Constraints and Potential for Efficient Inter-sectoral Water Allocations in Tanzania

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Abstract

In many sub-Saharan African countries, there are conflicts over water uses in most river basins. In Tanzania, conflicts are becoming alarming and are exacerbated by increasing water demands due to rapid population growth and expanding economic activities. This paper reviews the major constraints and potential for achieving efficient systems of allocating water resources to different uses and users in Tanzania. The following constraints are identified: a) the lack of active community involvement in management of water resources; b) conflicting institutions and weak institutional capacities both in terms of regulations and protection of interests of the poor; c) the lack of data and information to inform policy and strategies for balanced water allocation, and d) inadequate funds for operation, maintenance and expansion of water supply systems. Despite these constraints, there are also opportunities for improving water allocation and management systems in the country. These include: the available reserve of both surface and ground water resources, which remain unexploited; high demand for water services; a high potential for investing in the water sector; and availability of basic infrastructure and elements of institutional framework that can be improved. The paper recommends the use of combined variants of water allocation devices which: a) meet different water requirements and ensure desirable multiple-use outcomes; b) facilitate the classification of water resources in terms of desired environmental protection levels; c) allow reforms in water utilization to achieve equity and meet changing social and economic priorities; d) facilitate the development of effective local institutions; e) put in place the legal system that assigns rights to water resources and describes how those rights may be transferred; f) enforce the rights and punish infringements on those rights; and g) use cost-effective pricing systems to ensure that payment for water uses cover development, operational and management costs.

Key words: Inter-sectoral water allocation; Allocation devices; River Basin Management; Water demand

1. Introduction

As in other Sub-Sahara African countries, the need to achieve efficient allocation of water resources in Tanzania is becoming imperative, as water scarcity increases. The fundamental role that water

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plays in enhancing social, economic and environmental development makes water scarcity and competition for this resource a crucial problem. In Tanzania, the conflicts between irrigators and pastoralists or irrigators and the environment are becoming alarming. Examples include the existing conflicts between irrigation and conservation of natural wetlands in Usangu basin (Lankford and Franks, 2000; Barbier and Thompson, 1998; Masija, 1993; Postel, 1992; and Maltby 1986). The Usangu wetlands are increasingly threatened by conversion into irrigated paddy farms. Irrigated agriculture in this area is affirmed as utilizing more of the available water. On the other hand, the sector is also renowned as significantly contributing to enhancement of food security, agriculture based livelihoods and welfare of the rural people. In this context, water managers and policy makers in Tanzania (and in other parts of sub-Saharan Africa) are faced by the major challenge of balancing various water uses in a sustainable fashion. They have to answer complex questions like: how much water is needed by each sector? How can significant amount of water be saved from one sector or within sectors and be released for other sectoral needs. How can equitable allocation of water resources be achieved?

Given the fact that human population, water scarcity and conflicts over water resources are increasing, it is important that governments in sub-Saharan Africa pave the way to a new era of rational and efficient inter-sectoral water allocation. An era that will ensure adequate supply of water for different human demands today and for the future, and that will ensure that the integrity of the environment is not jeopardized. There are, however, many constraints that need to be considered, before the potential can be realised.

This paper reviews and discusses the current water allocation arrangements in Tanzania, allocation devices, their ‘success’ and ‘failure’ stories, constraints or critiques levelled against them and the

potential that is available for improvement. The discussion is supported by evidence drawn from international examples.

2. Area descriptions, methods and material studied

Area descriptions

The United Republic of Tanzania (URT) is located on the southeastern coast of Africa (figure 1). Its total area (Mainland and Zanzibar) is about 945,090 km^2 and it lies between latitudes 1^0 and 11^0 5' South and 29^0 5' and 40^0 5 East. To the north, the country is bordered by Kenya. Uganda borders it to the northwest; Rwanda, Burundi, Zambia and the Democratic Republic of Congo (DRC) to the west; Malawi and Mozambique to the south and the Indian Ocean to the east. Over half of the land consists of miombo woodland, bush and thickets. The cultivable land amounts to about 40 million ha, or 40% of the total land area in the country. The cultivated area is about 10 million ha. Over 25% of the total land is gazetted as Protected Areas (PAs), where wildlife is either completely or partially protected as National Parks (NPs); Conservation Areas (CAs); Game Reserves (GRs); Game Controlled Areas (GCAs), and Wildlife Management Area (WMAs). The country's renewable water resources amount to about 80 km^3 per year, of which 30 km^3 is ground water. Lakes cover about 7% of total land. These include lake Victoria (the second largest fresh water lake in the world), Lake Tanganyika (the second deepest lake in the world) and lake Nyasa. Inland lakes include Lakes Rukwa, Eyasi and Manyara. There are also big rivers flowing to the lakes. About 50% of the surface run off water is derived from the main rivers flowing directly to the Indian Ocean and these are: Pangani, Wami, Mkondoa, Ruvu, Rufiji, Ruaha, Kilombero, Mbarangandu, Matandu, Mbwemkulu, Lukuledi and Ruvuma. The remaining 50% is divided into surface water drainage into the main internal drainage basins which have no outlet to the sea (lake Rukwa, Bubu

depression complex, lake Eyasi and lake Manyara), others flowing into lake Victoria (Meri, Maru, and Kagera rivers), River Malagarasi draining into lake Tanganyika and rivers Songwe and Ruhuhu draining southwards into lake Nyasa Zambezi River system.

Figure 1: Map of Tanzania magnified from the map of Africa to show the major river basins

Most parts of Tanzania are over 200 metres above sea level with a good number of them located at altitudes of over 1 000 metres above sea level. The highest point (the summit of mountain Kilimanjaro – 5 895 metres above sea level) in Africa is found in Tanzania. The climate is typically tropical but the effect of high solar radiation is modified by altitude over much of the country. The mean temperature is high, especially in the coastal area (30^0C). Precipitation patterns vary widely throughout the country (averaging at 937 mm per year, but 50% of the country receives 750 mm and 80% receives less than 1 000 mm). From December to March much of the country experiences a northeastern air current caused by low atmospheric pressure at around 15^0 south. This period is referred to as the *kaskazi* monsoon season and it is the main rainy season in southern Tanzania. During this period, the northern part of the country experiences a dry period. From March to May the wind direction changes and the period is normally characterized by low wind speed. This is the main or long rainy season in the central and northern part of the country, and is known as *masika*. From June to September, the wind switches to the southeast due to the low atmospheric pressure in areas over Saudi Arabia. This is called the *kusi* monsoon. Little rainfall is usually experienced throughout Tanzania during this period. October and November is the period of short rains (*vuli*) with the wind veering again to the northeast. However, the areas found around the lakes in west and southwest have their own weather pattern, and they normally do not experience the bimodal type of weather just explained above.

Methods and material studied

This discussion includes a detailed literature review of inter-sectoral water allocation in Tanzania. Various allocation approaches or devices; their 'success' and 'failure'; constraints and opportunities available for improvement, are discussed. Evidence from other countries, which embrace interesting similarities to and lessons for Tanzania, particularly in the socio-political context, is included. For example, the objectives of, and approaches to inter-sectoral water management and allocation in South Africa and Zimbabwe.

3. Discussion

Policies and water allocation in Tanzania

According to the 1974 Water Utilization Act (amended in 1981), all water in the country is vested to the United Republic of Tanzania. The water utilization (Control and Regulation) Act. No.42 of 1974, referred to as the Principal Act and its Amendment Act No.10 of 1981 and written Laws (Miscellaneous) Act. No. 17 of 1989 and General (Regulations) Amendment, provide for the regulatory and institutional framework for water resources. The Act sets conditions on water uses and authorizes the Principal Water Officer with the authority and responsibility for setting policy and allocating water rights at the national level. For selected water drainage basins this responsibility lies with Basin Water Offices. Apart from individual domestic requirements, which do not use abstraction devices, water use requires a water right. The Act established the Central Water Board (CWB) as the main water regulation and control agency, and the Principal Water Officer (PWO) as the chief executing officer.

The River Basin Management (RBM) concept, which was introduced in 1981 allowed the gazettement and creation of Basin Water Boards. Nine basins were gazetted: the Ruvu-Wami Basin, Pangani Basin, Rufiji Basin, Ruvuma-Lukuledi-Mbemkuru Basin, Lake Nyasa Basin, Lake Rukwa Basin, Lake Natron-Manyara-Eyasi Basin, Lake Victoria Basin, and Lake Tanganyika Basin (figure 1). The Act also gave the PWO the executive function concerning water rights and the CWB an advisory role. However, each basin has its own Basin Water Officer and Basin Water Board. These report directly to the Minister of Water and Livestock Development. Regulations accompanying the Act define procedures for the application and issuance of water rights. In granting water rights, priority for use is given to domestic supply. Applicants for a water right submit the application to the Basin Water Officer who distributes copies of the applications to:

- The District Executive Director (DED) of the relevant district, especially for comments on current and customary rights,
- The District Administrative Secretary (DAS) of the relevant district, who publicizes water right applications (to permit potential objectors), and may report on any issues of concern, such as conflicts,
- The District Agriculture and Livestock Officer (DALDO) (under whom the District Irrigation Officer works) for an estimate of crop water requirements,
- The Regional Water Engineer (RWE) for a review of water availability (quantity and quality), and
- Relevant potential objectors.

The Basin Water Board then discusses the application and if approved, the Water Officer issues the right.

The water policy in Tanzania dates back to 1991, but its reviews has been carried out for several years now and in fact even before the policy itself was officially launched. The reviews started in 1986 when it was realized that some targets (for example, provision of safe and potable water within 400 meters to every household by the year 1991) would not be feasible. Targets were shifted to 2002, but these too were not feasible. In 1993 the then Ministry of Water, Energy and Minerals (MWEM) initiated a review of the water and sanitation sectors so as to identify constraints, plan interventions to facilitate sector progress, improve access to information to assist future planning and seek the commitment of External Support Agencies (ESAs) and Non-Government Organizations (NGOs) to support specific initiatives. The review found that the 1991 policy did not adequately address cross-sectoral interests in water, watershed management or sustainable river basin management.

In addition to the above initiative, MWEM also undertook, in 1994/95 a Rapid Water Resource Assessment (RWRA) to yield information on resource availability, resource use and the priority issues that needed to be addressed in each of the major river basins in the country. Major issues and recommendations from RWRA included the need to:

- Review the 1991 water policy so as to make it more elaborate on river basin management,
- Strengthen water resources assessments both in their quantity and quality as well as monitoring of aquatic ecosystems,
- Improve water rights administration and pollution control,
- Improve cross-sectoral planning, and
- Introduce a participatory approach of stakeholders in river basin management.

As envisioned in the Water Sector and Sanitation Review (WSSR) and detailed in the RWRA, a comprehensive water resources management strategy was deemed necessary to foster sustainable

development and management of water resources. This led to the review of the 1991 water policy, (which has been accomplished) and the new policy passed by the cabinet. Included in this new policy are the notions of promoting integrated planning and management of water resources, equitable access with priority to domestic and economically productive uses, efficiency of use, protection of water quality and stakeholders' participation in planning and management of water resources.

3.2 Water users and uses

The major water users in Tanzania are irrigated agriculture, hydropower generation, industrial and domestic water supplies. On a smaller scale, the fisheries, transportation and livestock sectors also utilize water resources. The government policy on agriculture attaches great importance to the development of the nation's considerable potential for irrigated agriculture. At present about 145,000 hectares of irrigated agriculture have been developed (Table 1). The major irrigated crops are rice, sugar cane and tea. The national irrigation potential is about one million hectares. About 60% of the irrigation potential in Rufiji Basin is found in the Kilombero and Lower Rufiji while 40% lies in the dry Usangu and Pawaga plains in the Great Ruaha Basin.

Most of the country's hydropower potential is in the Rufiji river system. Other rivers with hydropower potential are Kagera, Wami and Pangani. Most of the hydropower potential for Pangani and Great Ruaha has been developed. Water for use in industries is usually obtained through municipal water supply systems, though there are also some private groundwater supplies. Much of the domestic water supply is from surface water. Traditionally water for domestic uses has been obtained from natural sources such as springs, lakes and streams. Shallow wells are also used where conditions for their construction are favorable. Groundwater sources are not used to any great extent

because water recovery from these sources involves the use of more expensive technology than surface water extraction. Water withdrawal for agriculture, domestic and industrial purposes was estimated at 1.17 km^3 in 1994 (FAO, 1995).

Table 1: Water resource potential and utilization in Tanzania

3.3 Water supply systems

The administration of water supply systems in Tanzania falls into two categories namely *rural water supply* and *urban water supply*. The concepts of *rural water supply* equally apply to peri-urban areas. *Rural water supply* systems are generally simple and small and they are based on the Tanzanian Temporary Water Quality Standards. The development of water supply in Tanzania started during the colonial times in 1930s under the supervision of the Public Works Department until 1945 when the Water Development and Irrigation Department (WD&ID) was established. During this time, priority was directed to urban settlements, trading centers, Missions and large estates.

The *rural water supply* coverage of 42% (table 1) in terms of installed capacity is reported for the year 2000 and this is mainly obtained from springs, lakes and streams (FAO, 2001) and shallow wells. This coverage, however, does not take into account the quality of water supplied. In addition, many schemes are either partially or completely non-operational.

Urban water supply coverage is estimated at 80% (mainly referring to municipal water systems). In general, the existing water pumping systems and treatment plants are working under their installed capacities and are producing water of low quality due to old age. On the other hand, water losses

resulting from leakages in the distribution systems are as high as 30 - 40% in most of the towns (DFID, 1999).

Until recently, the country's water supply and sewerage systems have continued to be managed directly by the government. Bureaucratic procedures in purchases and payments, as well as inadequate prioritizing, led to poor operation and maintenance of these systems. The arrangement also imposed pan territorial flat rate tariffs, which did not take into account the varying costs of water supplies in individual towns. Furthermore, the institutional arrangement reinforced further the longstanding customers' attitude of free water services. This environment also did not encourage participation of the private sector in the delivery of water and sanitation services. Mobilization of financial resources from the private sector has therefore not been possible. Penalties for polluting water sources, misuse of water and illegal connections, until recently have not been an effective deterrent enough. On one hand, water legislations do not adequately protect consumers against poor services and unfair practices by water authorities. In addition, the existing legal and regulatory framework does not adequately encourage private sector participation in the delivery of water and sanitation services.

3.4 Conflicts

There are already serious water use conflicts in Tanzania, particularly in the Pangani and Rufiji Basins. These are mainly attributed to uncoordinated developments by different sectors that involve use of water resources. Conflicts, for example, are experienced between the hydropower sector mainly by the Tanzania Electric Supply Company (TANESCO) and the farmers, between groups of farmers (upstream and downstream), between the farmers and pastoralists, between water managers

and farmers. There are also conflicts between institutions and other users (including the environment).

In the upper part of the Rufiji Basin, for example, water use conflicts are mainly associated with development in irrigated agriculture. This area has attracted cultivators from highland regions and pastoralists from northern and central Tanzania (Mbonile et al., 1997). The establishment of irrigation schemes, like the large-scale Kapunga and Mbarali schemes and smallholder schemes (e.g., the Majengo, Kimani, Ipatagwa, Mswiswi and Motombaya) has attracted more immigrants to the area leading to concomitant expansion of both rain-fed and irrigated agriculture as well as growing conflicts and competition for water resources. The conflicts have mainly arisen due to excessive use of water in irrigation systems causing serious water shortages downstream. This is particularly problematic during the dry seasons when people are experiencing serious deficit of water for domestic use and animal drinking, less pasture for animals, less water for hydropower generation, less area for fish breeding and growth and less area suitable for wildlife. Tourism in Ruaha National Park (RNP) also suffers as the Great Ruaha River (GRR) dries up (SMUWC, 2001).

Pollution from point and non point sources is another growing problem and major source of conflicts affecting water resources in Tanzania (DFID, 1999). Water pollution in rivers and streams typically impose a burden to downstream users. It reduces the quality of receiving waters and may generate conflicts by reducing the available quantity of usable water as well as raising treatment costs. Wastewater from municipalities and industries is also one of the major sources of pollution. Wastewater from these sources is typically discharged into receiving bodies untreated or only partially treated.

Water pollution from agriculture and mining is also increasing. The extent of severity of water pollution from agrochemical use is, however, not yet well studied but given the rate of importation of these chemicals (and therefore, its implied use), there is likely to be a substantial amount of pollution. Pollution from mining activities is also increasing and has impacted on public health. With trade liberalization, Tanzania has witnessed a dramatic increase in small-scale mining activities. Gold mining, which uses mercury in the recovery of gold, is increasing with considerable impacts on the quality of water resources.

3.5 Approaches to inter-sectoral water allocation

Various theoretical frameworks have been developed for inter-sectoral water allocation within river basin management (Mitchell, 1990; EC, 1998; Abernethy, 2001). According to these frameworks, water can be moved from one user to another using one or a combination of devices, including the economic or market forces; command and control devices; community-based devices; technological devices; information and education as well as natural devices. An inter-sectoral water allocation device will be considered as efficient if it ensures that the available and future water is shared between multiple users through a mixture of processes, institutional structures, and demand and supply management tools. In other words, the device will be deemed as efficient if it is able to balance the differing demands in manners that tie in with the available supply of water resource and ensure desirable multiple-use outcomes. The main question is, what mixture of water allocation devices is potentially efficient to achieve the various water allocation objectives socially, economically and environmentally? The remainder of this section provides a discussion of various water allocation approaches and their respective “win-win”, “failure” cases, and associated constraints as reported elsewhere in the literature.

Command and control devices versus market forces

C*ommand and control* is one of the main types of devices that are used to re-allocate water resources in Tanzania. The principle underlying the use of these devices assumes that water rights, fees, fines and enforcement can adequately tackle many of the problems associated with inter-sectoral water allocation. This approach is currently used by the River Basin Water Office (RBWO) in the upper part of the Rufiji basin to re-allocate water resources particularly in the agricultural sector. The water rights provided are based on flow rates (e.g., 0.6 cumecs), but these rights tend to focus mainly on wet season paddy. While this approach might have worked well in other countries, it seems to be the most inappropriate approach in the context of Tanzania. Lankford (2002) notes that irrigation water is unlikely to be metered and monitored so farmers can take more than their share. In some cases the rights are simply water duties without being reconciled with the size of the system, available water or downstream needs. Farmers may not use the marginal rule under this approach thereby using water until its costs outweigh its benefits. In fact having paid for a right, farmers might even be inclined to use more water than it is necessary (Lankford, 2000).

One of the available alternatives to *command and control* approach is the allocation of water resources through markets. The economic efficiency gains of using this approach and the disadvantages or inefficiencies that may arise from absconding its use are already well documented in the literature (Rosegrant and Binswanger, 1994; Briscoe, 1996; Hearne and Easter, 1995; Meinzen-Dick, 1996; Bauer, 1997; Holden and Thobani, 1997; Perry et al., 1997; Easter and Rosegrant, 1998; Kulindwa, 2000). In Kulindwa (2000), for example, two prime sources of inefficiency in the current water allocation arrangements in Tanzania are identified; first is the restriction on water transfer, which prevents water to be re-allocated to the highest value use in terms of market value, and secondly is charging inefficiently low prices for water. The Marginal Net Benefits accrued from water utilization do not equalize across sectors. Put differently, water

prices do not reflect the opportunity cost of a particular use, and the cost of supplying the last unit of water. According to Kulindwa (2000), this encourages wasteful use of water by some users.

In the hope of improving efficiency in management and allocation of water resources, a number of countries in the Southern African region have embarked on reforming their water sectors, with the central objectives of the reforms being the achievement of integrated management of water and land resources, recognition of the economic value of water, equitable allocation and sustainable utilization of water resources. It is envisaged that these objectives will be realized through devolution of management responsibilities from the government to private firms, autonomous utilities, and community-based institutions.

In South Africa, for example, the reform of water sector has culminated in passing of the National Water Act (Act 36 of 1998), which sets out the framework for the management of water resources in the country. The Act provides for the establishment of new water management institutions at local levels. These include Catchment Management Agencies (CMAs) and Water User Associations (WUAs). The latter are cooperative associations of individual water users who wish to undertake water-related activities for their mutual benefits. CMAs are statutory bodies governed by a board, which represents a broad stakeholder grouping together with experts. The board is expected to seek cooperation and agreement on all water-related matters from the various stakeholders and interested persons. Among other tasks, which CMAs are charged with are the general authorization and issuing of water licenses; reviewing licenses; making rules to regulate water use; undertaking temporal controls, limiting or prohibiting use of water during periods of shortages. The need to establish CMAs has led to the division of the country into 19 Water Management Areas (WMAs), which operate within the broader framework provided by the Ministry responsible for water resources.

In Zimbabwe, the debate over reform of the country's water sector began in the early 1990s — at the same time that the country introduced the Economic Structural Adjustment Programme (ESAP). The influence of ESAP is reflected in principles that were eventually adopted such as treating water as an economic good. In 1995, a Water Resources Management Strategy unit (WRMS) was established to produce a comprehensive strategy for reforming the water sector and managing water in the country. The reform entailed drafting of a new Water Act for the country through a stakeholder consultation process and the development of new institutions for managing water. This led to establishment of catchment-based water management structures, which started with two pilot catchment areas, namely: the Mazowe and Mupfure. Catchment Councils (CCs) were then formed at the catchment level to take the overall responsibility for the management of water in their respective catchments. These composed of different stakeholder groups in the catchment in order to ensure adequate sectoral representation and participatory decision-making. Below the CC, were the Sub-catchment Councils (SCCs) that were formed so as to assist the CC in carrying out its mandate. The SCCs were given the right to form any other unit below them for the effective management of water in their areas of jurisdiction. As a result, WUAs and Water User Boards (WUBs) composing of different stakeholders were formed. The country is now divided into 7 catchment areas managed by CCs and SCCs with the assistance of WUBs and WUAs. The specific terms of reference for the CCs include the development of a catchment plan, granting, reviewing or cancelling water permits, regulating water use rights and ensuring compliance with all water regulations.

Several other countries of the Southern African region have also reformed their water policies, but as argued by Chikozho (2002), most of these reforms have their origin in international conventions and paradigm shifts in water resources management, and are in most cases adopted without a critical analysis of their compatibility with existing situations in the recipient countries. The shift

towards making water an economic good (using market devices to allocate water), for example, is brilliant on paper but making it operational in the Southern African region context could be problematic as the majority of the region's population is poor.

Community-based devices

Fundamentally, the proponents of "community-based" devices see the lack of *active* stakeholders' involvement as the major challenge to sustainable and efficient water resource management and allocation in Tanzania. Most of the smallholder irrigation schemes in the country have recorded 'unsuccessful stories' because of this. Evidence includes that of the Mlali (Morogoro); Mombo (Korogwe); Mto wa Mbu (Arusha) (Mrema, 1984); and Kitivo irrigation scheme in Lushoto (Kaswamila and Tenga, 1997). Conversely, a good number of authors also cite triumph evidence where communities are *actively* involved. Examples include the Uroki – Bomang'ombe Water Supply Trust (Moshi rural water supply) in Kilimanjaro region (Kulindwa, 1997; 2000; Braasch, 1999; Reweta and Sampath, 1998); and the Traditional Irrigation Improvement Programme (TIIP) (Burra, 1999).

There is one key lesson that can be drawn from the above cases: enabling local communities to control water implies giving the responsibility of managing water resources to users and hence increasing efficiency in water utilization and reducing conflicts among water uses and users. The TIIP approach, for example, has registered declining conflicts in water distribution and increased water availability in several areas in the country. Examples are drawn from groups like Kwa Simba Juu; Tewe-Lunguza (Lushoto district); Mgambalenga-Ikula (Iringa district); Kisangara Juu-Chini (Mwanga district); Hingilili river basin (Same district); and Nduruma (Arumeru district) (Burra, 1999).

Recognizing this, many of the current government and sectoral policies in Tanzania have included the notion of incorporating the human resource of local communities into management of natural resources. Cases in point include many of the new policies and programmes of the Central and Local Governments, which stipulate that local people should be involved *actively* in planning and management of natural resources. This is essentially a move from resource "management *against* and *for* the people" to "management *with* and *by* the people." Some district governments have even gone further to developing and implementing approaches to planning, which support community involvement in planning at the village level. The Mbarali district in Mbeya region, for example, has established a multi-disciplinary district participatory team called *WAMISHI* (*Wawezeshaji Mipango Shirikishi*) since 2000 (SMUWC, 2001). The team reports to the District Planning Officer, and has three full time members coming from community development, agriculture, and lands and surveys. It is supported by a group of specialists from planning, health, education, finance, natural resources and water. These specialists provide technical assistance to village and ward governments, as and when required. The roles of *WAMISHI* are to:

- Support villages and wards in the development and implementation of village and ward development plans,
- Raise awareness of the benefits of planning *with* and *by* people within the district, and
- Assist the district in establishing a participatory approach to district planning.

WAMISHI has recorded significant success at the village level. It has 'facilitated' the development and implementation of village plans in several parts of the Usangu basin in Tanzania. These plans address both the villages' short term and long-term development needs.

Another promising initiative in Tanzania is that of the Kimani Sub-catchment Resource Management Programme (SRMP) in the Usangu basin. This brings together different users and

associations involved in the use and management of the Kimani River. These users and associations include: nine villages, two district governments (Mbarali and Makete), Zonal Irrigation Office (ZIO), *HIMA* (*Hifadhi Mazingira*) offices, Rufiji Basin Water Office (RBWO) and the River Basin Management and Smallholder Irrigation Improvement Project (RBMSIIP). These are working together to identify users and uses of water resources within the catchment and the ways in which these users and uses utilise the available water resources. They also prepare plans for better management of water and land resources.

In essence, the idea of SRMP builds upon the existing concerns over water scarcity demonstrated by users at the lowest scales of the hydrological system, which in turn helps to reduce conflicts among various water users and leads to improved management of water resources. While it is still early, the SRMP programme is encouraging for Tanzania since the approach could possibly solve the main operational problem in most inter-sectoral water allocation arrangements. SRMP could succeed in providing different users (e.g., farmers and other users or uses) with adequate and reliable water, fair control over water resources and ensure reduced conflicts among water users and uses.

One of the greatest attractions of community-based devices in resource management is the suggestion that these devices have the potential to meet multiple objectives and satisfy the aspirations of different constituencies. There is a great deal that can be said in support of these devices. Water resource-use conflicts, for example, do not necessarily evolve irrationally. They may originate from realistically structured interests of the larger collective whole and those who use and manage its constituent elements. In such cases, the conflicting parties can often be brought together to identify mutual benefits and realise these through collective actions. This is the implicit assumption that lies behind much of the advocacy for community-based devices.

Community-based devices: The right prescription?

Community-based devices, however, do not inevitably lead to "successful stories". Providing effective incentive packages for adoption of these devices will usually require significant transfers of power, rights and resources. Not everyone will gain in these endeavours.

The paper, therefore argues that, community-based devices are not the only cure for inefficient water management and allocation. In some instances, these may also lead to inefficient allocation, which may ostensibly spring from the basic problem of 'absence of cooperation.' This notion has been widely phrased in game-theoretical terms. North (1990) summarizes the conclusions from the game theory in the following manner: "individuals will usually find it worthwhile to cooperate with other players when the play is repeated, when they possess complete information about the other players' past performances, and when there are small numbers of players." The following concepts are widely suggested in the literature for successful use of community-based devices: shared norms, intimate mutual understanding and knowledge, trust and reciprocity, and repeated dealings. These closely match those identified by Ostrom (1990, 1992, 1995); Oakerson (1992); and Baland and Platteau (1996) as conditions conducive to the successful creation and operation of "collective" or "common" property regimes.

Technological devices

Advocates of technological devices see technical novelties that allow usage of alternative sources or multiple re-usage of water from an existing source as holding some promise. Pumping from deep groundwater sources, for example, can do much to tackle the problem of water scarcity, but such reserves are finite, and there are environmental externalities associated with them and the costs of pumping are also high (Webb and Iskandarani, 1998). Just as important, recycling of water may also offer potential gains, but this also has a cost implication and most users (e.g. the manufacturing

industries) in developing countries have little incentives to invest in such a technology since they pay only a fraction of the actual cost of water (Oodit and Simonis, 1990). Multiple usage of water does of course occur in some cases. The extracted water, for example, may be used in an urban setting before later being diverted again for hydroelectricity generation or for agricultural use, as in the case of Egypt, where urban wastewater is channelled to the desert-based irrigation schemes west of the Nile and in the Sinai (The Times, 1997, cited in Webb and Iskandarani, 1998).

In Tanzania, increasing storage or access from groundwater may help to solve the problem of water shortages, but these are problematic in some areas due to lack of suitable sites (i.e. tapping the groundwater resource may not be economically viable) and lack of significant aquifers. Nonetheless, more appropriate ideas of *local* supply-side (e.g., boreholes for domestic users, borehole and sand-dams for wild animals and livestock; making design alterations to increase hydroelectric power (HEP) storage capacity; and the possible construction of weirs to provide controllable storage of water in swamps and wetlands) would also help to lessen the problem of water crisis, but all these require adequate funds — a requirement which appears to be limiting in Tanzania.

Are technological devices a panacea?

Obviously, technological devices are not the only solution to all problems of inefficient water allocation. As several authors have also argued (Marcoux, 1999 and Webb and Iskandarani, 1998), technological devices merely 'buy time.' They are only part of the solution or temporary remedies. In addition to technological considerations, water resource managers need to approach the issue of inter-sectoral water allocation in an integrated manner by taking into account other aspects as well (e.g. the economic management of water commodities, the institutional requirements for sustainability and equity aspects) and how best these can be combined in different contexts. In

irrigation, for example, evidence in Tanzania has shown that a highly appropriate intervention is not necessarily the upgrading of infrastructure or establishment of Water Use Associations (WUAs), but the provision of predictable, accessible markets, among other things (Lankford, 2002). Lowering transaction costs (e.g. by reducing the number of rural taxes on the movement of goods) – as also explored in Ellis and Mdoe (2002) help to motivate farmers to participate in irrigated agriculture.

3.6 Summing up the constraints, potential and allocation devices

Summarized in Table 2 are the constraints, potential and devices that could be used to achieve an efficient system of water management and allocation in Tanzania.

Table 2: Summary of constraints, potential and devices for efficient water allocation in Tanzania

The current system of water management and allocation in Tanzania is faced by the following major constraints, some of which are having straightforward solutions (e.g., acquisition of funds and facilitation or empowerment of local communities) while others require complex research work and debate:

- Lack of *active* community involvement in management of water resources. An effective system of water management and allocation requires that all water users and other stakeholders at all levels are *actively* involved,
- Conflicting institutions and weak institutional capacities both in terms of regulations and protection of interests of the poor. The coordination mechanism between various institutions, which are either directly or indirectly involved in water issues needs to be streamlined and

clearly defined so as to avoid duplication of responsibilities and dilution of efforts or wastage of resources, to ensure effective implementation of their mandated functions,

- Lack of data and information to inform policy and strategies for balanced water allocation, and
- Inadequate funding for operation, maintenance and expansion of water supply systems. This has resulted into deterioration of facilities and quality of services, which in turn has adverse impact on the customers' willingness to pay for the services.

Despite the above constraints, there is also evidence that indicates that there is great potential for improving water management and allocation systems in Tanzania. These include:

- The large available reserve of both surface and ground water resources which remains unexploited for some economic reasons;
- The existing demand for the sectoral services that is still unmet and continues to grow as both the population as well as economic development in the country increases;
- The current Government policy, which calls for increased promotion and participation of other sectors, in the development of social sectors, water being included;
- The existence of a great number of institutions which have invested in the water sector and which have already positive experiences to learn and provide opportunities for forming partnerships;
- The wide available field for investing in the sector, that is, from direct delivery of water to construction of infrastructure (e.g., sources, supply mains), manufacturing and supply of machinery, equipment, and training of professionals;
- The existence of a good number of higher learning institutions, like the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), University College of Lands and Architectures Studies (UCLAS); other ordinary and advanced level training institutes (e.g., MATI – Igurusi and Uyole), and research centres (e.g., Ukiliguru, Mlingano);

- The government policy environment, which calls for active involvement and empowerment of local communities in management of natural resources, water being included;
- The existence of some community based initiatives and or Water User Groups dealing with water allocation and management (e.g., the Kimani SRMP case in Usangu plains); and
- The Government has also already implemented various water projects (e.g., construction of irrigation headworks and conveyance), the performances of which only require improvement.

Exploiting the above potential requires that a right combination of allocation devices is employed. Where compatible, several variants of one device may spatially or temporarily be used together with other devices. In Usangu plains (part of the Rufiji Basin in Tanzania), for example, Lankford (2000) suggests the use of variants of water rights: *proportional water rights*, *sub-catchment water rights*, *passive water rights,* and or *seasonal water rights*. With respect to *proportional water rights*, the RBWO and users may negotiate a use based on a proportion of whatever the flow is in the river, let say 10%, or 45% of the available flow. This approach can be used together with other devices (e.g., technological devices to redesign the intakes) so as to ensure that only the agreed proportion of water is abstracted both during the low and high flows. Detailed explanation of the other variants is as given in Lankford (2000).

In the context of inter-sectoral water allocation, several other devices may be used in sync with the above variants of devices. These, for example, may include technological devices like installation of improved canal distribution systems within irrigated areas; installation of piped and borehole domestic water supplies; installation of diversions in rivers where needed to reduce losses into intermediate swamps; ceasing the upgrading of intakes; reducing the maximum capacity of selected intakes; installation of drains from areas below irrigated areas to rivers; checking of drains and river channels for blockages, just to mention a few. In addition, economic or market devices may also be

added, but as Perry et al., (1997) argue, when these are introduced into the process of allocating water resources, the following set of preconditions should be observed:

- Definition of entitlements of all users under all levels of resource availability and inclusion of specified assignments to social and environmental uses;
- Placement of infrastructure to deliver the defined entitlements;
- Ensuring that measurement standards are acceptable to the delivering agency and users;
- Effective recourse is available to those who do not receive their entitlements;
- Water reallocations are measurable and deliverable, and third-party impacts (in quality, time, quantity, and place) are identified;
- Effective recourse is available to third parties affected by changes in use;
- Users are legally obligated to pay defined user fees through effective legal and policy procedures; and
- Large-scale transfers of water within and between sectors are subject to approval and relevant charges by regulatory agencies.

In addition, it is important that 'education and information' devices are used. These are widely used in other countries to help introduce demand management practices. This includes generation and dissemination of information aimed at increasing water use efficiency and productivity. In irrigation, for example, the following practices can be useful:

- Increasing yield per unit evapotranspiration during crop growth (e.g., through adoption of improved, early maturing, high yielding seed varieties, better soil nutrient management, proper weed management, shifting to higher value crops);
- Reducing evapotranspiration, especially during land preparation (e.g., through reduced water use and period of land preparation, restricting the formation of soil cracks);

- Reducing seepage and percolation during land preparation and crop growth periods (e.g., by puddling the soil during land preparation); and
- Reducing surface run-off.

Introducing management practices and infrastructure improvements that result in either of the first two will increase the efficiency of the system and basin. The potential of the last two for system and basin productivity will depend on opportunities for and costs of recycling at downstream locations. However, all of these practices require an assured support for research, extension, and marketing services. A top-down approach might not be too successful, instead a two-way process makes more sense as a part of discussions between water users and external institutions. This for example, may happen as water institutions respond to the users' requests for assistance, arbitration and clarifications regarding water management issues.

4. Conclusion and recommendations

There is great potential for improving water management and allocation systems in Tanzania. These include the available reserve of both surface and ground water resources that remain unexploited, mainly due to economic limitations. There is also a big demand for the sector services that is still unmet and the government policy calls for increased promotion and participation of other sectors in the development of social sectors. Just as important, there is a big range of fields for investing into the sector (i.e., from direct delivery of water to construction of infrastructure, manufacturing and supply of machinery, equipment, and training of professionals). There are also some basic infrastructures and elements of institutional framework, which may help taking off (e.g. irrigation headworks and conveyance, training and research institutions, and some community based initiatives). The following, however, appear to be the major obstacles:

- Lack of *active* community involvement in management of water resources;
- Contradicting institutions and weak institutional capacities both in terms of regulations and protection of interests of the poor;
- Lack of data and information to inform policy and strategies for balanced water allocation; and
- Inadequate funding for operation, maintenance and expansion of water supply systems.

Different types of devices can be used to overcome the above obstacles. These may include community-based devices; economic devices (market forces); command and control devices (e.g., water rights and their variants); education; technological; and natural devices (doing nothing option) where appropriate. Of these, those which have recorded relatively more 'successful stories' are probably the community-based devices. In sense, these have sought to co-opt the managerial capacities of water resources to the local people, who have been very often by-passed in the conventional approaches. They have operated using a principle akin to "water management *with* and *by* people" which is a reflection of new recognition of water management insights of local people's cultures and the determinative power of the rural people to shape their future. To some extent these devices have proved successful. But, do these devices always lead to 'successful stories? The answer is obviously no! The outcomes will depend on many other factors including the social, economic and environmental configurations and the extent to which these devices are complimented with other devices. Recognizing this, and the heterogeneity that exits among regions, this paper therefore, does not intend to impart a sweeping recommendation for what should be taken as the proper water allocation devices, but it rather puts emphasis on the use of combined water allocation devices, which given the existing heterogeneity will be able to:

- Meet different water requirements and ensure desirable multiple-use outcomes (e.g., meeting the basic human needs and maintaining the environmental integrity),

- Facilitate the classification of water resources in terms of desired environmental protection levels,
- Allow reforms in water utilization to achieve equity and meet changing social and economic priorities,
- Facilitate the development of effective local institutions,
- Put in place the legal system that assigns rights to water resources and describes how those rights may be transferred,
- Enforce the rights and punish infringements on those rights, and
- Use cost-effective pricing systems to ensure that payment for water uses cover development, operational and management costs.

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Table 1: Water resource potential and utilization in Tanzania

Item	Value
• Human population (Mainland total) (2002 estimate)	34,021,000
• Average annual precipitation (mm per year)	937
• % Of the country receiving 750 mm precipitation	50
• % Of the country receiving less than 1000 mm precipitation	80
• % Surface run-off derived from main rivers to the Indian Ocean	50
• Renewable water resources (km^3 per year)	80
• Renewable ground water (km^3 per year)	30
• % Surface water drainage into the main internal drainage basins without outlet to the sea	50
• Area under lakes and swamps (ha)	5,439,000
• Water withdrawal for agriculture, domestic and industrial purposes (1994 estimates) (km^3 per year)	1.17
• % Total area covered by lakes	7
• Area under irrigated agriculture (ha)	145,000
• % Urban water supply coverage in 2000	80
• % Rural water supply coverage in 2000	42
• % Total water supply coverage in 2000	54
• % Urban water sanitation coverage in 2000	98
• % Rural water sanitation coverage in 2000	86
• % Total water sanitation coverage in 2000	90
• % Water losses resulting from leakages in water distribution systems	30 – 40

Sources: FAO (1995; 2001); DFID (1999)

Table 2: Summary of constraints, potential and devices for efficient water allocation in Tanzania

Potential/opportunities	Main constraints	Key devices
• There is huge reserve of both surface and ground water resources which remains unexploited,	• Lack of financial and economic resources to enable its exploitation, • Inadequacy of information about the characteristics of the available reserve	• Technological devices, • Information and education, • Community-based devices,
• There is big demand for the sector services that is still unmet,	• Lack of financial and economic resources to enable adequate investment into the sector, • Imperfection in water markets • Lack of active involvement of both local communities and the private sector in provision of water resources, • Inadequacy of information on the side of investors • Weak institutional capacities	• Market forces, • Technological devices • Information and education, • Community-based devices,
• The government policies call for increased promotion and participation of local communities and other sectors in the development (management and allocation) of water resources	• Lack of active involvement of both local communities and the private sector in provision of water resources, • Weak institutional capacities • Inadequacy of information on the side of both the government and investors, • Lack of financial and economic resources, • Imperfection in water markets	• Information and education, • Community-based devices, • Technological devices,
• There are some institutions which have invested in the water sector and which have shown some positive results to learn, and there is a big range of fields for investing into the sector, that is, from direct delivery of water to construction of infrastructure (e.g., sources, supply mains), manufacturing and supply of machinery, equipment, and training of professionals,	• Weak institutional capacities • Imperfection in water markets • Little cooperation and lack of active involvement of the private sector, • Lack of financial resources, • Inadequacy of information on the side of investors,	• Market forces, • Technological devices, • Community-based devices, • Information and education,
• There is a good number of higher learning institutions (e.g., the University of Dar es Salaam, Sokoine University of Agriculture, University College of Lands and Architectures Studies); other ordinary and advanced level training institutes (e.g., MATI – Igurusi and Uyole), and research centres (e.g., Ukiliguru, Mlingano), that can be used to provide expertise in water management and allocation,	• Little funding for training, • Little collaboration among training and research institutions,	• Information and education • Technological devices • Market forces,
• There are some community based initiatives and Water User Groups dealing with water allocation and management (e.g., the Kimani SRMP case in Usangu plains),	• Weak institutional capacities • Lack of active community involvement, • Lack of financial resources,	• Community-based devices, • Information and education, • Market forces,
• There is some basic infrastructure already in place (e.g., irrigation head works and conveyance, HEP reservoirs),	• Weak institutional capacities (poor management) • Inadequacy of funds for operation, maintenance and expansion. This has led to deterioration of facilities and quality of services, and hence adverse impact on the customers' willingness to pay for the services, • Lack of active community involvement,	• Community-based devices • Market forces, • Information and education, • Technological devices,

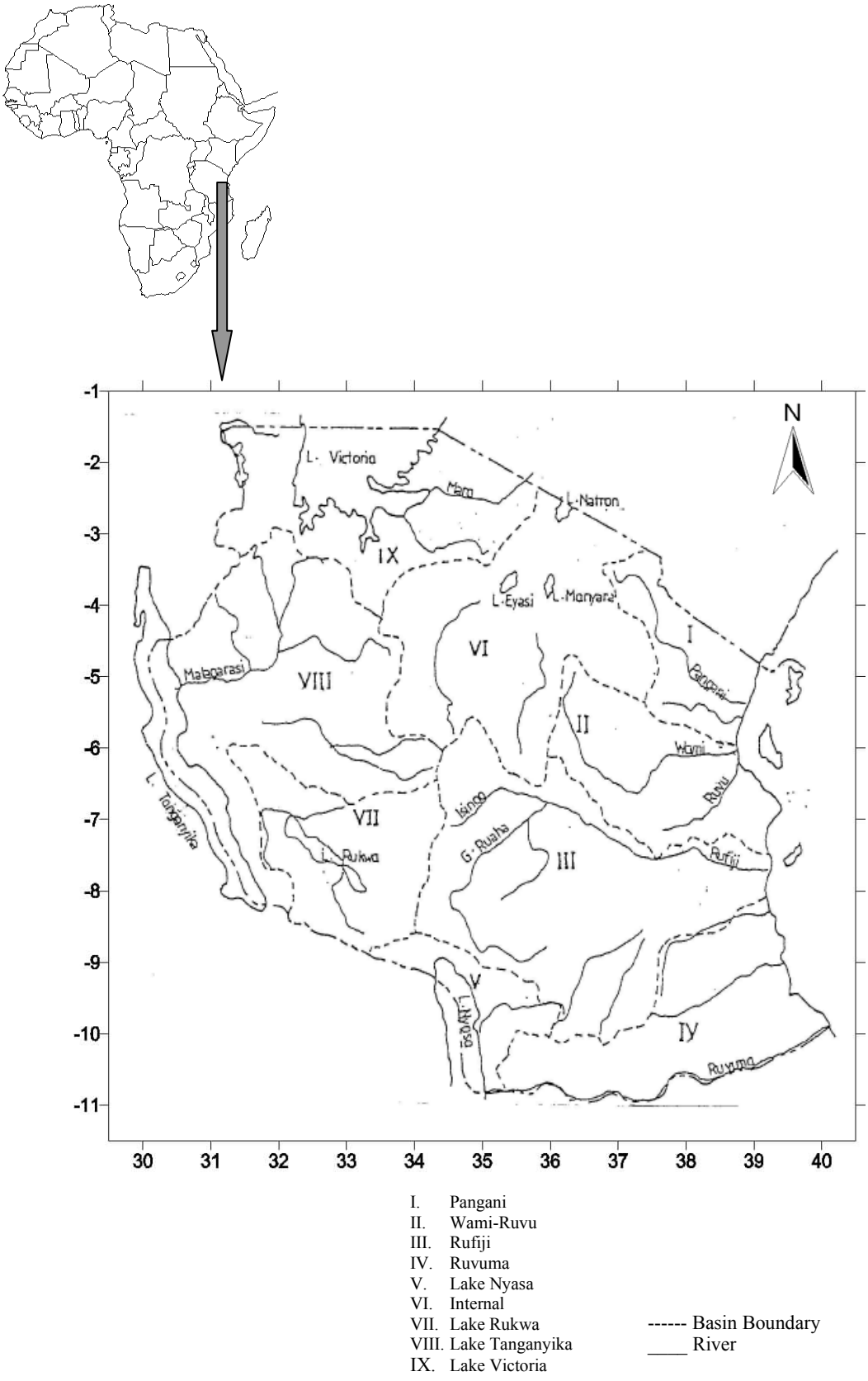

Figure 1: Map of Tanzania magnified from the map of Africa to show the major river basins