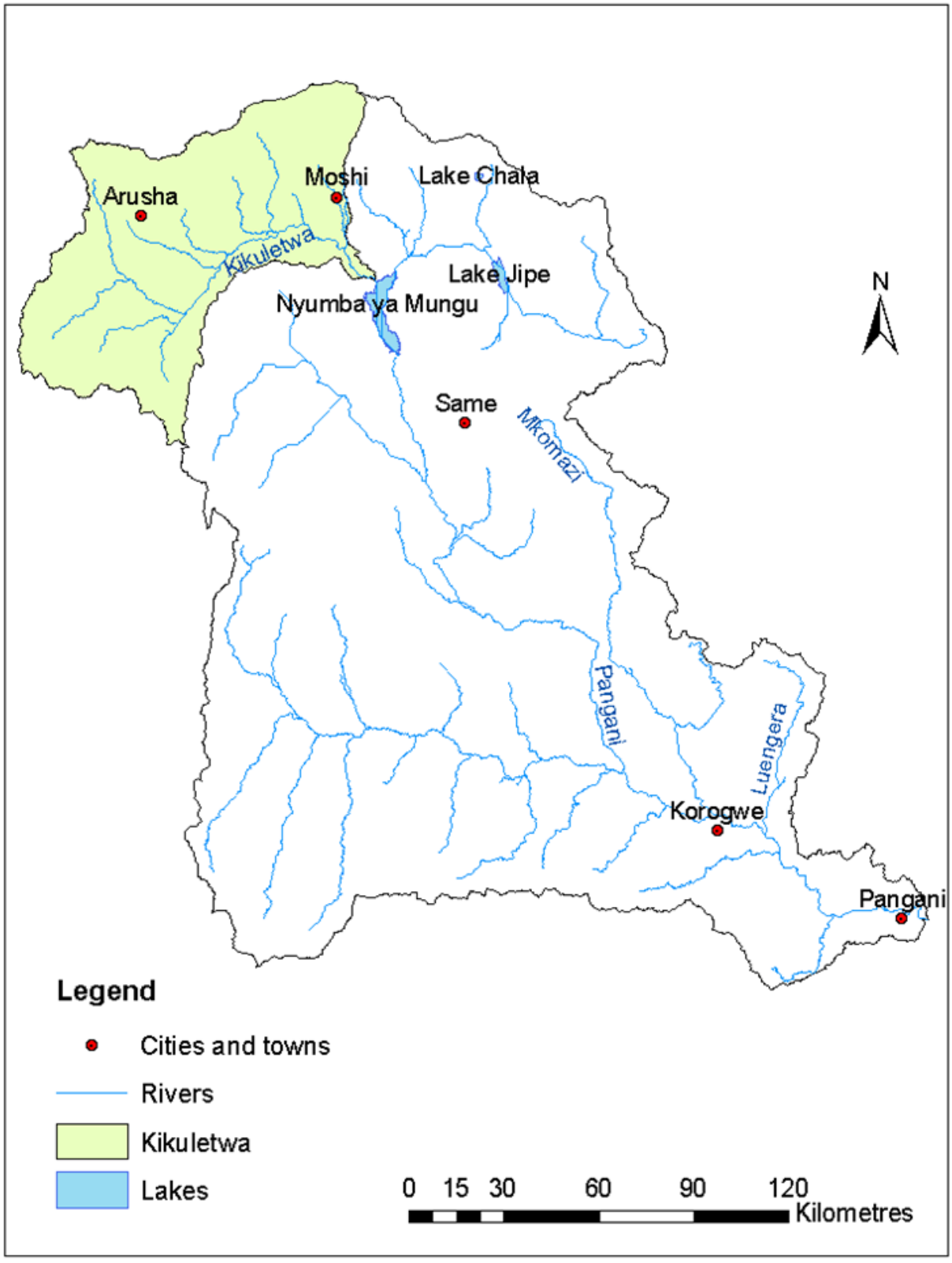
The Pangani river basin is one of the nine basins in mainland Tanzania. It covers a land area of approximately 43,650 km^2, 5% of which is in Kenya. The headwaters of the basin are located on the slopes of Mount Kilimanjaro and Mount Meru, with Kikuletwa and Ruvu rivers being the major tributaries of the Pangani river. This paper focuses on the Kikuletwa tributary (figure 2). The Pangani river passes through arid Maasai steppe, draining the Pare and Usambara mountain ranges (Mkomazi and Luengera tributaries, respectively) before reaching the estuary and the Indian Ocean. The basin covers all or part of four administrative regions of Arusha, Kilimanjaro, Manyara and Tanga. In total 14 districts and two major municipalities (Arusha and Moshi) rely on the water resources of the basin.

The current population in the basin is estimated at 3.7 million (IUCN Eastern and Southern Africa Programme, 2009). The basin's population on the Tanzania side is influenced by in-migration of people in search of land and business opportunities (Mbonile, 2005). About 80% of the population depends directly or indirectly on agriculture for their livelihoods. Local farmers in the highland areas (e.g. Kilimanjaro and Meru highlands) have practised canal irrigation for more than 200 years, and currently there are over 3400 known water users but the actual number is likely to be much higher (Komakech et al., 2011). Intensive canal irrigation in the highlands compensate for the small farmland sizes (about 0.6 ha per household), while in the lowlands where agricultural land is abundant (about 10.4 ha per household) irrigation buffers against climate vagaries (IUCN Eastern and Southern Africa Programme, 2009).

The two cities of Arusha and Moshi are located in the upper part of the basin (figure 2). The development in these urban areas is partly driven by their location in regions with productive agriculture, mining activities and a booming tourism industry. In 1977, both cities had about 50,000 residents each. In 2010 number of residents of Moshi and Arusha had increased to 156,000 and 367,000, respectively. This growth puts significant pressure on the basin's limited water resources in terms of water for domestic, commercial and industrial uses and crop production.

The fast expansion of irrigated areas and increased cropping intensities, rapid urbanisation and an increased demand for water from cities, combined with climate variability have resulted in many tributaries of the Pangani river now only flowing in parts of the year, i.e. during the rainy seasons (Mul et al., 2009). The basin is therefore experiencing stiff competition and conflict over its water resources. Conflicts between city water authorities and smallholder irrigated agriculture; between farmers and hydropower facilities located downstream; and between large commercial farmers and small-scale irrigators are all increasing in both scale and frequency (Komakech et al., 2011).

Figure 2. Pangani river basin, reservoir, lakes, cities, towns and Kikuletwa case study catchment.



Research material and methods

To understand the implication of urban water appropriation on smallholder farmers we studied the historical processes through which water transfers had taken place. Field studies were conducted (January to March 2009 and February to June 2010) on two cases of long-standing water conflicts between smallholder farmers and cities competing for water in the basin. The case studies are Shiri Njoro spring and the Nduruma river both located in the Kikuletwa catchment. The study involved interviews, and discussions with furrow (locally constructed irrigation canals) and river committees,[2] village leaders, farmers, city water authorities (technical manager), and staff of the Pangani Basin Water Office (PBWO). In Shiri Njoro spring we conducted group interviews with the chairmen and secretaries of three irrigation canals (total six members), and leaders of Shiri Njoro village irrigation canals association (total three members). We interviewed a representative of Moshi Urban Water Authority (the technical manager). The interviews focused on understanding the development of water use, the evolution of conflicts in the area and the strategies followed by the different users. Further downstream of Shiri Njoro spring, we interviewed five out of the seven irrigation committees (in total ten members, two from each furrow) and leaders of the overarching Kiladeda river committee (chairman and secretary). Shiri Njoro spring is one of the sources of the Kiladeda river.

In Nduruma, we conducted group interviews with village furrow committees of Bangata, Nduruma, Moivaro, and Midawe villages (total 28 members). We interviewed the representatives of commercial estates located in the mid-section of Nduruma sub-catchment: Old River Farm; former owner of Gomba Estate; manager of Dekker Bruins; the director and the irrigation manager of Arusha Blooms; and the environmental and fertigation[3] officers of Kiliflora. We conducted a group interview with the leaders of Nduruma river committees (chairman and secretary) who were asked about their role in water allocation and management and how they relate with the Pangani Basin Water Board (PBWB).

To get a broader understanding of the administration of water rights we interviewed Meru and Hai district irrigation officers, the officer at the PBWO, the Nduruma ward executive officer and the Sokon II ward office chairman.

The study also benefited from unpublished sources. For the Shiri spring we reviewed letters, minutes of past meetings and reports compiled by the farmers, while for the Nduruma conflict secondary materials reviewed were mainly from Pamoja Trust (a local NGO based in Moshi) and PBWO archives. We also consulted relevant government documents, policies, water acts, and media reports on the water conflicts.

PANGANI WATER CONFLICT: CITY VERSUS SMALLHOLDER AGRICULTURE

In this section we present the water conflicts between the city of Arusha and Moshi and their rural neighbourhoods (Shiri Njoro and Nduruma). Currently water and sewerage services within the municipality of Arusha and Moshi are provided by fully autonomous public entities (Arusha Urban Water Supply Authority and Moshi Urban Water Supply Authority). Arusha city abstracts about 39,500 m^3/day, and Moshi about 24,000 m^3/day (EWURA, 2010). However 26 and 32% of the abstracted water for Arusha and Moshi, respectively, is non-revenue water. To meet the demand of their growing population these cities increasingly appropriate water from sources already used by smallholder farmers.

[2] River committees are water management structures created by the users to allocate and solve water conflict between users of a common river source (Komakech and Van der Zaag, 2011).

[3] Fertigation is the application of chemical fertiliser and other products through an irrigation system.

Before presenting the two case studies, we first provide a historical overview of the water rights administration in the Pangani river basin and in Tanzania as a whole (for more details, see Komakech et al., 2011, 2012a).

Historical context of water right development

The government's initial attempt to regulate water use by issuing water rights in the Pangani basin started during the colonial times. The colonial administration's intervention in water allocation in Tanzania as a whole was not about ensuring equity and sustainability of the water resources. Rather it was to support the interests of the commercial farmers and hydropower plants downstream. The Pangani and Rufiji basins were particularly designated for hydropower production and a special ordinance was prepared to protect such interest. In 1923, the British put in place the first Water (Utilization and Control) Act. Water users were required to acquire water rights, which were mainly issued to white commercial farmers who had settled along the mid-reaches of Tanzania highlands. In the Pangani basin the commercial farmers settled on the slopes of Mount Meru and Mount Kilimanjaro forming what Spear (1997) called the 'iron ring' of land alienation. The Africans ('natives') were however allowed to develop a separate water allocation system building on local customs and traditions. The British created crown lands to be governed by statutory law and native reserves (land occupied by the Africans) to be governed by local law (Komakech et al., 2012a). This marked the beginning of a plural system of water governance in Tanzania's river basins. Local users have developed separate water-sharing arrangements at the level of an irrigation canal (between irrigated plots), between nearby irrigation canals along a river within one village, and between distant villages sharing a river (Komakech et al., 2011).

The 1923 water act was subsequently amended by the colonial government in 1948 and 1959. The British declared absolute authority over water resources in the territory and introduced (nominal) water right application fees. In 1959, options of registration were extended to all water users including the Africans. National water officers were authorised to allocate and charge water right fees. These functions were delegated to regional offices. However, the British also put more emphasis on improving irrigation efficiency of farmer-initiated irrigation canals, which were believed to be wasteful.

The independent government of Tanzania later continued with the colonial policy of regulatory water allocation and management. All water resources were declared vested in the United Republic of Tanzania under the 1974 Water Utilization (Control and Regulation) Act. In later amendments the country was zoned into nine basins and Basin Water Boards were created to allocate and manage water resources. Under the influence of foreign donors, enforcing water rights became a mechanism for taxation. The World Bank particularly argued that rational water use could only be achieved through increasing economic water use fees. Low tariffs were stated to contribute to inefficient water use (World Bank, 1996).

Irrigation improvement was recommended, since improved irrigation efficiency would release water from the agriculture sector to be used by highest-value uses whichin the case of Pangani and Rufiji basins, are hydropower plants located downstream. To support this point, the World Bank (1996) estimated the value of water in traditional irrigation at US$ cents 0.5 per m^3 of water and in improved irrigation schemes at US$ cents 3.0 per m^3 of water.

Following the recommendation of a rapid water resources assessment by the World Bank (1996), Tanzania embarked on a legal reform of the water sector with emphasis on regulatory water use. To regulate water use gates were constructed on irrigation canals abstracting water from major tributaries of the Pangani river. However, many gates were destroyed by farmers who did not agree with the state-led water right system. A revised National Water Policy was put in place in 2002 and passed into law by the Water Act of 2009. The policy embraces the principles of IWRM with the major goal of attaining equitable and sustainable management of the water resources. All water users are required to

register and obtain permits indicating the purpose of use and the annual volume of water the users are entitled to. The permit holder must pay an annual water use fees calculated according to volume allocated and purpose of water use.

Current state-led water allocation and management in the Pangani basin are the responsibility of the PBWB. In accordance with the provision of the Water Utilization (Control and Regulation) Act of 1974 and its amendments of 1981, 1989, 1997, and 2009, an individual user, city authority or institution must apply for a water use permit. Officially, all rights applications are to be gazetted in a government newspaper for at least 40 days, during which all affected users have to be consulted and local district authorities must submit reports on the status of the water source. This includes recommendations from the District Agricultural and Livestock Development Officer, Regional Water Engineer, District Administrative Secretary, and District Executive Director. For large projects, clearance certificates of environmental impact assessment must be acquired from the National Environment Management Council. The PBWO also conducts studies on water availability. Based on the district department heads' recommendations and the water supply assessment report, the PBWB decides to grant or reject a water right application. In general, the application process can take months to years before a water right is granted (the PBWB only meets once every 3 months). Projects of national interest, e.g. water right applications for cities are, however, often expedited.

Moshi Urban Water Supply Authority vs. Shiri Njoro village farmers

In addition to three other sources (combined capacity 13,850 m^3/day), Moshi Urban Water Supply Authority (MUWSA) also obtains water from Shiri spring (10,150 m^3/day). Shiri spring is located about 7 km from Moshi town on the way to Arusha in the village of Shiri Njoro, Hai district (figure 3).

The spring feeds the Kiladeda river and forms parts of the river network originating from the slope of Mt. Kilimanjaro flowing into the Pangani river. MUWSA is the biggest water user but farmers from Shiri Njoro village rely on the spring for small-scale irrigation, and domestic and livestock needs. Farmers have constructed three irrigation canals (Kitifu Mashariki, Kitifu Kati, and Kitifu Magharibi) which they use to irrigate yams, bananas, maize, coffee and vegetables.

PBWB has so far issued six volumetric water use rights on Shiri spring (collective and individual): MUWSA 116 l/s; chairman Kitifu Mashariki 30 l/s; chairman Kitifu Kati 30 l/s; chairman Kitifu Magharibi 30 l/s; Elisa G Mallya 1 l/s; and J.P. Muro 1 l/s. The total allocated abstraction of the spring flow is thus 208 l/s, and the PBWB estimated the average yield of the spring at 218 l/s, so about 10 l/s is left to flow into the Kiladeda river.

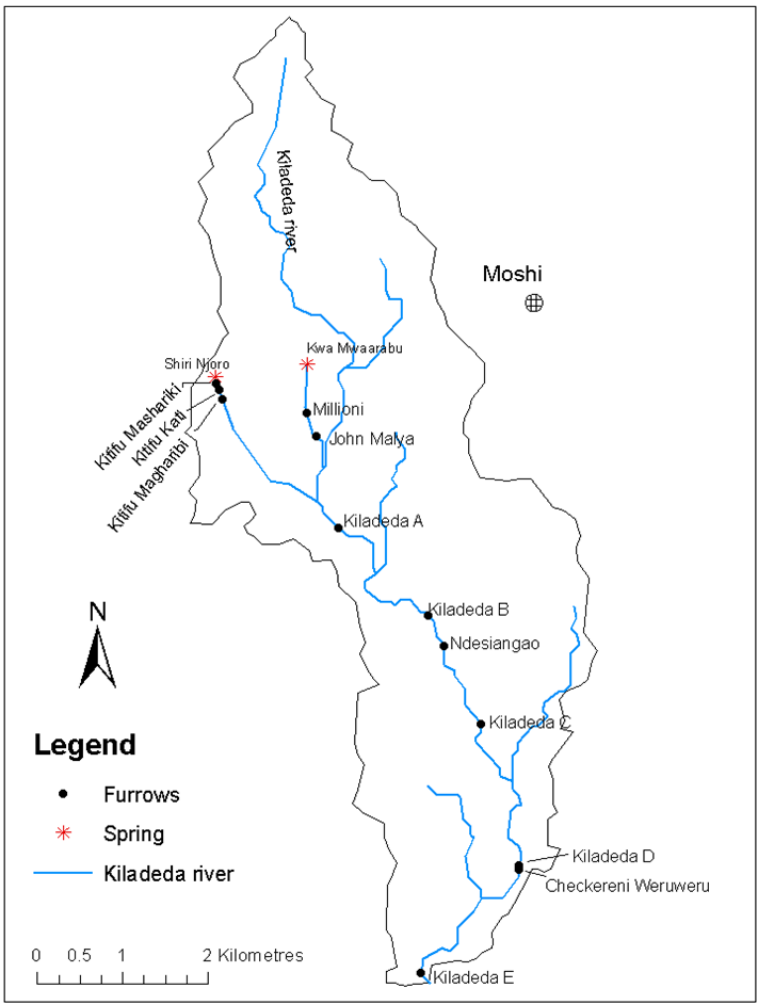
Historical evolution of Moshi city control of Shiri spring

In the 1950s, farmers established the three canals drawing from the Shiri spring for supplemental irrigation during rainy seasons and full irrigation in the dry seasons. To construct the canals, farmers sought permission from the area chief. About the same time the British colonial administration also constructed a water supply line (10 inch pipe with abstracting about 56 l/s) for Moshi town on the same source. Moshi town's intake was located upstream of the existing Shiri Njoro village canals. According to the farmers there was no water conflict but once in a while they would experience water shortages.

In 1994, MUWSA applied for an additional allocation of 68 l/s from Shiri spring and was granted 60 l/s by the PBWB. The new allocation thus increased total water right of MUSA on Shiri spring to 116 l/s. The Regional Water Engineer of Kilimanjaro informed the Shiri Njoro village chairman about the additional allocation. The chairman however responded by highlighting water shortage in the village and stated that during a village meeting farmers objected to the additional water allocation to MUWSA. Several communications, meetings and confrontations have since taken place and still continued when fieldwork was conducted. No solution has been found according to the chairman of the village canal association. The village canal association kept records of all meetings, letters, water conflict events and

reports related to the spring water conflict. We were provided access to these records by the secretary of Shiri Njoro village canal association. Shiri farmers are now looking for a lawyer to argue the case in court. Box 1 presents a review of the evolution of water conflict in the Shiri spring.

Figure 3. The Kiladeda river sub-catchment, springs, furrow intakes and location of Moshi town.



Summary of Shiri spring water conflict

Shiri spring is a small water source but the issuing of water rights has not led to orderly use or even increased efficiency. The Shiri spring case highlights the challenges of administering a formal water right system in the Pangani river basin. The smallholder farmers are willing to jointly manage and allocate the waters of Shiri Njoro. MUWSA has been uncooperative and PBWO has been unable to resolve the emerging conflict. The spring flow is over-allocated. Fixed volumetric water rights were issued based on the assumption of a constant spring yield of 218 l/s. However, recent field measurements by PBWO indicate that the spring yield is frequently much lower. MUWSA continues to abstract over and above its allocated share including during periods of low flow, leaving the villages with about half their formally allocated right. MUWSA technical manager states that since the government gives first priority to domestic water use, the city does not feel obliged to reduce its share when the spring yield decreases. When asked if they could compensate the farmers for the lost income, the manager said that the city already does that by paying the annual water user fee to the PBWB. The case also shows that the water scarcity created by Moshi city causes internal water struggles between irrigators.

The following section presents a similar water conflict in the Nduruma sub-catchment. Unlike Shiri spring, Nduruma water is used by both smallholder and large-scale commercial farmers.

Box 1. Evolution of Shiri spring water conflict (Source: based on Shiri Njoro farmers file).

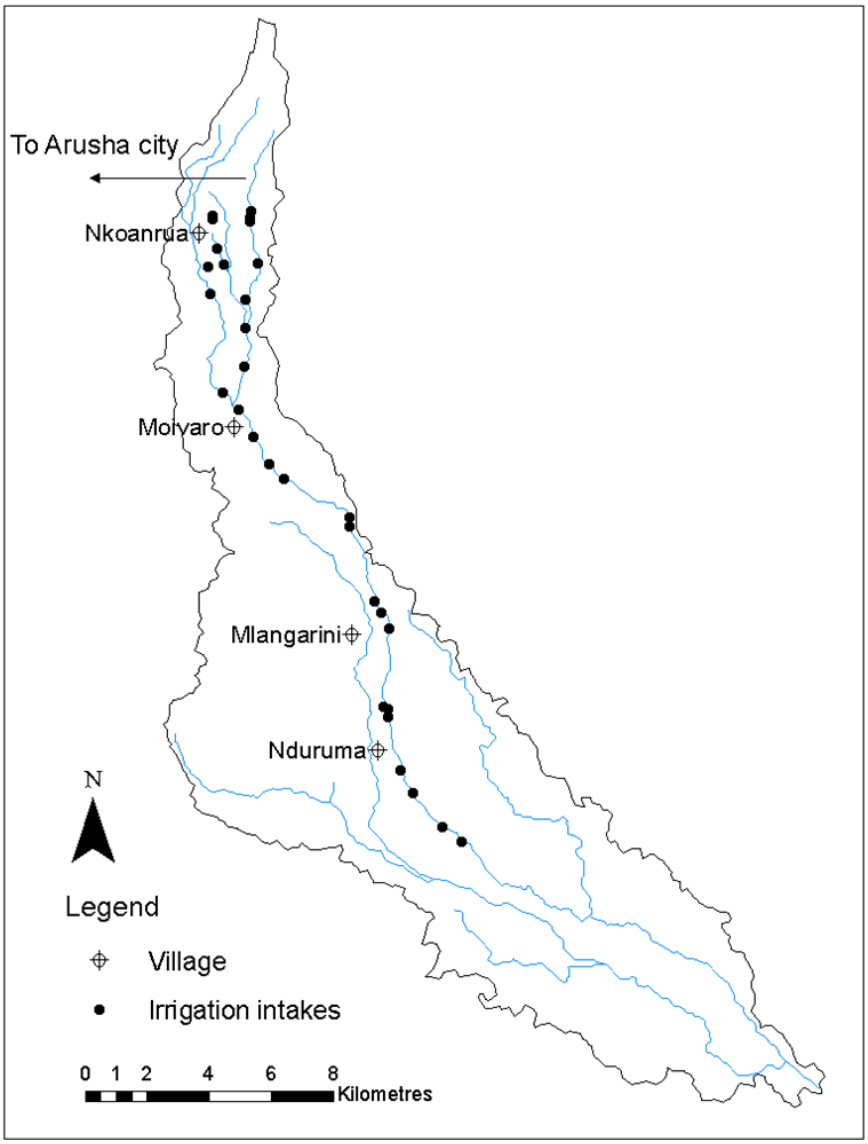
1994	Kilimanjaro Regional Water Engineer informs Shiri Njoro village about the new water project of MUWSA. The villagers responded that additional abstraction by MUWSA will aggravate water shortages in the village.
1998	Farmers create the Shiri Njoro canal association and write to MUWSA that the new project will affect the 411 households dependent on the water for domestic use and irrigation. The farmers apply for a formal water right for the entire spring water (300 l/s) but the PBWB allocates the three canals 30 l/s each.
1999	The village canal association petitions the Director of Development of Hai district about the additional allocation to MUWSA. Lyamungo Division Secretary writes to MUWSA advising the authority to dialogue with the village.
2000	The Regional Water Engineer holds several meetings with the village and MUWSA. The PBWO clarifies that MUWSA will take 116 l/s and that with a spring yield of 300 l/s there will be sufficient water for the canals. PBWO directs MUWSA to provide domestic water through standpipes to the village. When MUWSA fails to abide by the agreement, the farmers petition the Kilimanjaro Regional Commissioner, who calls for proper research on water availability. PBWO finds that the spring yield was 218 l/s, total abstraction 209 l/s, leaving 9 l/s as inflow to Kiladeda.
2001	The village Executive Officer of Shiri Njoro complains to the regional water engineer of Kilimanjaro that MUWSA now abstracts all the water from the spring and uses two pipelines. He states that the villages are preparing to destroy the MUWSA pipelines. The Regional Water Engineer states that field measurement carried out in March (start of the rainy season) found that the available water at the spring had reduced from 218 to 181 l/s. The District Commissioner tells MUWSA to remove the old pipeline. MUWSA refuses to ration water and continues to abstract more than allocated, arguing that since domestic water takes priority, it is up to the village farmers to reduce their use.
2002	The District Commissioner contacts the Kilimanjaro Regional Commissioner, stating that the main problem was that the new MUWSA pipeline takes 127 l/s and that only the first canal (Kitifu Magharibi) receives water. Downstream farmers react by destroying the intake of the first canal. The PBWO intervenes and tells the farmers to rebuild the canal intake.
2003	MUWSA continues to abstract more water than allocated. The village farmers refuse to pay the annual water fees.
2004	The village canal association chairman writes to the PBWO, complaining that the three village canals have failed to get their allocated 30 l/s per canal and that cash crops have dried up.
2007	The Shiri Village Executive Officer writes to the PBWO complaining of over-abstraction by two individual farmers, Elisa Mallya and Lt. Col. Muro. The farmers invade their homes, destroying water infrastructures. The PBWO conducts flow measurements and finds that MUWSA abstracts 120 l/s; the first canal (Kitifu Magharibi) 17 l/s; the second canal (Kitifu Kati) 13 l/s and the third (Kitifu Mashariki) 15 l/s. Mallya and Muro abstract no water because their intakes are destroyed. PBWO warns that damaging the infrastructure of other users is against the Water Act of 1974 section 33(2).

Arusha Urban Water Supply Authority vs. Nduruma water users

Nduruma river crosses eight administrative wards of Arumeru district, with its headwaters located within a protected forest reserve on the slopes of Mount Meru (figure 4).

The highlands are occupied by smallholder farmers who maintain irrigation canals and grow crops like beans, coffee, bananas and potatoes. The midlands are the most intensively farmed along the Nduruma river. Here the majority of the farmers have large commercial estates (mostly foreign-owned), first created by the colonial government (Spear, 1997) and later privatised in the 1990s. Crops grown include coffee, flowers, horticultural crops, fruits, bananas, maize and beans. The lowlands were recently settled by people escaping land shortage in the highlands and former estate workers. The first group of immigrants moved into the area during the colonial period and a second group arrived in the 1970s mainly stimulated by the national government's village resettlement programme. The inhabitants came from different groups and most are smallholder farmers. Crops grown include maize, beans, banana, cassava, pigeon peas and horticultural crops. Also a significant number of freely grazing livestock are kept. This zone experiences extreme water shortages during the dry seasons.

Figure 4. Nduruma sub-catchment, irrigation intakes and villages.



Irrigation along the Nduruma river has been practised for over 200 years (Spear, 1997). Nevertheless, agricultural intensification started during the colonial period when commercial farmers (Germans, Greeks and British) settled in the area. At the end of colonial rule, the majority of the irrigation canals in the Nduruma highlands belonged to Africans, the midlands to Europeans and the lowlands to Africans (Komakech et al., 2012a). The situation is nearly the same today. The Nduruma river is over-committed to agriculture such that it now only flows for part of the year (figure 5). The estates were first issued water rights during colonial times. These were later reviewed by PBWO in the 1990s.

However, with the increasing population of Arusha city and the booming tourism and mining industries the water demand of the city is on the rise (Komakech and van der Zaag, 2011). The city therefore was forced to look for water from the surrounding rivers, including Nduruma. Here, Arusha city built an intake located upstream of all the existing water users (figure 5). For farmers, the arrival of the Arusha city water authority could only exacerbate the competition over scarce water.

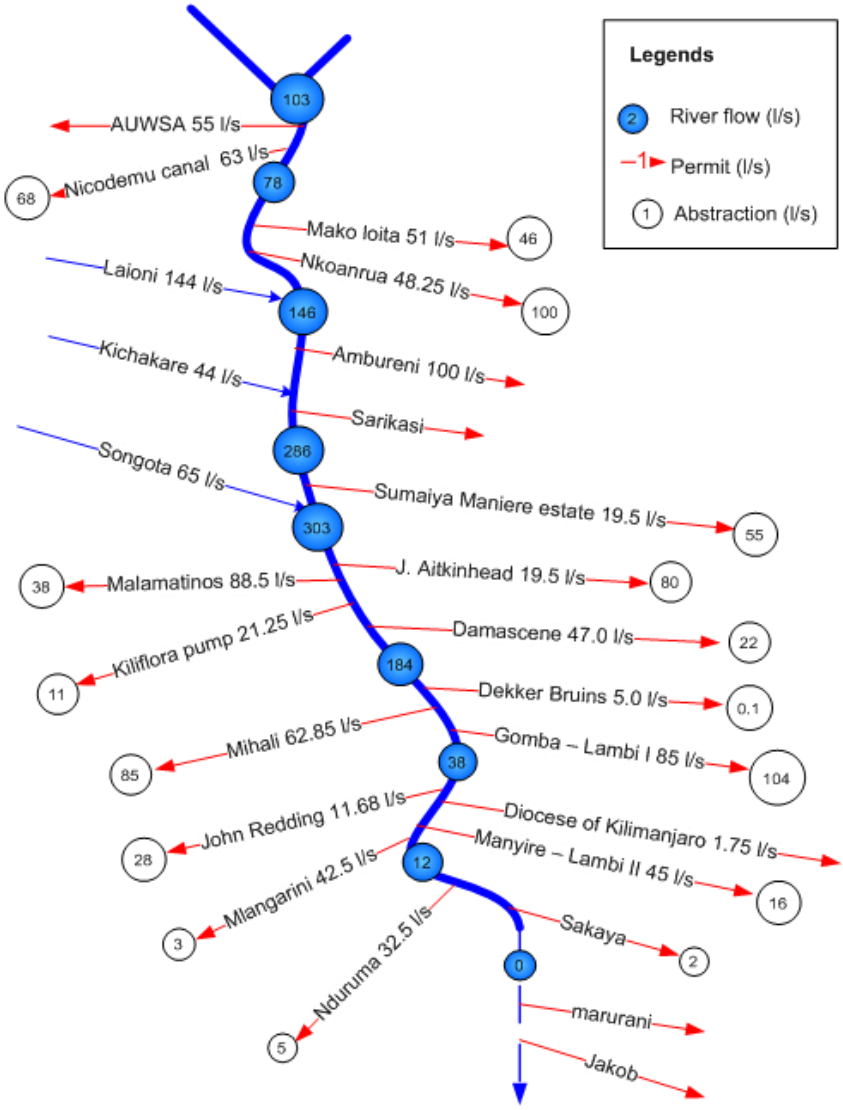
Historical evolution of Arusha city water control in the Nduruma catchment

The struggles over land and water access in the Nduruma sub-catchment started during colonial times when local farmers were dispossessed of their lands and water resources (Spear, 1997; Komakech et al., 2012a). The commercial estates were issued water use permits while Africans were allowed to use water according to their customary arrangements. In 1968, the commercial estates formed the Nduruma Water User Association to strengthen their negotiation position. However, around the same time the government started its resettlement programme (the villagisation programme). Most of the coffee estates collapsed and have only recently been revitalised. Since its creation the Nduruma water user association has never really functioned and is not known to the PBWB or to the district authorities.

However, a river committee has been created by the farmers to oversee the water allocation between the midland and lowland farmers (Komakech et al., 2012a). This river committee attempts to reduce water use by the estates from 24 hours, as stipulated in the state-issued water right, to 6-9 hours per day. The weakness of the Nduruma river committee is that its membership excludes highland users and only encompasses commercial estates and the downstream small-scale irrigators. The committee members are in effect distributing amongst themselves the water that the highland villages were unable to use (Komakech et al., 2012a). The river committee leaders explained that they lack the power to reach out to the representatives of the upstream users. This is because the upstream villages have water allocation arrangements that lack formal structures for downstream villages to engage with. The highland irrigation canals have a committee which is responsible only for maintenance and allocation of water to individual farmers (Komakech et al., 2012a). Representatives from two midland estates (Dekker Bruins and Tanzania Flowers) confirmed that on their own it is not possible to discuss water-related issues with upstream users; they need the district office to act as an intermediary. They also explained that even when the district office intervenes their influence only lasts about a week, after which upstream users stop cooperating.

In 2001, the PBWB granted AUWSA a 55 l/s water use right on the Nduruma river to supplement the city's growing domestic water needs. AUWSA gets most of its water supply from springs, boreholes and river sources located within the Themi sub-catchment (Komakech and van der Zaag, 2011). The Nduruma permit gave priority of allocation to Arusha city which is located 40 km outside the Nduruma sub-catchment. It also allowed the city to construct its pipe intake upstream of existing users, creating a locational advantage that coincides with the priority status of the permit. Existing users were not involved or consulted in the issuance of this water right as stipulated in the water act. In 2003, AUWSA started constructing the Nduruma water pipeline, but conflicts between AUWSA and the various downstream users soon erupted. This included a violent riot in October of that year which temporarily put the AUWSA project on hold.

Figure 5. Flow diagram of the Nduruma river, showing water abstractions and inflows as measured by PBWO in November 2003 (dry season).



Source: Komakech et al., 2012a; as groundwater inflow was not accurately determined, values do not add up.

Against the threat of this new pipeline, all midland and lowland users – villagers and estates alike – found themselves momentarily on the same side. The Gomba Estate manager (Mr. Michael Chamber) knew that Arusha city would reduce his water supply in the dry season, when he needed it most, far below the flow levels stated in his water right. He petitioned the district commissioner on the new allocation to Arusha city and when the district commissioner refused to respond to his complaints, Chamber decided to engage with the villagers. According to Chamber, he discovered that there was an inactive Water Users Association (WUA) that had been founded in 1968 but not registered with PBWO. He thought that if this extinct WUA were legally recognised it could add potency to his arguments against the pipeline construction. He helped revive the Nduruma WUA with Mr. William Nassari of the downstream Nduruma Village acting as chairman, and Michael Chamber serving as secretary. The District Irrigation Office interprets these events as Gomba Estate using the downstream smallholder farmers to protest against AUWSA. He claims that Chamber even hired trucks to transport the angry villagers up Mount Meru to the source of the Nduruma, were they began to riot. A publicity campaign

was later launched by AUWSA in an attempt to sensitise the downstream users about the importance of Arusha's domestic water project. Security was increased at the water abstraction site, including the construction of a permanent police station to monitor the area. PBWO and the district authority organised meetings in each ward and the villagers were strongly dissuaded from continuing to participate in 'Chamber's WUA'. The reconstituted WUA meetings have since stopped and there has been no effort to revive it since 2004 when the AUWSA pipeline became operational, and downstream users try to cope with increased water shortages, especially during the dry seasons. Box 2 presents the historical evolution of the conflict between AUWSA and Nduruma water users.

More recently, in 2011, PBWB and its development partners (International Union for Conservation (IUCN), Pamoja Trust and Stichting Nederlandse Vrijwilligers (SNV Netherlands Development Organisation) created a separate Nduruma river committee that is supposed to link all the water users in the sub-catchment (Komakech and van der Zaag, forthcoming). However, the new Nduruma committee has not been operational as yet, as the upstream farmers remain unwilling to cooperate with the downstream users.

Box 2. Evolution of AUWSA versus Nduruma farmers' water conflict.

2001	PBWB issues a water permit to AUWSA to abstract 55 l/s of water from the Nduruma river. The local farmers and estates, having state-issued water rights, are not informed.
2003	AUWSA starts constructing a pipeline at the source of the Nduruma river. In October 2003, farmers attack the contractor employed by AUWSA, his car and 300 culverts are destroyed. Construction is stalled.
	Commercial farmers with water rights issued by PBWO get involved. The Gomba estate managing director sends a letter of objection to PBWO, highlighting the importance of Nduruma to Tanzania's largest flower, fresh vegetables, and horticultural farms. He argues that water availability in Nduruma is at a point where an upstream user cannot access his or her full water right without affecting the allocated rights of other users downstream. The letter is copied to the President of Tanzania and the Ministers of Finance, Agriculture and Food Security, and Water and Livestock Development.
	The chairman of the reconstituted Nduruma Water User Association appeals to the Minister of Water and Livestock Development, stating that contrary to the Water Utilization Act of 1974, they were not informed of the AUWSA water project.
	The Principal Water Officer, Ministry of Water and Livestock Development, urges PBWO to conduct a water assessment and to encourage dialogue between the users. The Basin Water Officer meanwhile responds to the Gomba estate's director that he will review all existing water rights and ajust all right holders as the available water is inadequate to satisfy all rights.
	PBWO conducts a (new) water assessment and through an extraordinary PBWB meeting reduces all water permits by 20% and all permits are declared provisional rather than permanent. AUWSA is allocated 44 l/s but permitted to increase its use to 55 l/s during the rainy season.
2004	IUCN and Pamoja (a local NGO), through a 'dialogue on water project', try to get involved but are unsuccessful in mediating the water conflict.
2006	Gomba estate closes down partly due to lack of water security. Its property is sold to Arusha Municipal council, who intends to establish a satellite township. AUWSA completes its water project. The site is guarded by a private security company and locals are denied entry to the forest without security escorts.
2009	Young farmers from Bangata and Nkoanrua villages attack the AUWSA abstraction point with machetes.

Summary of the Nduruma river water conflict

Like Shiri Njoro farmers, existing water users in Nduruma were not consulted or compensated. To this day, farmers remain dissatisfied with the situation. They claim that AUWSA abstracts far more water than their nominal allocation and that AUWSA does not respond with any sympathy to the farmers' complaints of scarcity in the dry season. Their position is also shared by the Arumeru district executive director. According to the director it is unfair for AUWSA to tap Nduruma water without making any contribution to the villagers using the same water source. The director argues that AUWSA earns a hefty income from Nduruma water so it would be fair to pay royalties to villagers for the management and protection of the water resources. The AUWSA managing director, in contrast, claims that since water resources in Tanzania are government property it is the responsibility of the government to decide how best it is used. Occasionally the frustration of the villagers is manifested in violent ways. In January 2009, a band of young farmers from Bangata and Nkoanrua villages attacked the AUWSA abstraction point with machetes. Interestingly, in 2003 the PBWO revised all water rights downwards by 20%, and further made the water right of the city flexible: AUWSA was allowed to increase its use to the originally allocated 55 l/s during the rainy seasons only. Farmers interviewed from the villages of Mako Loita, Bangata, Midawe, Mlangarini, and Nduruma all stated that they would like PBWO to institute a system that obliges AUWSA to reduce its allocation during the dry season.

The people affected most by AUWSA water use are farmers using the nearest three irrigation canals, i.e. Nicodemu, Mako Loita and Nkoanrua. Downstream of these irrigation canals there are more springs and streams joining the river. Midland and lowland farmers have initiated a rotational allocation system (domestic and livestock uses inclusive) that is negotiated on a seasonal basis (Komakech et al., 2012a). Although commercial estates and smallholder farmers tried to create a front by reconstituting the 1968 Nduruma Water User Association, they were not able to stop AUWSA from taking control of Nduruma water. AUWSA was the last user to arrive in Nduruma but has now the first call on the water. Water use by Arusha has had negative local socio-economic consequences: one estate (Gomba) closed down and many villagers lost temporary or permanent employment opportunities.

DISCUSSION

Water distribution in Pangani is characterised by local investments in water infrastructure and local distribution rules that evolved over time. These infrastructures and customary allocation rules take water variability into consideration. In many places, irrigation areas expand and contract in sync with water availability and the allocation rules also change with the seasons (dry and wet seasons). In the nearby Themi river, for example, water is reserved for domestic and livestock use during certain periods of the dry season (Komakech and van der Zaag, 2011), while in Makanya catchment downstream farmers are encouraged to borrow land in the upstream parts of the irrigation command areas during dry seasons (Komakech et al., 2012b). Lankford and Beale (2007) found a similar arrangement in the Usangu basin, also in Tanzania, and report that 20% of the maximum area could always be irrigated and that the maximum area can only be served during exceptionally wet years.

Both case histories presented in this paper show the existence of a hybrid, plural legal situation: prior customary uses co-exist, and sometimes clash, with formal government laws first initiated by the colonial administration and later revived by the independent government of Tanzania. Officially, the Pangani Basin Water Board and Office is responsible for the allocation of water use rights and management of water resources of the basin.

The PBWO relies on reports and assessment studies to allocate water rights, but does not monitor actual water use. The board's staff only moves around to collect the annual water user fees. In many places, water abstraction exceeds the allocated amount and the increased use of mobile water pumps by dispersed smallholder farmers particularly renders the water administration system ineffective. We

observed a complex water-sharing arrangement, especially in coffee estates on the slopes of Mount Kilimanjaro. These estates were originally managed by rural cooperative societies, which have now leased their estates to private investors with the mandate to grow coffee. However, these investors are also subletting the farms to other private investors who mostly grow high-value crops: flowers, tomatoes and green beans for international markets that incidentally also require to be irrigated. The complex arrangements mean that those private investors without water rights collaborate with those with water rights to abstract more water. PBWO does not have the means of verifying the water use by the estates. An interviewed officer of PBWO said that "if there is no problem, you do not need to disturb the equilibrium or the flow of the system. It is difficult for us as PBWO to check all water use; we only get involved when there is conflict".

Cities acquire their water rights from PBWO. The smallholder farmers use their prior customary uses and governance arrangements to claim access right, while cities use formal law (particularly priority allocation to domestic uses) to gain control of water. The smallholder farmers are officially obliged to apply for formal water rights as well, but in practice only some irrigators with individual canals and pumps have done so, but none of the furrow irrigators. This may possibly be explained by the fact that the latter are not as administration-savvy compared to cities and commercial farmers or that they find the statutory system lacks legitimacy. Although smallholder farmers were the first to start using the water sources, they are increasingly being made the last by PBWO which gives allocation priority to cities.

Water transfers to cities in the Pangani river basin may be categorised as permanent and outright (cf. Molle and Berkoff, 2009). The mechanism used to reallocate water to the city of Arusha and Moshi followed a combination of administrative decision and stealth. The formal water law requires that before issuing a water use right, all potentially affected parties be consulted and existing or potential water conflicts should be resolved before any new allocation can be made (URT, 2009). In both Shiri spring and Nduruma, farmers were not properly consulted by the basin water board/office. Farmers using Shiri spring and Nduruma both contested the appropriation (e.g. by rioting, by involving various department heads and political leaders), but they were not able to stop the powerful city water authorities from gaining control of the water.

The two case studies highlight aspects not often mentioned in the literature on inter-sectoral water transfers. First, unlike other cases (see Loeve et al., 2004; Bhattarai et al., 2005; Hearne, 2007; Celio et al., 2010), Pangani is a basin where 80% of the users are smallholder farmers who have invested significant time and labour in the construction and maintenance of irrigation canals. In such a setting reallocation to cities does not only deprive farmers of water but may also render their long-term hydraulic property investment (partly) obsolete. Smallholder farmers rely on the irrigation canals to mitigate the impact of agricultural drought, and realise their food security. In addition, these canals serve other purposes as well, including livestock watering, construction (brick-making) and, importantly, domestic uses. This domestic use is often overlooked, yet should also be accorded priority. Further, it could be noted that furrow water use is fully consistent with the government policy that aims at eliminating rural poverty.

Second, the water policy and act give priority to registered domestic water uses and cities and only state that the other uses will be allocated taking into consideration the economic and social values. In the Pangani, cities are given first priority and the other users get a proportional reduction in the allocation (illustrated in the Nduruma case where the basin board reduced all existing allocation by 20%). There are no planned measures for unregistered uses and registration does not change the priority allocation of the furrow. Although the new water act recognises customary water users and obliges them to formally register their use, it does not have a mechanism for compensation for lost livelihood in case the water is reallocated to new users (URT, 2009). This in a way explains why the smallholder farmers do not bother to register. In our view, the recognition of customary uses should be

grounds for compensation in case existing uses are impaired. This would create incentives for any newcomers to look for alternatives before appropriating water from existing users.

Third, the current water right licensing system does not match the basin reality. It is a system that allocates fixed water use rights on the assumption that an average level of supply exists. However, water supply in the Tanzania river basins is highly variable due to unpredictability of rainfall and recurrence of droughts and floods (see Lankford and Beale, 2007). In such a situation, and in the absence of water storage infrastructure, it is the low flows during the dry seasons that pose allocation challenges. The water act makes a provision for the revision of water use permits in any specified area where the available water is insufficient to satisfy all permits. But the process does not work fast enough especially for dry-season scarcity. Formal water rights could benefit from local water allocation systems (cf. Horst, 1998). In Pangani, local farmers have developed flexible water allocation rules, schedules or abstraction turns that are renegotiated on a seasonal basis within the area served by irrigation canals and also among intakes along the river (Komakech et al., 2012b). Lankford and Mwaruvanda (2007) propose one such framework: a legal-infrastructure framework that integrates formal water rights and customary agreements by establishing a wet-season volumetric cap and a dry-season proportional cap for all allocations. The decision to award AUWSA a water right that may increase during the wet season by 20% may be seen as a first step in this direction. Negotiated water allocation is driven not only by economic power but also by other values, including social values and interests, which are allowed to be heard in the negotiation process (see Molle, 2004 for a discussion on negotiated water allocation). Given the context of water use development and variability in the basin, negotiated water allocation can potentially mitigate water conflicts and reduce potential downstream impacts.

Finally, given the power inequality between the city authorities and smallholder farmers, the capacity of the PBWO to set, monitor and enforce fair water allocation rules is very important. In the Pangani basin, the capacity (technical and financial) to enforce and monitor compliance with water allocation rules is still weak. City water authorities exploit this gap and abstract more than they are allocated but go unpunished. In both Nduruma and Shiri spring, the rural-to-city water transfers have had significant downstream impacts. Shiri farmers claim to have lost entire coffee plantations and fish ponds and that conflicts over water among farmers has increased. Three irrigation canals in Nduruma – Nicodemu, Mako Loita and Nkoanrua – despite being among the oldest users do not receive sufficient water most of the time. Gomba estate, that was very vocal and outright in objecting against the allocation to Arusha city, collapsed. The impact of this water appropriation, however, disproportionately affects the smallholder farmers. While the large commercial farmers can leave with some of their investments and look for alternatives, the smallholder farmers lose all their investments with much fewer alternatives and are forced to rely on marginal rain-fed agriculture, or have to join the peri-urban poor.

CONCLUSIONS

This paper described and analysed appropriation of water from smallholder irrigators by cities in a river basin that is becoming water-stressed. In such a stressed river basin there is a need for the state-based water rights allocation system to have legitimacy. However, in practice the rights system as administered by many governments may in fact provide the legal means for some actors to dispossess existing users. Powerful cities discussed in this paper selectively use the law to gain leverage over water control.

In general, water appropriation and transfer to growing cities in the Pangani basin and other basins in sub-Saharan Africa is an ongoing process (Gupta and van der Zaag, 2008). These transfers take place in a context where prior investments (infrastructure and institution) have been made by smallholder farmers. This is in contrast to situations where the state has invested heavily in hydraulic infrastructures

(e.g. in storage, conveyance) and where there is a strong institutional capacity and where prior uses are recognised.

Water reallocation to the cities of Arusha and Moshi was achieved through a combination of administrative decision and stealth. The justification was that domestic water use has the highest priority as stipulated in the water policy and law. However, in issuing priority rights to these cities, the domestic needs of the smallholders were not considered, let alone the fact that the farmers rely on the irrigation canals to realise their food security and livelihoods.

Water capture of rapidly expanding cities seems inevitable. It is therefore essential that suitable options for water allocation be applied to minimise the potential negative impacts of the agriculture-to-city water transfers or water allocation in general. We propose the following for Pangani, but this may also be applicable to other basins in semiarid areas particularly in sub-Saharan Africa. First, the state-administered water rights system could incorporate a proportional allocation system that comes into operation during periods of water scarcity (see van der Zaag and Röling, 1996; Horst, 1998). By proportional allocation we mean a situation whereby the state-issued water right entitlements are reduced in proportion to the expected/observed shortfall in river flow. This could be negotiated by the users at the river level – for instance in Nduruma the river committee currently negotiates rotational allocation between smallholder farmers and estates, the latter having state-based water rights. Presently, the Tanzania water right system is based on average flows, without recognising the normal flow variability (in the absence of storage reservoirs which could buffer such fluctuations). Formal water rights could benefit from the time-tested local water allocation system that does take variability into account (Komakech and van der Zaag, 2011), and from the suggestions made by Lankford and Mwaruvanda (2007) and Lankford and Beale (2007) on a legal-infrastructure framework.

Second, the PBWO capacity (technical and financial) to enforce and monitor compliance with the state water allocation rules is weak. Currently the basin water board does not monitor water allocation; it only gets involved in cases of conflict. This may explain why the water authorities in both cities continue to over-abstract water, leaving little to smallholder farmers. The institutional capacity to monitor and enforce agreements has thus to be strengthened. This could be done by recognising local arrangements (e.g. river committees active in Nduruma and Kiladeda rivers) and make them responsible for the negotiation of water allocation (Komakech and van der Zaag, 2011). It also means that any water transfers or allocations to cities would be negotiated by these river committees. The PBWO would then focus on backstopping with technical information.

Finally, when there is good knowledge of the water resource, it may be possible to introduce a system of water trade or payment for lost benefits in the form of lease or option contracts that would only come into operation in times of scarcity (see Howitt, 1998; Characklis et al., 2006). In the Pangani, smallholder farmers are not being compensated when their water is appropriated by cities. Since the water law does recognise customary uses, allows water trade and also allows the basin water board to attach any condition to a use permit (including compensation to any other person), it is theoretically possible to institutionalise a compensation scheme that recognises the prior water use and farmers' investments in water infrastructure. This could be grounds for compensation of smallholder farmers and may create incentives for newcomers to look for alternative water sources, invest in additional storage options or invest in demand management and leakage control. In so doing the first would not have to become the last.

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