Water Policy 11 (2009) 203–220

Tanzanian water policy reforms—between principles and practical applications

Haakon Lein and Mattias Tagseth*

*Corresponding author. Department of Geography, Norwegian University of Science and Technology (NTNU), NO-7491, Trondheim, Norway. Fax: + 4773591878. E-mail: mattias.tagseth@svt.ntnu.no

Abstract

The paper presents and discusses different approaches to water management, termed "state centred", "market-based" and "community-based". Each provides different answers to how and by whom limited water resources best could and should be managed. They are based on different development ideologies and advocated by different professions. The article elaborates on the strengths, limitations and compatibility of the three models. These models provide a basis for discussing national water policy and water management reforms in Tanzania as well as the more practical implications of this in one of the main river basins in the country: the Pangani River Basin. Central to the water management problem in this basin are conflicts between communities and the water bureaucracy over what constitutes "proper" management of water. The policy and the activities of the river basin authorities continue to reflect a traditional top-down bureaucratic approach to water management, with colonial roots. The water legislation and the formal water management system seem neither to be set up to facilitate the active participation of local communities in water management, nor to facilitate the development of a water market.

Keywords: Pangani River Basin; Tanzania; Water legislation; Water management reform; Water policy

Introduction

In the International Year of Freshwater in 2003, sustainable utilisation of water resources was placed high on the international development agenda. In the years leading up to this event there were many calls to give more attention to the problems of water scarcity (Falkenmark *et al.*, 1990) and an apparently emerging global water crisis (Clarke, 1991; Postel, 1992) as well as an increasing likelihood of violent conflicts over water. Although such crisis narratives have become widely accepted, they have been challenged by critics who questioned the idea of water as a particularly scarce (Lomborg, 2001) or conflict-ridden resource (Lonergan, 2001). Water shortages in particular regions can and are being solved by technological solutions (e.g. desalinisation) and water being traded mostly in the form of food ("virtual water"). However, both those who anticipate an impending water crisis and those presenting more optimistic visions seem to agree that

doi: 10.2166/wp.2009.024

freshwater in the future should be managed "better". Yet what does "better" or "improved" water management really mean? How should it be carried out in practice?

The discourse on water management in global forums dates back to the Stockholm (Sweden) conference in 1972 and the UN conference on water in Mar del Plata (Argentina) in 1977, but the 1990s witnessed the emergence of what has been described as a new international consensus on key principles for sound water management. A recent Word Bank water policy paper simply states that: "There is a broad consensus of what constitutes good water resources management, but all countries are far from managing water resources according to these principles" (World Bank, 2003, 29). This claimed consensus is referred to as being based on the four original "Dublin principles"[1] from 1992, which have since been developed and interpreted through a series of conferences and policy papers, including the 1992 RIO Earth Summit (Rio de Janeiro, Brazil) (Johnson, 1993), as well as various reports and policy papers prepared by international institutions (e.g. World Bank, 1993, 2003; UNESCO, 2003). The World Bank report previously quoted also summarises the current version of this consensus as follows: "water resources should be managed holistically and sustainably, respecting subsidiary and ensuing participation and treating the resource as an economic as well as social good" (World Bank, 2003, 29). With the exception of the claim that water should be treated as an economic good (on which there is definitely no consensus, at least not on what it means in practice), this statement is apparently not very controversial. However, moving beyond the rhetoric and finding ways of implementing these principles may lead to practical solutions which are much more controversial.

In the first part of this article, we present and discuss three different approaches or models (these two terms will be used interchangeably) to water management (Table 1). All can be said to address the problems of "sound" water management and the need to prescribe solutions and interventions in response to the approaching "water crisis". These three approaches have been labelled "state centred" "market-based" and "community-based", respectively. Each provides different practical answers to how and by whom water resources best could and should be managed. They are grounded in different ("classic", "neoliberal" and "neo-populist") development ideologies (Blaikie, 1998; Tagseth, 2002; Lein, 2004) and they are advocated by different professions. The three models will be used as a basis for analysing and discussing past and current approaches to water management in Tanzania, showing how the practice of water management is influenced by the global water policy process as well as geographically and historically contingent national and regional settings. The main focus is on the new National Water Policy of Tanzania (United Republic of Tanzania, 2002a) as well as recent experiences from water management reform in the Pangani River Basin.

Three models of water management

State management

For many, the term "water management" is closely associated with what is here labelled a

[1] The four original 'Dublin principles' adopted in the Dublin Statement by the International Conference on Water and the Environment in Dublin on January 31 1992 are: No. 1—Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. No. 2—Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels. No. 3—Women play a central part in the provision, management and safeguarding of water. No. 4—Water has an economic value in all its competing uses and should be recognized as an economic good (http://un-documents.net/h2o-dub.htm).

Table 1. Three models of water management.

Issues	Model Community	State	Market
Principal agent	Community, civil society, water users associations	State (executive), planner, expert	Market, judiciary
"Ownership" of water	Commons with varying systems of rights of use	State property	Individual property, private enterprises
Mechanism for allocating water	Access to water through participation/investment in scheme, inheritance or usufruct	Access to water through bureaucratic allocation of water licences subject to fees	Access to water through purchase of a right in a market
Resource mobilisation	Labour and other contributions to local water users groups	Taxes/water fees to government	Water fees and private investments
Ways of solving conflicts	Civil society: committees, hearings, general meeting, village elders	Executive: boards representing "stakeholders" Expert decisions	Market/judicial: market, courts of law
Scale/regional focus	Local village, community, watershed	River basin	Individual user
Dominant professional perspective	NGO professionals, (farmers)	Hydrologists, engineers, (economists)	Economists

state-centred or technocratic approach to water resource management[2]. This technocratic management model is based on the notion that the state, through its administrative and political institutions, can and should plan and allocate scarce water resources in the interest of the common good. The model is based on a strong notion of expert decisions and the ideology that water, societies and humans can be planned and managed so as to produce optimal solutions.

Owing to the nature of the resource, water management should be carried out within the framework of the river basin. Planning, management and conflict resolution are tasks to be carried out by special water management authorities, having superior knowledge and overview of available resources, possible ways of using water and also ideas and tools to decide on the optimal way of allocating resources. Such water management organisations are to be governed by boards, often involving different "stakeholders", understood to represent various interests groups or sectors (civil administration, ministries, economic actors, farmers, women, etc.). The main purposes of water fees are to recover costs of providing water (infrastructure) and to fund the operations of water management authorities. The dominant professional perspective is hydrological and water management is primarily seen as a task for hydrologists and to some extent for agronomists and irrigation engineers.

The prime example of such a technocratic water management approach is what is termed "integrated river basin planning". Inspired by the Tennessee Valley Authority (TVA) model, associated with the New Deal policies of the depression in USA, river basin planning has been applied in several African countries since the 1960s. Adams (1992) argues that this model initially became so popular because it appealed to the idea of modernisation, rationality and planning. It also carried the notion of a strong and active state as an engine of development. Further, the approach promised to solve a number of

[2] The term water management has been defined as "planned development, distribution and use of water resources" (Johansson, 1983: 138).

development problems, such as hydropower development, irrigation development and general rural development, all in an "integrated manner". While popular in many countries, the results of large-scale river basin projects in Africa have often been quite disappointing. This can be attributed to a number of aspects linked to design and practical implementation (Barrow, 1998). It is easy to imagine that the systematic use of river basins or watersheds—cutting across strong existing social boundaries (e.g. ethnic groups) as well as political and administrative boundaries—as a territorial basis for environmental planning and action, may lead to substantial political and practical controversies. Furthermore, it is important to acknowledge that the systematic use of ecological boundaries as political and planning units is a modern idea with little historical precedence and that what Barham (2001) terms the "watershed rule" may come into conflict with basic democratic rights. Further, and linked to this, is the notion that participation and many democratic aspects of water management can be adequately served through "stakeholder participation" in river basin institutions at various levels. Such stakeholder participation may range from nothing more than token interest to serious attempts at initiating real participation. However, the idea of stakeholder participation raises a series of fundamental issues linked to the identification and selection of stakeholders and to how these could be held responsible *vis-à-vis* their "constituencies" (Wester, 2003).

The aforementioned technocratic approach falls well within what Blaikie (1998) has termed the classical, statist top-down approach to rural development and environmental management. This development approach was challenged in the 1990s by both neoliberal and neo-populist development paradigms.

Management by the market

The market-based model presents a critique of the principles of the technocratic model outlined in the previous section. This critique is primarily related to questions of how and by whom, decisions about the allocation of water should be made.

The most controversial issue in global water reforms outlined in the Introduction is the argument that "water has an economic value in all its competing uses and should be recognized as an economic good", as stated in the fourth principle in the Dublin statement on water and sustainable development[3]. Perry (2001) identifies three main motivations for water charging: it can be used to recover the cost of providing the service; it can provide an incentive for the efficient use of scarce water resources; and water charges can be used as a benefit tax on those receiving water services to provide potential resources for further investment for the benefit of others in society. The idea of a water fee or tax to cover the cost of providing services may be controversial and difficult to carry out in practice, but in theory it could easily be incorporated into the traditional river basin model. The second point is more complicated, as it requires the establishment of some kind of private property rights to water and some kind of water market.

The market-based model for water management is based on the very fundamental neoliberal argument that while markets may not be perfect, they are certainly better than bureaucrats and politicians in allocating scarce resources. With regard to the water sector, this general argument has been phrased thus:

[3] It is worth noting that the text following the statement presents what is basically an environmental argument for the claim: "Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources" (http://un-documents.net/h2o-dub.htm).

"As with anything in water management, the choice is not between first and second best but between 'imperfect' and 'even more imperfect'" (World Bank, 2003, 26). It is argued that water can and should be treated as a commodity along with oil and other natural resources and can thus be traded at auctions or in other ways. By establishing clear tradable property rights, a market for water can be established. Efficient use of scarce water resources would be secured if those who are willing and able to pay the most for water gained access to it, assuming that these would be able to secure the highest returns. A water market can be organised in different ways, but in this model, water management is basically about developing a legal framework and setting up functioning water markets based on, for instance, tradable water rights (Rosegrant & Binswanger, 1994).

Developing a system of tradable water rights is seen as a way of empowering water users, providing security of tenure regarding water rights and providing incentives to consider the full opportunity costs of water (Schleyer & Rosegrant, 1996). A market can be seen as a highly decentralised system of decision making, so it resonates with the requirement of another core principle of the Dublin statement, that water should be managed at the "lowest appropriate level".

Despite the push towards allocation through the market, examples of functional water markets with a significant trade in water in developing countries are still hard to come by. In 1981 Chile introduced a new water law, defining transferable water rights separated from land rights and this has been termed a success story where an active water market has led to more efficient use of water and, it is claimed, more pro-poor use of resources (Schleyer & Rosengrant, 1996). Other empirical studies on Chile have shown a fairly limited market with very few transactions in general and especially between sectors, leading to a suggestion that some of the claims about the functioning of the market are "so sweeping that they are best understood as political and theoretical statements rather than balanced or empirical analysis" (Bauer, 1997, 646; see also Bauer, 2004).

Within this model there is little room for river basin authorities to make priorities or plan strategically. The role of the state lies in facilitating and overseeing that the market works, which can be challenging enough in some situations. This approach to treating water as a commodity to be traded on a market has also been criticized for being based on a reductionist view of what is a truly multifaceted resource and for ignoring the strong symbolic and cultural elements and values associated with it (e.g. Strang, 2004). Others have argued against giving private investors control over this "blue gold" and claim that access to water should rather be seen as a human right (Gleick, 1998; Metha, 2000; Petrella, 2001), more in line with prior global recommendations from the Mar del Plata conference in 1977 (Gleick, 1998).

Management by community

The statist, technocratic approach to water management has been challenged not only by the market model of water management but also increasingly by neo-populist ideas which gained ground in the general development discourse in the 1980s, when new arguments about the need for increased participation by community in development as well as in natural resource management and criticisms of the practice of "normal professionalism" emerged (Chambers *et al.* 1989). Since then, "community-based natural resource management" (CBNRM) has become a standard part of the international aid vocabulary. The idea that local communities can manage resources—also water—in a sustainable way corresponds well with the second original Dublin statement, which states that "Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels" (http://un-documents.net/h2o-dub.htm).

The importance of local or indigenous knowledge is emphasised in (but is not exclusive to) the populist development discourse. It is claimed that there are important lessons to be learned from local management practice (Coward, 1977; Adams, 1992) and that we should look for more creative interactions between indigenous and scientific (or "Western") knowledge systems (deWalt, 1994). In fact, many (perhaps most) water management systems in developing countries can be described as forms of "community management". Such management systems developed to facilitate traditional irrigation systems may face serious challenges, for instance from increasing numbers of users ("the tragedy of the commons"), in enforcing rules ("the freerider problem"), or due to new management problems involving increasing regional scales and the emergence of new competitors for the water (i.e. urban water supply, large-scale irrigation schemes and hydropower). Nevertheless, there is little doubt that actual community-based water management systems do have some success as they contribute to sustaining the livelihoods of many people and they can have more success in mediating conflicts and mobilising local resources than other systems (Adams, 1990; Ostrom, 2002). The crucial point from the neo-populist discourse on development is not so much the insight that irrigators can know how to run the schemes that they have made, but the vision that these models and capabilities can be successfully mobilised or replicated in outsiders' quests to improve water management.

A "water management community" may typically be a village or a group of water users sharing a scheme or a source of water. Although there are wide variations in actual institutional set-up and practices in such communities, it can be argued that they share some common traits. The "members" of the community have the right to utilise the resource, but there is usually no individual ownership. Rights in these commons are embedded in a system of reciprocal rights and obligations. In order to access water, one has to fulfil certain obligations (e.g. be a member of the village or group, contribute in construction or maintenance of infrastructure). Once these obligations are fulfilled, a person has a claim to water along with other members of the community. "Payment" for water takes place mainly in the form of labour or other contributions needed for running the system. Various types of community organisations decide on the principles and rules for water allocation and negotiate in cases of conflicts, for example in parleys or hearings negotiated by water specialists, local leaders and village elders. Influential attempts to systematise and formalise such principles more theoretically have taken place within the field of institutional economics. Common pool resources (CPR) theories provide a possible basis for designing and setting up new community-based systems. Ostrom's well-known design principles for successful CPR systems can be seen as a guideline in processes of crafting institutions (Ostrom, 1990, 1992). Further, it has been argued that it is possible for outsiders to strengthen social capital in farmers' irrigation organisations and that this may yield positive results with regard to water use efficiency and output (Uphoff & Wijayaratna, 2000). Within the water sector, the idea that water users associations (WUAs) can be crafted or transformed and given responsibilities for running irrigation schemes or even smaller catchments has rapidly gained ground and seems to have become a panacea. References to participation and the need to establish WUAs have become the standard rhetoric repertoire of both technocratic and neoliberal approaches to water management.

In a review of studies of various interventions and projects for increasing local participation and decentralisation of river basin management around the world, Mody (2001, 45) finds very few truly successful examples and concludes: "It is premature to be 'disappointed' but the lessons are sobering. While examples of success exist and do show the way forward, success has tended to be localised and, even there much work lies ahead". As funds for state-led developments projects have become more scarce, many irrigation management transfer (IMT) projects have been devised, based on the idea that

communities can manage water in large-scale irrigation systems better and cheaper (at least for the government) than traditional irrigation bureaucracies (Turral, 1995). Closer involvement of users, it is argued, should not only help to reduce operating costs, it should also make water distributors more responsible *vis-à-vis* the farmers, thereby increasing efficiency and contributing to a general "democratisation" of the irrigation systems.

The concepts of the designed WUA and community-based water management have been promoted with great enthusiasm in many water policy documents produced in recent years. It has been pointed out, however, that such models readily lend themselves to fairly idealistic and simplistic notions of community, or what Mosse & Sivan (2003, 15) term "imaginative constructs of indigenous, local or community institutions". Such "imaginative constructs" tend to underestimate political, historical and ecological specificities of communities and community institutions. As Agrawal & Gibson (1999) have demonstrated, the very idea of community in much of the writings on CBNRM is based on the questionable conception that communities are socially homogeneous and filled with people sharing common norms and values. However, communities can be conflict ridden and highly unequal societies, not necessarily well suited to sustainable management of natural resources (Metha, 2000). On the other hand, interventions which aim at improving or replicating existing farmer-managed irrigation organisation, built on a model which reduces the social organisation of a commons to a set of "operational rules" inspired by functionalist theory in social science, are likely to show weaknesses in terms of dealing with change and politics. Leach *et al.* (1999), Cleaver (2000), among others, have criticised the institutional approach for putting too much faith in the idea that specific strong institutions for natural resource management can be designed and crafted and they underline the embedded nature and multifaceted aspects of water resource management.

The main elements of the three models are summarised in Table 1. In the remaining part of this article, the ongoing water reform processes in Tanzania will be analysed. As in the global discourse on water reforms, calls for water reform in Tanzania have been based on claims and notions of a water crisis. As we will show, the ongoing reforms call upon elements from all the three models, thus creating a water policy reform and a process of implementation which is hybrid in form and historically and geographically rooted.

Tanzanian water laws and policies

The first water control system and statutory water laws in what is now Tanzania were established by colonial authorities in the early 20th century. A main purpose was limiting the use of water among the native inhabitants while at the same time securing access to water for European settlers (Mwita, 1975). A draft water ordinance was prepared during the period of German rule, but the first water law was approved under British rule in 1923. A new ordinance was not passed until 1948 and was replaced in 1959 and subsequently again in 1974. According to the current water laws in Tanzania[4], water belongs to

[4] Water utilisation is basically regulated by the *Water Utilization (Control and Regulation) Act, 1974 (No. 42)* (United Republic of Tanzania, 1974), with later amendments. The *Water Utilization (Control and Regulation) Act (Amdt.) 1981 (No. 10)* (United Republic of Tanzania, 1981) deals with water quality issues and the establishment of water authorities. Later regulations include: *Water Utilization (General) (Amendment) Regulations, 1994* (United Republic of Tanzania, 1994a), *Water Utilization (General) (Amendment) Regulations, 1996* (United Republic of Tanzania, 1996) and *Water Laws (Miscellaneous Amendments) Act, 1997: An act to amend certain written laws pertaining to water. April 4th, 1997* (United Republic of Tanzania, 1997). These are regulations concerning fees for water right applications and volumetric fees for water abstractions.

the state and all water users who want to abstract water from a river or stream must have a "water right". Such water rights, or licences, can be obtained from the water officer, who can grant or refuse water rights to any person. If granted, the water right defines the amount of water to be abstracted, for what purpose it can be used, the duration of the right and also the source of the water. A water right, or part of it, can be transferred along with land, but only if the water right is made explicitly appurtenant to it. There is no other provision in the current legislation for sale or other types of direct transfers of water rights. A volumetric fee for water use was set in the Water Utilisation Act (United Republic of Tanzania, 1974), in order to provide funding for water management, as first suggested in a study of water management made during construction of hydropower plants in the Pangani River Basin in the 1930s (Teale & Gillman, 1935).

Customary or traditional rights to water have coexisted with the statutory water licences since their inception. In communities with a long-standing practice of traditional irrigation, rightful access to water is seen as a matter of usufruct, inheritance or local custom. Tanzania has legal pluralism and varying customary laws are accepted under the Judicature and Application of Laws Ordinance (No. 453) of 1961 as equal to written law (United Republic of Tanzania, 2004a). Despite this, customary rights to water are not recognised in the same way as rights to land (see United Republic of Tanzania, 1994b). The uneasy coexistence between customary and statutory rights to water has been an issue during legislative review on more than one occasion (Teale & Gillman, 1935; Government of Tanganyika, 1956; Scott, 1962; United Republic of Tanzania, 2004a). Provisions were made for the registration of traditional rights in the 1959 Ordinance, but actual registration during the short moratorium was limited and rights accrued by "custom" or long undisturbed use are not acknowledged by the Water Utilisation Act (United Republic of Tanzania, 1974), nor by the water officers who implement it[5]. Only administrative water rights already registered under the old water ordinances or the current act, are acknowledged as existing rights. As a result, the legislation and the records of water rights still tend to favour the estate sector, formal irrigation and hydropower over farmer-managed irrigation (Tagseth, 2000; Reed-Erichsen, 2003)[6].

A new water policy document, replacing the 1991 water policy, was prepared by the Ministry of Water in 2000 (United Republic of Tanzania, 2000a) and eventually sanctioned in 2002 (United Republic of Tanzania, 2002a). The new national water policy emphasises the river basin as the administrative unit and the vision of integrated water resources management. The previous priorities[7] between alternative sectors have been abandoned in the new policy, where human needs are defined as a first priority before environmental flow, while water allocation for "other uses will be subject to social and economic criteria, which will be reviewed from time to time" (United Republic of Tanzania, 2002a, 18). Furthermore, the policy proposal states that "in order to realize the objectives of water resources management, all water uses, especially water use for economic purposes, will be charged for" (United

[5] Interviews, principal water office at Ubungo, Dar es Salaam 18.01.1996.

[6] An examination of the records of water rights at regional, basin and national level showed that past management has resulted in a bias towards a "formal" sector of water use on matriculated, alienated land. Many registrations date from the British colonial period, while some certificates originate in the original German alienation of land in Kilimanjaro more than one hundred years ago. Water rights acknowledged by a sovereign *mangi* (prince, chief) prior to 1886 have left no such records.

[7] The former (1991) water sector policy ranked priorities (in order of importance) for domestic use, livestock, food production and industries before hydropower (informants under the Ministry of Water and the Ministry of Agriculture interviewed in Dar es Salaam January 1996 and Moshi in June 2000).

Republic of Tanzania, 2002a, 29). The principle that "water has a value in all its competing uses" (United Republic of Tanzania, 2002a, 15) and the volumetric pricing of water in order to increase efficiency (United Republic of Tanzania, 2002a, 7, 14) are also recognised. Trading of water rights is to be introduced as a means of demand management and water conservation (United Republic of Tanzania, 2002a, 19). The documents also mention water user and stakeholder participation, which could be interpreted as embracing more neo-populist methods of water management.

Through adoption of the basin as a management unit, through attempting to place a value on the use of water and through the focus on stakeholder involvement at various levels, the policy document undoubtedly embraces core elements of the "international consensus" on water management as expressed in the Dublin principles. Integrated water resources management at river basin level, as well as water fees for the recovery of administrative and catchment management costs are, however, in line with old-established suggestions and priorities for this basin (Teale & Gillman, 1935, 137, 146; Scott, 1962). The policy also takes up again the old objective of establishing a universal system of water licences, still not fulfilled after two legislative reviews and 50 years to implement it (Government of Tanganyika, 1956). The idea that the volumetric water pricing is a method of demand management can be described as novel, yet in line with international neoliberal recommendations on water management. The implementation of this water policy will, among other things, depend on the ongoing revision of the national water legislation. Furthermore, the implementation will take place in the context of other (sectoral) policies and strategies which will tend to counteract the centralisation of water management and the use of price mechanisms for allocation.

Tanzanian planning is guided by the framework of a development vision (United Republic of Tanzania, 1999) and associated strategies for poverty reduction (United Republic of Tanzania, 2000b) and poverty eradication. These should, at least in principle, guide sectoral policy papers and finally strategy papers. However, various policies are likely to contain conflicting objectives. With food security as a national priority, the national irrigation master plan (United Republic of Tanzania, 2002b) aims to increase the irrigated area by 9% and to redevelop half of the area under traditional irrigation by 2017. The energy policy (United Republic of Tanzania, 1992), on the other hand, gives priority to hydropower development, which may reduce the use of foreign currency to import fossil fuels, but this is very likely to compete with irrigation development[8]. The implementation of the new water policy (United Republic of Tanzania, 2002a) will be guided by the National Water Sector Development Strategy, (United Republic of Tanzania, 2004c) (still in draft form), but the process will also be affected by other policies, strategies and processes, including the process of decentralisation intended to empower the district level (United Republic of Tanzania, 1998).

A legislative review was called for in the water policy paper (United Republic of Tanzania, 2002a, 9, 28). The dual system of water rights has been identified as an issue in the ongoing legislative process and the recognition of "customary rights" was among the objectives of a proposed "bill for the water resources management act of 2004" (United Republic of Tanzania, 2004b), whereby customary rights are to be "of equal status and effect to a granted right" (United Republic of Tanzania, 2004b, Paragraph 21(1)). Within a two-year period, those who have abstracted and used water undisturbed for a period of time are entitled to "water use permits" upon application to the water officer. After this period has

[8] It is apparent that the conflict has not been resolved at this policy level, but it seems that the situation is somewhat eased by the development of domestic natural gas resources as an alternative to erratic hydropower.

expired, the water officer will be authorised to register them regardless. Various local organisations are to be registered and given a formal status by the officer. An apparent objective is to incorporate customary rights in the registry of statutory licences, thus creating a single path to a legitimate right to water. This is in line with the water policy, which states that "[r]elevant customary law and practice ... will be institutionalised into statutes" (United Republic of Tanzania, 2002a, 29). This is an improvement over the past assessment that all unlicensed abstractions are illegal, even if it could be seen as a repetition of a strategy that failed following water legislation reforms in 1959 and 1974. Juma & Maganga (2005) have warned that the expectation that customary laws are a transitory system which will die out may not be fulfilled. The acknowledgement of customary or common law principles of prescriptive rights could nevertheless be seen as a movement towards a formal acceptance of community-based management. However, the provisions will also make it easier to incorporate and charge traditional abstractions. Another important suggestion involves authorising the permanent or temporary transfer of water permits, which is one of the prerequisites for establishing a water market. This is clearly a licence for market-based ideas. Furthermore, provisions are made to set up sub-catchment organisations with boards and water officers. The latter would involve some decentralisation of authority to local level and possibly some adaptation to local practice in water management. These provisions are closer to suggestions from NGOs involved in the water sector aiming to improve communication, participation and representation in water management.

Water mangement in the Pangani River Basin

It can be argued that developments in the Pangani River Basin have been important in defining problems and solutions in Tanzanian water management for a long time, owing to the intensive utilisation of the available resources for smallholder irrigation, plantations, industrial irrigation and hydroelectric power. European explorers arriving in the highland areas in the Pangani River Basin from the mid-19th century onwards were impressed by the hill furrow irrigation systems found in the mountain areas in the basin and by the available water resources (Rebmann, 1860; New, 1873; Johnston, 1886; Baumann, 1891, among others). However, from the period of colonisation onwards, the system was often described as wasteful and in need of improvement, reflecting increasing conflicts of interest (Griffith, 1930; Swynnerton, 1949). The independent state of Tanzania, as well as the many donors involved in water development projects in the region over the years, appears to have inherited the latter perception (Daluti, 1994; United Republic of Tanzania 1994c). Despite many attempts to control, reform and "improve" the indigenous water management systems (see for instance, Lein, 1998, 2004), most irrigation schemes operate under forms of farmer and community management and these continue to play a key role in intensive local farming systems.

Mt. Kilimanjaro, together with other mountain areas, catches orographic precipitation which makes up most of the runoff to the Pangani River. The retreating glacier on Mt. Kilimanjaro is now rapidly becoming an icon of global climate change, following a remote sensing study by Hastenrath & Greischar (1997) and a much-quoted study of palaeoclimate by Thompson *et al.* (2002, 580), warning that that "if current climatological conditions persist, the remaining ice fields are likely to disappear between 2015 and 2020". This is, however, not a new claim, as the process of glacial retreat has been observed and published since shortly after Hans Meyer's first climb in 1887 (Geilinger, 1936, 9) and investigated by Klute (1920) and by Geilinger (1936). Geilinger (1936: 20) warned that "should the climatic conditions that have existed for the last fifty years prevail, ... the ice within the crater may

disappear entirely in the decades to come, followed later by the disappearance of the glaciers on the outer slopes"[9]. The glacial retreat may reflect changes since the 19th century and not only the recent decades (see Cullen *et al.*, 2006).

With the dwindling snows of Kilimanjaro having become the most visible and powerful icon of global climate change, the International Union for the Conservation of Nature (IUCN) (2003) and others have started to blame the inadequate water supplies on a regional impact of climate change (global warming). However, the perception that the ice in the high alpine desert is a significant source of runoff at lower elevations (e.g. Gasse, 2002) can be rejected on the basis of a review of data on precipitation by altitude[10].

The African climate is an uncertain factor and it does change on varying temporal scales. A change in precipitation on the mountain has been ruled out by some hydrologists (Sarmett & Faraji, 1991), while increased demand and environmental degradation caused by population growth were identified as key causes of the regional water crisis in the basin (Sarmett & Faraji, 1991; Daluti, 1994). Mkhandi & Ngana (2001) have identified negative trends in linear regressions for the period 1930–1990 from the precipitation records. Three precipitation stations which started recording in the first quarter of the 20th century yielded data showing negative regressions for the period up to 2004, according to Hemp (2005). The glacial retreat and the reduction in precipitation could be caused by the same climatic changes, whether this is due to an increase in temperature or other changes, such as a reduction in cloud cover. It now appears likely that changes in climate in the form of a decrease in precipitation during the 20th century and an associated reduction in runoff are contributing factors to water scarcity in the region.

Policy makers and various consultants have identified poor implementation of existing regulations as a major cause of the impending water crisis in the basin (United Republic of Tanzania, 1994c). Among these were the Scandinavian donors, who pushed for changes in water management in the 1990s (Hjorthol, 1994; Rudberg, 1994; Development Today, 1995), owing to concerns about the availability of water to run the redeveloped hydropower plant downstream at Pangani Falls (Bryceson, 1994). An interpretation of a water crisis was developed and a set of interventions prescribed and given backing from the Norwegian Agency for Development Cooperation (NORAD) and the World Bank. The Scandinavian involvement in water management reforms in the Pangani Basin lasted through the 1990s, in parallel with World Bank involvement, which is still ongoing. More recently, the basin has become a pilot site for the Water and Nature Initiative of the IUCN.

The water crisis in Kilimanjaro and the Pangani Basin is multifaceted and experienced in different ways by different actors. Its causes are still open to debate, as are the cures. Thus, in a constructivist interpretation, the emergence and definition of a water crisis in Pangani and Kilimanjaro is linked not only to a possible physical process of desiccation but also to concerns about water for the major development projects in the region and to the need for state control over water.

A conflict perspective on water management at the basin level shows that interpretations of the crisis are associated with the diverging interests of sets of actors. In the Pangani Basin, farmer-managed irrigation competes with irrigation development projects and irrigation competes with hydropower (Mujwahuzi, 2001). Plans for irrigated development in the lowlands have existed since the 1930s (Buckland, 1939). These plans have been reconfirmed on many occasions, but concerns about water for hydropower are

[9] The reading that Professor Meyer concluded in 1896 from his observations that the glaciers of the Kibo crater were likely to disappear prior to Geilinger's publication is even more intriguing (Geilinger, 1936: 9).

[10] The precipitation peaks in the lower part of the forested belt at *c.* 2000 m.a.s.l., while the alpine zone is arid, cover a small area and presumably have high levels of evaporation (see Figure 2.2 in Tagseth, 2000: 18).

among the factors that have slowed the development (Teale & Gillman, 1935). Irrigation development in the semi-arid lowland followed at a moderate pace (Lein, 2004). A Scandinavian preoccupation with hydropower and a Japanese preoccupation with the production of paddy led to two major development projects within a decade. The first phase of the Japanese-sponsored Lower Moshi Irrigation Scheme was completed in 1986 had been funded by US$31 million by 1992 (Beez, 2005, 33–34), while the rehabilitation of the hydropower station at Pangani Falls was completed in 1995 at a cost of 850 million NOK (*c*. US$136 million). This contributed significantly to the water stress in the region, resulting in the establishment of the Pangani Basin Water Office (PBWO) in 1992, as the first river basin authority in Tanzania. The Pangani Basin's water officer was given the tasks of bringing water use under control through implementation of the mandatory water licence in accordance with statutory law and implementing the new volumetric fees for water use. When the PBWO was established, the basin officer was given the task of collecting data on hydrology and water use, and 1015 abstractions with water rights and 1881 unlicensed abstractions were identified[11]. A crash programme to install several hundred control gates to limit the abstractions of water for farmer-managed irrigation was launched. The unlicensed users were told to apply for statutory water rights and to pay an application fee. Other important objectives were to collect the revised fees for water use in order to fund the activities of the PBWO and also to reform the traditional organisation of farmer-managed irrigation into registered, standardised water users associations, which could be held accountable to the water authorities.

The implementation of river basin management along these lines met with resistance and what can be described as widespread non-cooperation in the effort to install control structures and in the process of implementing the administrative water licence. The relationship with groups of irrigators became strained during the crash programme and there were locations which the basin water officer and his staff could not visit safely[12]. There was also resistance and non-cooperation from local government, and water management became an object of debate during the first multiparty parliamentary elections in Tanzania. In the districts with long-established practices of irrigation, the prescribed measures have been met with different notions of the rightful access to water and what constitutes proper management of water. Water itself is understood to be "a gift from God", owned by no-one. The scheme may belong to a family group ("clan"), which appoints the leader of water, while members of the community maintain rights of use. Contribution to the common good (the scheme), long undisturbed use and inheritance are the principles underlying discussions over rightful access to water. The relevance of the statutory licence in local disputes remains minor and it is associated with the colonial estates and other outside interests. The local institutions and practices of water management are varied, but in some of the communities with a long history of irrigation, the combination of cash payment and access to water from a canal is seen as immoral, "a sin against God". The apparent problem of legitimacy of statutory water rights and the efforts to improve water management through integrated water resources management is still seen as a problem of an inefficient communications strategy (United Republic of Tanzania, 2004c), rather than as a conflict over resource tenure, procedure and the objectives of water management.

By 2002/03, the PBWO was able to collect US$75,000, that is, 38% of the amount due from water rights holders[13]. Owing to the cost of monitoring the many water abstractions, a flat rate minimum fee

[11] PBWO database 1994: *watright* and *tradfur*.
[12] Interviews with Ministry of Water personell at Ubungo Dar es Salaam, Hale and Moshi 18.08.1995–20.02.1996.
[13] Regional Hydrologist, Kilimanjaro, archive (H1\22RBM-SIIP).

(van Koppen *et al.*, 2004) and a practice of billing according to installed capacity rather than actual water use have been adopted. This is rational in terms of cost recovery, as the costs of monitoring and billing these abstractions even on an annual basis in areas with poor road access are considerable, but it undermines the intended role of fees as an economic incentive. The progress in registration of water rights was limited, owing to lack of both applications and caution in issuing new water rights. The difficulties in establishing a single statutory system of licences may have been underestimated, repeating the failures of the campaigns following the legislative reforms in 1959 and 1974. Despite emergency measures in water management and because of subsequent droughts and competing demands for water for irrigation in the industrial and traditional sectors, in recent years the flow of water through the turbines has been less than the hydropower plant at Pangani Falls was designed for (the reservoir's water level was within 4 cm of the critical level in 2004[14]). In 2006 the national power grid had to schedule blackouts owing to water shortage in reservoirs across the country (IPP, 2006; Saleh, 2006).

Alternative proposals have been put forward by NGOs engaged in giving assistance to traditional irrigation and the environment[15], with some support from the World Bank's Traditional Irrigation Improvement project and the IUCN. The suggestion is to integrate the varied scheme organisations into catchment organisations controlling a source of water[16]. These could form the basis for a tiered water management organisation and make improved representation of stakeholders on the River Basin Board possible[17], These principles have been tested only to a limited extent in a few project areas in this river basin[18], but they are given consideration in the review of the water legislation (United Republic of Tanzania, 2004b). The water sector development strategy (United Republic of Tanzania, 2004c, 15), suggests an organisational structure with financially and administratively autonomous basin water boards funded by user charges (and free to negotiate support independently) and sub-catchment committees with powers delegated from the basin level. The latter will be financially self-sustaining through user charges. Finally, the objective of organising the users into legal, registered formal organisations (water users associations) financed from user fees is reconfirmed. The strategy devises charges for water mainly as a way to overcome inadequate funding for management activities (United Republic of Tanzania, 2004c, 57). The Pangani River Basin Management Project supported by the IUCN and the United Nations Development Programme is planning to implement a "catchment forum" for a sub-basin (Kikuletwa) as a pilot project where water users can be given a voice (United Republic of Tanzania, 2006). This strategy has backing in the water policy and is seen as important by the PBWO[19]. The prospects and importance of this forum will improve if provisions for a formal status are made by new water legislation.

---

[14] PBWO data for Week 44 in 2004 reported by Pål Tengesdal (personal communication 4 November 2004).

[15] Among these are PAMOJA (Kilimanjaro Joint Action Project), TIP (Traditional irrigation and environmental development organisation).

[16] *Water Use Management and Traditional Irrigation Systems in Tanzania. A Presentation for the Second World Water Forum*, TIP/Traditional irrigation and environmental development organisation, World Water Fair, The Hague, 17–22 March 2000, (TIP Archive Moshi).

[17] H. Keizer personal communication, 2001; field conversations traditional irrigation and environmental development organisation (TIP) staff Moshi (June 2003).

[18] Zongolo, S.A. *Identification of Problems Experienced in Irrigation Practice in Runduguai Area, Hai District*, Memo, PAMOJA (Kilimanjaro Joint Action Project), Moshi, December 2001.

[19] Pangani Basin Water Office file PBWO/PBWOQR # 24: Quarterly report for the period October–December 2004, p 9.

Conclusion

The three approaches to water management outlined in this article each provide different answers to how and by whom limited water resources best can and should be managed. The traditional technocratic model found in many river basin water management projects around the world is currently being challenged by both neoliberal and neo-populist ideas.

In the recent water policy documents (United Republic of Tanzania, 2002a, 2004c), as well as in the activities of the PBWO, there is evidently some adjustment to more general and global trends in water management reforms, with at least some token references to issues such as water pricing and local participation. The suggestion to legalise the sale of permits is clearly a gesture to the neoliberal model, but with the implementation of the new policy there remains a distinct possibility that "the value of water" may translate into a water tax and not a competitive market-based pricing ensuring efficient use of available resources in economic terms. The drive towards "demand management" through the price mechanism has provided arguments for a strategy based on water fees, but in practice this is more about cost recovery for water management than about attempting a more controversial and difficult market allocation mechanism.

Devolution or decentralisation is definitely an issue in African and in Tanzanian resource management[20], but the impact on the water sector still remains comparatively small. The Dublin principles on public participation and devolution of management to the "lowest appropriate level" can be, in the Tanzanian policy context, translated into campaigns for the "creation of awareness" in order to increase compliance with regulations. Consultation, transparency or the transfer of responsibilities to sub-catchment organisations or communities may be more difficult to achieve. The acknowledgement of customary or common law principles of prescriptive rights in the proposed new water legislation could be seen as a movement away from the technocratic model. The establishment of sub-catchment organisations would involve some decentralisation of authority to a local level and perhaps some adaptation to local practice in water management related to the neo-populist influence. A water management organisation covering a smaller hydrological region could provide a meeting place between the traditional and modern water management systems (Tagseth, 2006), or a framework for incorporating traditional irrigation into the state management system.

Central to the development of water management in the Pangani River Basin in Tanzania is what can perhaps best be understood as a conflict between a local, community-based water management system and a fairly technocratic water management system. The activities of the Pangani Basin Water Office and the donors supporting it, as well as the new water policy and strategy, can probably best be interpreted as a continuation of a traditional top-down bureaucratic approach to water management, rather than representing a renewal. The water laws and the water management system—formulated by the British and later carried on by Nyerere's socialist government and continuing right up to present-day policies—have neither been designed to secure local communities' active participation in water management nor to facilitate the emergence of a functioning market for water.

[20] The local government reforms and the reforms towards village land titling in Tanzania from the 1990s are two examples.

References

Adams, W. M. (1990). How beautiful is small? Scale, control and success in Kenyan Irrigation. *World Development*, *18*(10), 1309–1323.

Adams, W. M. (1992). *Wasting the Rain. Rivers, People and Planning in Africa*. University of Minnesota Press, Minneapolis.

Agrawal, A. & Gibson, C. C. (1999). Enchantment and disenchantment: the role of community in natural resource conservation. *World Development*, *27*(4), 629–649.

Barham, E. (2001). Ecological boundaries as community boundaries. The politics of watershed. *Society and Natural Resources*, *14*, 181–191.

Barrow, C. J. (1998). River basin planning and management. A critical review. *World Development*, *26*(1), 171–186.

Bauer, C. J. (1997). Bringing water markets down to earth: the political economy of water rights in Chile, 1976–95. *World Development*, *25*(5), 639–656.

Bauer, C. J. (2004). *Siren Song: Chilean Water Law as a Model for International Reform*. Resources for the Future, Washington DC.

Baumann, O. (1891). *Usambara und seine Nachbargebiete*. Reimer, Berlin.

Beez, J. (2005). Die Ahnen essen keinen Reis. Vom lokalen Umgang mit einem Bewässerungsprojekt am Fuße des Kilimanjaro in Tansania. *Bayreuth African Studies Working Papers No. 2*. Universität Bayreuth Institut für Afrikastudien & Kulturwissenschaftliches. Bayreuth. [Available from: http://opus.ub.uni-bayreuth.de/volltexte/2005/168/ accessed 19.04.2007].

Blaikie, P. (1998). Paradigms for environment and development. In *Looking at Maps in the Dark. Directions for Geographical Research in Land Management and Sustainable Development in Rural and Urban Environments in the Third World*. de Haan, L. & Blaikie, P. (eds). Nederlandse Geografische Studies/Netherlands Geographical Studies 240. Royal Dutch Geographical Society, Utrecht, pp. 9–40.

Bryceson, I. (1994). Norske kraftutbyggere i Tanzania. In *Kraft og konflikter. Norske vannkraft-utbyggere i den tredje verden*. FIVAS, Oslo, pp. 97–104.

Buckland, L. L. R. (1939). *Water Executive Annual Report*. Government Printer, Dar es Salaam.

Chambers, R., Pacey, A. & Thrupp, L. A. (eds) (1989). *Farmer First. Farmer Innovation and Agricultural Research*. Intermediate Technology Publications, London.

Clarke, R. (1991). *Water—The International Crisis*. Earthscan, London.

Cleaver, F. (2000). Moral ecological rationality, institutions and the management of common property resources. *Development and Change*, *31*, 361–383.

Coward, E. W. (1977). Irrigation management alternatives. Themes from indigenous irrigation systems. *Agricultural Administration*, *4*, 223–237.

Cullen, N. J., Mölg, T., Kaser, G., Hussein, K., Steffen, K. & Hardy, D. R. (2006). Kilimanjaro Glaciers: recent areal extent from satellite data and new interpretation of observed 20th century retreat rates. *Geophysical Research Letters*, *33*(16) art. no. L16502.

Daluti, L. R. (1994). *Draft report on the Agro-Socio-Economic Situation in Pangani River Catchment*. Concultancy for NORPLAN. Zonal Irrigation Office, United Republic of Tanzania, Moshi.

Development Today (1995). Conflicts over Pangani dampen enthusiasm for hydro power in Tanzania. *Development Today: Nordic outlook on Development Assistance, Business and the Environment*, *5*, 1–6.

deWalt, B. R. (1994). Using indigenous knowledge to improve agriculture and natural resource management. *Human Organization*, *53*(2), 123–131.

Falkenmark, M., Lundqvist, J. & Widstrand, C. (1990). *Water Scarcity: An Ultimate Constraint in Third World Development: A Reader on a Forgotten Dimension in Dry Climate Tropics and Subtropics*. (Tema V Report 14, 1990). University of Linköping Department of Water and Environmental Studies, Linköping.

Gasse, F. (2002). Kilimanjaros secrets revealed. *Science*, *18*, 548–549.

Geilinger, W. (1936). The retreat of the Kilimanjaro glaciers. *Tanganyika Notes and Records*, *2*, 7–20 (October).

Gleick, P. H. (1998). The human right to water. *Water Policy*, *1*, 487–503.

Government of Tanganyika (1956). *Report of the Water Legislation Committee 1956*. The Government Printer, Dar es Salaam.

Griffith, A. W. M. (1930). *Chagga land tenure report*. Government of Tanganyika, Moshi District.

Hastenrath, S. & Greischar, L. (1997). Glacier recession on Kilimanjaro, East Africa, 1912–89. *Journal of Glaciology*, *43*(17), 455–459.

Hemp, A. (2005). Climate change-driven forest fires marginalize the impact of ice cap wasting on Kilimanjaro. *Global Change Biology*, *11*, 1013–1023.

Hjorthol, L. M. (1994). Norad-press mot Tanzania. *NTB, 27.05.1994*. Oslo.

IPP (2006). Tanzania should boost water management—World Bank. *IPP media* 2006-04-05. http://www.ipp.co.tz/ipp/financial/2006/04/05/63581.html (accessed 29.03.2007).

IUCN (2003). *Pangani Basin: A Situation Analysis*. International Union for the Conservation of Nature and Natural Resources, Eastern Africa Programme. Nairobi.

Johansson, I. (1983). *Nordic Glossary of Hydrology*. Almqvist & Wiksell International, Stockholm.

Johnson, S. P. (1993). *The Earth Summit: The United Nations Conference on Environment and Development (UNCED)*. Graham & Trotman, London.

Johnston, H. H. (1886). *The Kilima-njaro Expedition. A Record of Scientific Exploration in Eastern Equatorial Africa. And a General Description of the Natural History, Languages and Commerse of the Kilima-njaro District*. Kegan, Paul Trench and Co., London.

Juma, I. H. & Maganga, F. P. (2005). Current reforms and their implications for rural water management in Tanzania. *International Workshop on African Water Laws: Plural legislative frameworks for water management in Africa*. 26–28 January 2005, Johannesburg. http://www.nri.org/waterlaw/AWLworkshop/JUMA-IH.pdf (accessed 11.04.2007).

Klute, F. (1920). *Ergebnisse der Forschungen am Kilimandscharo 1912*. Dietrich Reimer (Ernst Vohsen) A. G., Berlin.

Leach, M., Mearns, R. & Scoones, I. (1999). Environmental entitlements: Dynamics and institutions in community-based natural resources management. *World Development*, *27*(2), 225–247.

Lein, H. (1998). Traditional versus modern water management systems in Pangani River Basin, Tanzania. In *Looking at Maps in the Dark. Directions for Geographical Research in Land Management and Sustainable Development in Rural and Urban Environments of the Third World*. de Haan, L. & Blaikie, P. (eds). Royal Dutch Geographical Society, Utrecht &Amsterdam, pp. 52–64.

Lein, H. (2004). Managing the water of Kilimanjaro: irrigation, peasants and hydropower development. *Geojournal*, *61*, 155–162.

Lomborg, B. (2001). *The Sceptical Environmentalist: Measuring the Real State of the World*. Cambridge University Press, Cambridge.

Lonergan, S. C. (2001). Water and conflict: rhetoric and reality. In *Environmental Conflicts*. Diehl, P. F. & Gleditsch, N. P. (eds). Westview Press, Boulder, pp. 109–124.

Metha, L. (2000). *Water for the Twenty-First Century: Challenges and Misconceptions*. IDS Working Paper 111. Institute of Development Studies, Brighton.

Mkhandi, S. & Ngana, J. (2001). Trend analysis and spatial variability of annual rainfall. In *Water Resources Management in the Pangani River Basin. Challenges and Opportunities*. Ngana, J. (ed.). Dar es Salaam University Press, Dar es Salaam, pp. 11–20.

Mody, J. (2001). *Management of river basin systems through decentralization*. World Bank, Washington. http://lnweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/LiteratureReview/$FILE/RiverBasinProjectLiteratureReview.pdf (accessed 14 April 2008).

Mosse, D. & Sivan, M. (2003). *The Rule of Water: Statecraft, Ecology and Collective Action in South India*. Oxford University Press, New Delhi & Oxford.

Mujwahuzi, M. R. (2001). Water use conflicts in the Pangani Basin, an overview. In *Water Resources Management in the Pangani River Basin. Challenges and Opportunities*. Ngana, J. (ed.). Dar es Salaam University Press, Dar es Salaam, pp. 128–137.

Mwita, D. M. (1975). *Rights in Respect of Water in Tanganyika*. LLM degree thesis. University of Dar es Salaam, Dar es Salaam.

New, C. (1873). *Life, Wanderings and Labours in Eastern Africa. With an Account of the First Successful Ascent of the Equatorial Snow Mountain, Kilima Njaro and Remarks upon East African Slavery*. Frank Cass & Co., London.

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

Ostrom, E. (1992). *Crafting Institutions for Self-Governed Irrigation Systems*. ICS Press, San Francisco.

Ostrom, E. (2002). How farmer managed irrigation systems build social capital to outperform agency management systems that rely primarily on physical capital. In *Farmer Managed Irrigation Systems in the Changed Context*. Preadhan, P. & Gautam, U. (eds). Farmer Managed Irrigation Systems Promotion Trust, Kathmandu, pp. 25–32.

Perry, C. J. (2001). *Charging for Irrigation Water: The Issues and Options, With a Case Study from Iran*. International Water Management Institute Research Report 52. IWMI, Colombo.

Petrella, R. (2001). *The Water Manifesto. Arguments for a World Water Contract*. Zed Books, London.

Postel, S. (1992). *The Last Oasis*. Earthscan Publications, New York.
Rebmann, J. (1860). Journey to Jagga. In *Travels, Researches and Missionary Labours During an Eighteen Years' Residence in Eastern Africa. Together with Journeys to Jagga, Usambara, Ukambani, Shoa, Abessinia and Khartum; and a Coasting Voyage from Mombaz to Cape Delgado*. Krapf, D. J. L. (ed.). Trübner and Co., London, pp. 230–265.
Reed-Erichsen, M. (2003). *Negotiations over Rights to Water. The Process of Determining Allocation of Water between Farmers and Estates, in the Context of Coffee-Producing Estates in Kilimanjaro Region—Tanzania*. Cand. polit. thesis. Department of Geography, Norwegian University of Science and Technology (NTNU), Trondheim.
Rosegrant, M. W. & Binswanger, H. P. (1994). Markets in tradable water rights: potential for efficiency gains in developing country water resource allocation. *World Development*, *22*(11), 1613–1625.
Rudberg, T. (1994). Spilt vann kan koste Tanzania norsk støtte for 400 mill. *NTB, 29.06.1994*. Oslo.
Saleh, A. (2006). Drought cutting Tanzania's power supply. *Reuters News Service*, 9 January 2006 http://www.planetark.com/dailynewsstory.cfm/newsid/34374/story.htm (accessed 18.06.2005).
Sarmett, J. D. & Faraji, S. A. (1991). The hydrology of Mount Kilimanjaro: an examination of dry season runoff and factors leading to its decrease. In *The Conservation of Mount Kilimanjaro*. Newmark, W. D. (ed.). IUCN (World Conservation Union), Gland, pp. 53–70.
Schleyer, R. G. & Rosegrant, M. W. (1996). Chilean water policy: the role of water rights, institutions and markets. *Water Resources Development*, *12*(1), 33–48.
Scott, P. (1962). *The Development of the Pangani River Basin*. Sir William Halcrow and Partners, London.
Strang, V. (2004). *The Meaning of Water*. Berg, Oxford.
Swynnerton, R. J. M. (1949). Some problems of the Chagga on Kilimanjaro. *East African Agricultural Journal, (Amani) January*, 117–132.
Tagseth, M. (2000). *Knowledge and Development in Mifongo Irrigation Systems. Three Case Studies from Mt. Kilimanjaro, Tanzania*. Cand. Polit. thesis. Department of Geography, Norwegian University of Science and Technology (NTNU), Trondheim.
Tagseth, M. (2002). Contested waters. Issues in water management for the Pangani Basin. In *Geographical Methods—Power and Morality in Geography. Proceedings of the Annual Conference of the Norwegian Geographical Society, 5–6 April 2002, Acta Geographica Trondheim. Series. A: 2*. Setten, G. & Rudsar, S. (eds). Department of Geography, Norwegian University of Science and Technology, Trondheim, pp. 226–235.
Tagseth, M. (2006). The 'mfongo' irrigation systems on the slopes of Mt. Kilimanjaro, Tanzania. In *A History of Water. Volume 1: Water Control and River Biographies*. Tvedt, T., Coopey, R., Jakobsson, E. & Ostigaard, T. (eds). I.B. Tauris, London, pp. 488–506.
Teale, E. O. & Gillman, C. (1935). *Report on the Investigation of the Proper Control of Water and the Reorganisation of Water Boards in the Northern Province of Tanganyika Territory November–December 1934*. The Government Printer, Morogoro/Dar es Salaam.
Thompson, L. G., Mosley-Thompson, E., Davis, M. E., Henderson, K. A., Brecher, H. H., Zagorodnov, V. S., Mashiotta, T. A., Ping-Nan Lin, Mikhalenko, V. N., Hardy, D. R. & Beer, J. (2002). Kilimanjaro ice core records: evidence of Holocene climate change in tropical Africa. *Science*, *298*(5593), 589–593.
Turral, H. (1995). *Devolution of Management in Public Irrigation Systems: Cost Shedding, Empowerment and Performance*. Working Paper 80. Overseas Development Institute, London.
UNESCO (2003). *Water for People—Water for Life. The United Nations World Water Development Report*. UNESCO-World Water Assessment Programme, Barcelona.
United Republic of Tanzania (1974). *Water Utilization (Control and Regulation) Act, 1974 (No. 42)*. Dar es Salaam.
United Republic of Tanzania (1981). *Water Utilization (Control and Regulation) Act (Amdt.) 1981 (No. 10)*. Dar es Salaam.
United Republic of Tanzania (1992). *The Energy Policy of Tanzania*. URT, Ministry of Water, Energy and Minerals. Government Printer, Dar es Salaam. http://www.tzonline.org/pdf/theenergypolicyoftanzania.pdf (accessed 18.01.2006).
United Republic of Tanzania (1994a). *Water Utilization (General) (Amendment) Regulations, 1994*. Dar es Salaam.
United Republic of Tanzania (1994b). *Report of the Presidential Commission of Inquiry into Land Matters*. The Ministry of Lands, Housing and Urban Development, Government of the United Republic of Tanzania in cooperation with the Scandinavian Institute of African Studies, Uppsala.
United Republic of Tanzania (1994c). *Water Utilisation and Shortage in the Pangani River Basin*. United Republic of Tanzania. Ministry of Water Energy and Minerals, Moshi.

United Republic of Tanzania (1996). *Water Utilization (General) (Amendment) Regulations 1996. Gazette* 77:6, Supplement No. 23.
United Republic of Tanzania (1997). *Water Laws (Miscellanous Amendments) Act, 1997*. An act to amend certain written laws pertaining to water. April 4th, 1997. *Gazette* 8:1997.
United Republic of Tanzania (1998). *Policy Paper on Local Government Reform*, October 1998. Ministry of Regional Administration and Local Government, Dar es Salaam.
United Republic of Tanzania (1999). *Development Vision 2025*. Planning Commission. Dar es Salaam. http://www.tzonline.org/pdf/theTanzaniadevelopmentvision.pdf (accessed 18.01.2006).
United Republic of Tanzania. (2000a). *National Water Policy*. Ministry of Water, United Republic of Tanzania, Dar es Salaam.
United Republic of Tanzania (2000b). *Poverty Reduction Strategy Paper (PRSP)*. Government Printer, Dar es Salaam. http://www.tzonline.org/pdf/FinalPRSP25.pdf (accessed 18.1.2006).
United Republic of Tanzania (2002a). *National Water Policy*. Ministry of Water and Livestock Development, United Republic of Tanzania, Dar es Salaam.
United Republic of Tanzania. (2002b). *The Study on the National Irrigation Master Plan*. Japan International Cooperation Agency and United Republic of Tanzania–Ministry of Agriculture and Food Security, November 2002. Nippon Koei Co., Dar es Salaam.
United Republic of Tanzania (2004a). *Review of Customary Water Law Regimes: Issues for the Reform of Water Laws*. Consultancy Services on Reviewing Water Resources Legislation Water Supply and Sewerage and Rural Water Supply & Sanitation by Mawenzi Advocate's Chambers. RBM SIIP project. Ministry of Water and Livestock Development United Republic of Tanzania, Dar es Salaam.
United Republic of Tanzania (2004b). *Proposed Draft Bill for the Water Resources Management Act, 2004*. Consultancy Services on Reviewing Water Resources Legislation Water Supply and Sewerage and Rural Water Supply & Sanitation by Mawenzi Advocate's Chambers. RBM SIIP project. Ministry of Water and Livestock Development, United Republic of Tanzania, Dar es Salaam.
United Republic of Tanzania (2004c). *National Water Sector Development Strategy*. United Republic of Tanzania–Ministry of Water and Livestock Development. Circulation draft June 2004. Dar es Salaam.
United Republic of Tanzania (2006). *Developing a Forum for Water Users in the Kikuletwa River Catchment*. (folder) United Republic of Tanzania—Pangani River Basin Management Project, Moshi.
Uphoff, N. & Wijayaratna, C. M. (2000). Demonstrated benefits from social capital: the productivity of farmer organizations in Gal Oya, Sri Lanka. *World Development*, *28*(11), 1875–1890.
van Koppen, B., Sokile, C., Hatibu, N., Lankford, B., Mahoo, H. & Yanda, P. (2004). *Formal Water Rights in Tanzania: Deepening the Dichotomy?* International Water Management Institute, Colombo. http://www.iwmi.cgiar.org/pubs/working/WOR71.pdf (accessed 01.01.2006).
Wester, P. (2003). Boundaries of consent: stakeholder representation in river basin management in Mexico and South Africa. *World Development*, *31*(5), 797–812.
World Bank (1993). *Water Resources Management. A World Bank Policy Paper*. The World Bank, Washington DC.
World Bank (2003). *Water Resources Sector Strategy. Strategic Directions for World Bank Engagement*. The World Bank, Washington DC.

Received 9 May 2007; accepted in revised form 12 June 2007