Assessment of water resources management in the Ethiopian Central Rift Valley: environmental conservation and poverty reduction

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Abstract

This article assesses the relation between water management, environmental degradation and poverty through a stakeholder analysis focused on the status and management of water resources. It draws from the situation observed at the Ethiopian Central Rift Valley, an endorheic basin south of Addis Ababa where human activities have resulted in the degradation of most freshwater ecosystems and the vast majority of its population lives in poverty. It proposes a shift in water governance that focuses on improving economic and social welfare and enhances environmental sustainability. This shift can help overcome some of the problems affecting the Central Rift Valley, namely: (i) the overexploitation of water resources, (ii) poor water quality, and (iii) high dependency of the population on water resources to sustain their livelihoods.

Key words

Water Resources Management, Central Rift Valley, Environmental Degradation, Poverty, Stakeholder Analysis

Introduction

Adopted in 2000, the eight Millennium Development Goals (MDGs) set targets to make significant strides in reducing extreme poverty in its many dimensions. In an effort to ensure that development is carried out in an environmentally sustainable manner, Goal 7, target A, states that country policies and programmes shall “integrate the principles of sustainable development and reverse the loss of environmental resources” (United Nations, 2000). This highlights the need to improve economic and social welfare without deteriorating environmental services and thus the present and future life of today’s and tomorrow’s inhabitants. The first step to maintain equitable access to environmental services should work towards the sustainability of vital ecosystems where water is key for their maintenance. Reaching this target is particularly significant for developing countries, where too many people rely on the natural environment to directly obtain water and food provisions and are still without safe and secure access to water.
According to the Global Water Partnership (2003) among the 'water-poor' are those who see their natural livelihood persistently threatened by severe drought or flood; those depending on food cultivation or on gathering natural products; and those for whom water resources are not dependable or sufficient. Therefore, water poverty does not mean just physical water scarcity. The lack of managerial or economical capacities may also lead to it (François Molle & Mollinga, 2003). One of the most relevant approaches to holistically address and unveil the different aspects of water poverty has been the Water Poverty Index. This composite indicator tries to show the connection between water scarcity and socioeconomic development. It thus focuses on five different components: the availability and access to water resources, their uses, water management capacities and the state of the environment (Giné Garriga & Pérez-Foguet, 2010; Sullivan, 2002). Further developments have led to extend the scope of this approach to basins (Pérez-Foguet & Giné Garriga, 2011) and also to water for agriculture by introducing the Agricultural Water Poverty Index (Forouzani & Karami, 2010).

Although these approaches are useful in policy making, they do not help to reduce the over-extraction of water resources in basins. This is a frequent problem worldwide and all the more worrying in arid and semi-arid regions, where not enough water is allocated for other important uses. From the governance point of view out of the existing water-balance a part should be ‘committed’ to meet other uses, such as downstream environmental requirements or water rights (Molden, 2003). If committed resources cannot be met during part of the year, it is said that the basin is closing but if committed resources cannot be met throughout the entire year the basin is closed (F. Molle, Wester, & Hirsch, 2007). Hence, in the closing or closed basin, either the environment degrades or water poverty is felt, or both.

In recognition of these challenges, the United Nations Millennium Declaration resolved “to stop the unsustainable exploitation of water resources by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies” (UN General Assembly, 2000). These strategies were later defined during the 2002 World Summit on Sustainable Development, when it was established that all countries should develop Integrated Water Resources Management (IWRM) Plans (United Nations, 2002). Prior to this declaration, water management had only been organised at the basin level from the 1920s in Spain and from the late 1930s in the Tennessee Valley (Akpabio, Watson, Ite, & Ukpong, 2007; Kitchens, 2012). This more holistic approach was later adopted in other areas of the world but overall water management has taken place within administrative boundaries rather than natural hydrologic basins, in a fragmented rather than a holistic manner, and in a technocratic rather than a participatory fashion (Gourbesville, 2008).

Conversely to these approaches, IWRM promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the
sustainability of vital ecosystems (Global Water Partnership, 2000). Although IWRM is a concept with no clear methodology and probably has not feasible global applicability due to contextual differences (Biswas, 2004), it is necessary to understand the relation linking water, the environment and social welfare to improve water management.

Similarly to other parts of the world, many countries in Africa have started to manage water by following an IWRM approach. Different examples can be found in transboundary basins, such as that of the Nile (Hanjra & Gichuki, 2008), the Volta (Rodgers, Giesen, Laube, Vlek, & Youkhana, 2007) and the efforts made by the Southern African Development Community (SADC) to implement an IWRM approach to basins in members countries (Nyagwambo, Chonguiça, Cox, & Monggae, 2008) as well as at the national level (Ako, Eyong, & Nkeng, 2010; Akpabio et al., 2007; Funke, Oelofse, Hattingh, Ashton, & Turton, 2007). Although constraints in implementing IWRM are locally determined and depend on the characteristics of the basin and national and local policies, Sub-Saharan African basins share at least three important aspects: (i) agricultural activities and development are a major force for economic growth; (ii) they require the mobilisation of financial resources and a system for water rights that match the African reality, where the majority of water users are scattered smallholders instead of large water users; and (iii) water scarcity is the product of economic activities rather than the availability of water resources (Van Koppen, 2003). These problems point at the still long way to go before the management of water resources is sound and equitable and fosters economic development.

The Ethiopian Central Rift Valley (CRV), for instance, illustrates some of the main challenges in adopting an IWRM approach at the basin level. Land in the Central Rift Valley basin (Figure 1), located south of Addis Ababa, has been intensified irrigation. Yet, even with more reliable water inputs, periodical droughts still have a strong impact on economic growth (FEG Business Development and Operations, 2009). The spatial and temporal variability of water resources limits development, poses important management challenges, and skews distribution. Moreover, freshwater ecosystems, containing important areas of both terrestrial and aquatic biological diversity, are degraded as a result of human activities. For instance, the Lake Ziway and its influent rivers are used for irrigation and are host to a wide array of economic, domestic and recreational activities, including the flower industry, soda abstraction and fish farming (Ayenew, 2007).

This paper focuses on Ethiopian water policies; stresses the socioeconomic context in the communities settled around the basin. It pays special attention to agricultural activities carried out in the Central Rift Valley as well as to the impacts of irrigation on both the quality and quantity of water. It also analyses the performance, position and linkages between different stakeholders, many of them belonging to different governmental administrative levels, as well as investors, representatives of the agricultural and industrial sector and from non-profit organisations.
Study area: the Ethiopian Central Rift Valley

The studied basin is part of the East African Rift, which extends along East Africa from the Red Sea to Mozambique. The CRV is located between 38°15’E and 39°25’E and 7°10’N and 8°30’N. Covering an area of approximately 10,000 km², the altitude of the plateau ranges from around 1,500 m a.s.l. in the lowest parts of the valley to more than 4,000 m on the eastern side. In 2007, there were around 1.9 million people living in the Central Rift Valley Basin, out of which 1.6 million were settled in rural areas (Population Census Commission. F.D.R. Ethiopia, 2008).

Mostly covered by woodlands and savannahs, the area is also under considerable agricultural use. Afro-montane forests and woodlands cover 10.9% of the area, mainly in the highlands, while 76.8% of the land has been cleared for cultivation. Despite such large tracks of land being under agricultural management in the valley areas, only around 1.3% is being irrigated (Jansen et al., 2007). Out of this amount, 44% of land relies on surface water diverted from nearby rivers while 31% of agricultural plots draw in water from Lake Ziway. Only 25% of irrigated land uses groundwater extracted through existing wells (Rodriguez de Francisco, 2008).

Agricultural production and related activities constitute the main pillar sustaining the economy in the Central Rift Valley. According to the Rift Valley Lakes Basin Master Plan Study Project on Integrated Resources Development carried out by the Ethiopian Ministry of Water Resources (2007), the agricultural sector of the area (i.e., crops, livestock, fisheries and forestry) is responsible for about 67% of the Gross Domestic Product (GDP), while the industrial and tertiary sectors account for 10% and 24% of national income respectively. The regional GDP per capita in 2005 was about 910 Birr (or 105 US$), which is low even compared to Ethiopian standards (on 2005 Ethiopian GDP per capita was 174 US$). Measured in Purchasing Power Parity (PPP), the regional GDP was estimated at $682 per capita.

From a hydrological point of view, the CRV constitutes an endorheic basin as it encompasses a chain of three large lakes: Ziway, Langano and Abyata. These lakes support a wide variety of aquatic and wildlife and are habitat to different kinds of autochthonous edible fish (Ayenew, 2007; Jansen et al., 2007). Furthermore, the perennial Meki, Ketar and Bulbula rivers, and other minor streams constitute the valley’s hydrographical network. The mean annual inflow to Lake Ziway from the Meki and Ketar rivers was around 260 million m³ and 360 million m³ for the 1996-2004 period respectively, while the streamflow from the Bulbula river was around 200 million m³.

The hydrological and climatic conditions in the Central Rift Valley vary significantly across time and space. The mean annual precipitation over the entire basin is around 900 mm/year with some regions recording 700 mm/year of rainfall and other areas up to 1200 mm/year. There is also patterned temporal variability as around 59% of the precipitation occurs during the main rainfall season (June to September), but only 13% of total rainfall
occurs during the dry season (October to February). The remaining 28% of precipitation falls during the minor rainfall months (March, April and May). Moreover, temperature ranges from 11.9°C to 29.5°C in lower parts of the basin, while it decreases to 4.3°C and 26.0°C in the regions located over 2500 m a.s.l.

Data collected in from 1994-95 shows that actual evapotranspiration oscillates from around 900 mm/year in the highlands to 650 mm/year in the rift (Ayenew, 2003). Actual evaporation from lake Ziway has been estimated at around 1800 mm/year according to records collected from 1968 to 1995 (Vallet-Coulomb, Legesse, Gasse, Travi, & Chernet, 2001). For the 1996-2005 period and according to the data provided by Jansen et al. (2007), the average annual rainfall in the basin was around 9100 Mm³, and evapotranspiration amounted to 8000 Mm³.

Water use in the CRV has been estimated in Table 1. Given the region’s socioeconomic profile, irrigation is the main water user, demanding 150 to 200 Mm³/year. Nonetheless, it is important to note that as environmental flows or water committed for the environment have not yet been defined, environmental water demands do not appear in the figures.

**Methodology**

This study conducted a stakeholder analysis in the Central Rift Valley in order to obtain local information on water management practices, policy implementation, stakeholders’ participation and public awareness of water-related environmental problems. Between July and September 2009, interviews were held with several stakeholders from different groups relevant for this research. The aim of this kind of analysis is to understand stakeholders’ interests, their perception of the problems, and their position vis-à-vis and relationships with other stakeholders (Runhaar, Dieperink, & Driessen, 2006). But most important, a stakeholder analysis may also assess the reasons behind conflicts and co-operation, increasing understanding of the situation and allowing the comprehension of the factors that may lead to conflict or successful collective action (Grimble, 2008).

Interviewed stakeholders were identified after carrying out an extensive desk review of the available and relevant literature reviews as well as on sector actors assessing Ethiopian water-related policies. Among the key identified stakeholders were government organisations at the federal, regional or local levels, private investors, non-governmental organisations (NGO) and community-based organisations (CBO). The adopted procedure consisted in preparing and submitting a questionnaire to the stakeholders some days prior to an interview lasting 30-60 min. The questionnaire was composed by open-ended questions and it was previously delivered to the selected stakeholders as a guide prior to the interview. Later the interview was conducted as a semi-structured interview, allowing the interviewer to deepen on relevant aspects that arose.
The objective of the interviews was to understand the views the selected stakeholders have on how water resources are being managed and how is this related to the environmental problems emerging in the CRV basin. Hence, interviews addressed two major issues: (i) the status of water resources, mainly focusing on water scarcity and water quality problems, but also considering biodiversity and ecosystems conservation; and (ii) water resources management, policies and capacities, coordination among different stakeholders, as well as water uses and the impact this has on agricultural productivity and land management.

**Results**

After analysing the interviews held with the abovementioned stakeholders (see Table 2) it was possible to draw the following findings regarding key water-related issues in the CRV basin:

**Water resources status**

The Ethiopian Central Rift Valley is facing a growing number of challenges related to the water resources available in the area. Issues range from falling lake levels to diminished water quantity, worsened water quality and the implications this has for human health, compromised gains in agricultural productivity and the overall deterioration of the surrounding ecosystems.

An assessment of land use based on satellite interpretations from LANDSAT MSS and ASTER images (Jansen et al., 2007) show that while forest coverage reduced by almost 50% in the CRV during the 1986-2006 period irrigation greatly increased. Large-scale irrigation started in the Lake Ziway catchment area in the 1970s and peaked one decade later (Legesse & Ayenew, 2006). It was also in the 1980s that the most marked decrease of the lake level was recorded at the same time that industrial water demand increased along the shore of Abyiata (Alemayehu, Ayenew, & Kebede, 2006). Since then, irrigation has continued to grow.

By way of an example, in the last 5 years, irrigated land in two districts on the western shore of Lake Ziway has gone up by around 70%. Studies conducted by the Ministry of Water state that the maximum increase in irrigation in the area accounts for approximately 7,000 ha (MoWR, 2007). However, the development plans on each basin district sets altogether increases of over 18,000 ha. Nevertheless, intensified irrigation has not always brought about the desired productivity gains. Indeed, recent studies of smallholder irrigation performance in the CRV indicate that attention should be paid to improving the performance of existing irrigation schemes rather than developing new ones (Van Halsema, Beshir Keddi Lencha, Mengistu Assefa, Hengsdijk, & Wesseler, 2011).
Moreover, the stream flow of the Bulbula river has decreased as the average Lake Ziway level has lowered by around 0.5 m since 2002 (Jansen et al., 2007). Accordingly, the water inflow of Lake Abyata, which is the outmost lake of the basin located in the Abyata-Shala National Park, has been drastically decreased. This is endangering the area’s rich biodiversity (Oromia Environmental Protection Office, 2005). The recent inflow decrease of Lake Abyata is another one of the perceived problems emerging from rapid changes in lake extension and volume over the last 40 years (Ayenew, 2007). Nevertheless, the general understanding of the causes behind such phenomena remains limited.

On one hand, the valley’s inhabitants are aware of the impacts of diminishing water resources. But on the other hand, people seem reluctant to accept that upstream water abstraction is detrimental for downstream users and ecosystems. Although precipitation has not seen substantial decreases over the last 50 years (Ayenew, 2004), people attribute the lack of water to perceived reductions in rainfall (Codony Gisbert, 2010). However, depletion of water resources can worsen in the mid term as population is expected to double and reach anywhere 4.0 to 4.8 million people by the year 2035, out of which 3.1 to 3.7 million people will live in rural areas. Moreover, due to global change, it has been estimated that over the next 50 years, water resources in Lake Ziway will sharply fall by 19% to 27% (Zeray, Roehrig, & Chekol, 2006). What is more, diminished water availability will invariably have significant impacts on quality as well.

Both human-induced and natural factors affect water quality in the area. Most of the rocky terrain in the CRV is of volcanic origin, leading to fluoride concentrations in groundwater sources of up to 200 mg/l in lower regions (Ayenew, 2008). In some habitations, the population is drinking this polluted water, which is leading to dental and skeletal fluorosis (Ayenew, 2008; Raventós Vilalta, 2010). Moreover, the water used for irrigation shows high levels of alkalinity and sodium concentrations that damage agricultural land (Chernet, Travi, & Valles, 2001). Furthermore, anthropogenic contaminants have been found in the basin. Deforestation and the loss of vegetation cover cause erosion and the transport of sediment and nutrients is responsible for the eutrophication in the terminal lakes that is already killing fish and other microorganisms in Lake Abyata (Ayenew, 2007). Although data has not yet been made available, it is not insensible to conclude that the agrochemicals and pesticides used in the area to improve land productivity may endanger water quality.

**Water resources management**

As stated by Gurria (2009) water scarcity is not only produced by physical conditions but is mainly a governance and management issue. In the CRV, improvements in policy formulation and implementation have taken a long time to come about and so has the development of water resources. Competences and responsibilities are not clearly defined, allocated and assumed by the involved stakeholders. The inclusive and true participation of all the water-related stakeholders is lacking. Moreover, the current water rights system does
not suit the reality in Ethiopia or that in many other African countries where the majority of water users are scattered smallholders. Finally, land productivity is quite low while households have just the usufruct of small plots, leading to subsistence agriculture and further pressure on natural resources. Nevertheless, national decentralisation efforts may prove helpful in bringing about the necessary improvements in water governance and management.

Decentralisation of water sector

Following the country’s decentralisation process, the water sector has also undergone similar changes. The Federal Government, through the Ministry of Water and Energy (MoWE), is in charge of policy and strategy development at the central level (Wube, Alemu, Endeshaw, & Girmaw, 2009) and of providing technical support to regional water bureaus and offices (MoWE, 2010). Under the umbrella of the MoWE, River Basin Organisations (RBO) have been established to promote and monitor the integrated management of water resources. As such RBOs: (i) provide policy guidance and planning oversight; (ii) prepare river basin master plans; (iii) make decisions over major water works; (iv) define water allocations; (v) propose water rates to the Government; and (vi) manage intraregional water use disputes in the basin (GoE, 2007a). The first RBO was developed for the Abbay Basin, also known as the Blue Nile Basin, and relevant legislation been drafted based on that management experience (Raventós Vilalta, 2010). Since then, other RBOs have been established, one of them in the Rift Valley Lakes Basin in which the CRV basin is included.

As part of the decentralisation process, regional governments have been made responsible for providing a wide array of services. In line with this, the region of Oromia and the Southern Nations Nationalities and Peoples Region (SNNPR) are both in charge of the administration of the CRV. Following a second wave of decentralisation in the country, districts have been bestowed with autonomy in planning, administering and managing public services, including water supply and sanitation.

Nonetheless, problems have arisen in both water resources management and service provision. On the one hand, skills and resource gaps in regional and local governments diminish water management capacities as local authorities lack the required capacities and are unaware of pertinent laws, regulations and procedures (Raventós Vilalta, 2010); have not yet coordinated with the various stakeholders involved (Codony Gisbert, 2010); and do not count with a proper monitoring network and an updated national database on water resources and use. On the other hand, the provision of services is failing since districts cannot cover both the operational and maintenance costs incurred by the local water systems (MoWR, 2007). Moreover, planning and personnel administration inconsistencies between regional and district bodies is also hindering the way districts provide services (Assefa & Gebre-Egziabhe, 2007). Lastly, despite policy guidelines to further
decentralisation and encourage the participation of relevant stakeholders in local decision-making, federal governments still have the greatest influence (Raventós Vilalta, 2010).

**Water allocation**

The water policy in Ethiopia attempts to attain both social equity and economic efficiency. Consistent with government laws and international conventions, every Ethiopian citizen has the fundamental right to access sufficient water and of acceptable quality in order to cover basic human needs (MoWR, 1999). Along these lines, any person, or any public or private agency, shall apply for a water use permit to use any water resource, provided they fulfil the requirements set out by the supervising body, namely, that the use of water does not infringe any other legitimate interests and does not entail pollution or harmful effects on the water resource and the environment. Nevertheless, a water use permit is no required for hand-dug water wells or for using water from hand-dug wells; nor is it needed to use water for traditional irrigation, artisanal purposes, mining, traditional animal rearing and the operation of water mills (GoE, 2000).

Besides acquiring water rights, some new development activities also require an environmental impact assessment. In 2003, the Environmental Protection Authority established procedural guidelines for such studies but this legislation was still awaiting approval in 2012. The proposed document states that while rural water supply systems require a preliminary environmental impact study, there is no need for such an assessment for surface water and ground water-fed irrigation projects that cover less than 50 ha, or for small-scale agricultural or livestock activities (cattle <50 heads, pigs <100 heads, or poultry <500 heads) (EPA, 2003).

**Land productivity and management**

As can be clearly identified from Table 1, the largest water user in the region is, by far, agriculture. Yet the importance of agriculture is not only due to the vast volume of water it requires, but also to the primordial role it plays in the basin’s economy. A household survey done for the Master Plan (MoWR, 2007) showed that the population’s main sources of income come from both crop cultivation and livestock products (see Figure 2).

Despite widespread agricultural activities, land productivity still remains quite low in some areas of the basin and the small-sized plots cultivated by farmers suggest farming remains at the subsistence level (Adimassu, Kessler, & Hengsdijk, 2012). The situation is such that certain areas of the CRV are even considered food deficit zones (FEG Business Development and Operations, 2009).

Land degradation, inappropriate agricultural practices and poor tillage systems have all put a cap on land productivity gains (Sissay, 2003). Moreover, increased irrigation with saline water is leading to soil salinisation. As farmers have been abandoning these no longer productive plots, (Shimelis, 2008) deforestation has been on the rise new areas are cleared
for agriculture (Sissay, 2003). Recent countrywide strategies to promote economic growth are centred around improvements in agricultural production by increasing irrigated lands from both ground and surface water, encouraging the use of agrochemicals and improved seeds, selecting appropriate crops according to soil characteristics, and by encouraging the adoption of soil conservation practices (MoFED, 2010). Moreover, this strategy focuses on augmenting the size of irrigated land, particularly among smallholders for whom more productive plots might lead to poverty alleviation (Van Koppen, 1999). Nevertheless, current land tenure systems complicate the implementation of such growth-oriented strategies.

Article 40 of the 1995 Ethiopian Constitution states that land ownership is exclusively vested in the State and the people of Ethiopia. It also establishes that land is a common property, and that peasants have the right of usufruct of a plot without paying for it (GoE, 1994). Some members of the Ethiopian Economic Association, donor agencies and some independent researchers are of the opinion that land productivity cannot be successfully raised due to the country’s common property laws and the consequently insecure land tenure system, although Ethiopian constitution sets compensations for land use termination for labour and capital investment and allows inheritance and leasing (Crewett & Korf, 2008).

Regardless the land tenure security, another important aspect is landholding size: agricultural activities in the CRV are carried out in landholdings averaging mere 0.85 ha per farm (Raventós Vilalta, 2010). In attempt to tackle this problem, the Oromia Regional Government has established minimum per household size plot values according to their use. A minimum of 0.5 ha are to be allocated for annual crops, 0.25 ha for perennial crops and a maximum of 0.5 ha for irrigated land (ONRS, 2007). Yet, these values vary from across regions.

For instance, the SNNPR Regional Government has established a minimum 0.5 ha plot without making differentiations of the type of crop and a maximum 0.5 ha plot size for government-promoted irrigation systems (SNNPRS, 2007). As this is not enough land to support a household - 7.8 members on average (MoWR, 2007) -, farmers find themselves in a poverty cycle in which they cannot afford the investments required to raise the yields that would allow them to make such investments to raise agricultural productivity. Fragmented land tenure, together with absent capacities, hinders productivity and leads to land overexploitation, intensive agrochemicals use and, where irrigation is available, fierce competition for water and its indiscriminate use. Population growth puts further pressure on available land and on clearing the remaining forests. Seeking to alleviate such pressures on existing agricultural land, regional legislation has allowed farmers to lease part of the plot. Nevertheless, this effort does not seem to facilitate the sort of land concentration that would led to the gains in agricultural productivity that families need to obtain higher incomes and improve their socioeconomic status.
Besides agriculture, land is deteriorating fast due to overgrazing (Jansen et al., 2007). In highland areas, livestock makes significant contributions to households’ income and is a key part of the farming system. Animals are grown for the production of meat and milk and are also used as draft labour to pull loads. In the drier southern lowlands of the Rift Valley, livestock production is based on semi-nomadic pastoral systems and constitutes the main source of wealth.

Around the basin, additional family income is obtained through charcoal production, which entails further deforestation. The disappearance of acacia forests is reducing the habitat and food sources of migratory birds (Shimelis, 2008). New legislation on forest management has toughened penalties on unlicensed forest exploitation (GoE, 2007b), but the lack of enforcement capacities may limit how fast and efficiently are forests safeguarded.

**Discussion**

As the Ethiopian water policy now establishes that all water resources are the common property of the people of Ethiopia and the State, irrigation water is no longer a private good. With this transformation of irrigation into a common good, no one is held responsible for any mismanagement (Raventós Vilalta, 2010).

The result is endangered water resources in the CR: water quality has deteriorated and quantity decreased in the last few decades. Although environmental flows in the CRV have not yet been defined, environmental degradation due to lack of available water resources in the basin shows that the basin is closing, if it not already closed. Some measures have to be undertaken in order to revert this situation. Unfortunately, lack of proper information on the importance and severity of this challenge suggests that it is first and foremost needed to set up a monitoring plan and network for water quantity and quality in order to assess water system behaviour, and also to study the relationship between water systems and environmental services. This may allow, on the one hand, to set the appropriate environmental flows to sustain ecosystems and, on the other, to monitor the impact of the measures adopted and to observe if the desired objectives are achieved.

Moreover, current management practices show no concern for the local water cycle, the effects of water withdraws and the consequences of environmental degradation. To tackle this, awareness raising campaigns should be conducted among the population to improve people’s general understanding of the issue and to foster a sense of joint responsibility for water and environment conservation among all citizens.

However, just monitoring the basin, setting environmental flows and raising awareness will not significantly improve the current situation. In other to allow for the sustainable exploitation of water resources and to adapt to mid-term scenarios, it is advised to implement different measures for natural resources management. Some of the key actions
include improving water governance, increasing water productivity in agriculture and effectively protecting the environment.

Developing the recently established River Basin Organisations could help improve how water resources are managed in the CRV as well as in other Ethiopian regions facing a similar situation. For water governance to significantly change, all relevant stakeholders should agree on the management of water resources. For instance, as the watershed is located in two regions, RBO has to be designed as a dialogue and cooperation mechanism between the regions themselves and the federal government in order to negotiate among different interests. This organisation should also foster the effective participation of all the other relevant stakeholders in the basin, such as farmers, fishermen, representatives of the CRV industrial and tourism sectors, pastoralists and members of the civil society.

RBOs should set as a priority to reach common agreements among the different stakeholders on water allocation, implement measures to rationalise water withdraws based on accountable criteria and ensure both the equitable and efficient use of water. Yet, this can only be achieved if at least three key aspects are thoroughly understood and assessed: (i) the understanding of water dynamics at the basin level, including the different impacts of water use; (ii) the value of the environmental services related to water and land management; and (iii) the socioeconomic impacts caused by the management of these resources. As previously proposed, setting up a monitoring network may help to gather the required data on water dynamics to then set up a water resources model. If such scheme is devised, then the future use of decision-support systems at the basin level can prove most useful. Some of these systems are already available, such as AQUATOOL (Andreu, Capilla, & Sanchís, 1996) or WaterWare (Jamieson & Fedra, 1996).

Gradually, agricultural water productivity needs to improve in order to reduce water depletion and to intensify food cultivation with less water. As previously explained, the federal government has recently approved the National Growth and Transformation Plan, which lists a series of activities focused on improving agricultural revenue mainly among small land holders. The document envisions: improving farmers’ capacities; making better management of natural resources; promoting partnerships between farmers and researchers; improving the use of rain water; implementing soil conservation techniques; and intensifying irrigation wherever feasible (MoFED, 2010). The plan appears to be moving in the right direction to help improve agricultural productivity, although more indicative results are yet to be seen. Naturally, not all the plan’s measures are relevant for the CRV; for instance, irrigation should not be furthered until water committed to the environment is defined and water withdraws reduced for the basin not to close or be proximate to closing.

Moreover, additional efforts to improve water governance are necessary. For instance, a clear and effective environmental protection policy should be formulated and implemented. Firstly, it needs to be clearly defined which projects require an environmental impact assessment study. Secondly, some measures should also be put in place to reduce
contamination. Bearing in mind the importance agriculture has for the people in the basin and the nonpoint source pollution it develops, pollution prevention seems an excellent approach. Tools such as Farm*A*Syst are already available and can serve to put those plans into action; and although they have been created for other contexts, these can be tailored to suit the local situation (Nevers, Castelnuovo, Jackson, & Moreau, 1998). In order to finance such programmes, an initial idea could be to apply levies on potential polluters, starting with large industries and agriculture producers, and gradually involving smallholders. Since there are fewer large producers than small landholders, this approach may facilitate real scheme implementation without jeopardising small farmers’ efforts to break the poverty cycle in which many of them find themselves.

**Conclusions**

The appraisal of existing literature works, policies in places and the interviews held with relevant stakeholders has allowed the authors to identify some existing constraints and opportunities in managing water resources in the CRV basin.

Some of the main water problems in the Central Rift Valley that make an urgent call for more appropriate water resources management include: (i) the overexploitation of water resources currently hindering ecosystem survival and is the result of growing competing uses among subsistence farming, industrial farming and tourism promotion; (ii) deteriorating water quality, which affects irrigated agricultural production and renders water unsuitable for drinking; and (iii) great dependency of the population on water resources to sustain their livelihoods. Fortunately, these issues can be addressed by strengthening water governance. Improved water quality and reduced over drafting will also enhance environmental sustainability and contribute towards reducing poverty.

New water governance systems are currently being developed with the creation of River Basin Organisations. But although these bodies offer some scope for improvement, significant work remains to be done, mainly in terms of enhancing coordination between stakeholders and make more suitable water allocations. Unless current water management regimes are not modified, vital ecosystems will continue to be endangered and the livelihoods of large numbers of people relying on them compromised. Environmental degradation intensifies socioeconomic inequality as it has adverse impacts on already disadvantaged people and at the same time inequalities in human development amplify environmental degradation (HDR, 2011). This cycle has to be broken if sustainable development is to be achieved. Proper development of water resources management may help improve economic and social welfare without deteriorating the life of today and tomorrow’s poorest inhabitants. But most important is that reinforced water governance can help these impoverished groups improve their livelihoods by means of dialogue between all the stakeholders involved.
Although the study has focused on water management problems specific to the Ethiopian Central Rift Valley, these are challenges affecting basins all around the world, particularly in Sub-Saharan Africa. As previously mentioned, some common problems are the local economy’s dependence on agriculture, small and scattered water users, economic water scarcity, large pockets of poverty and widespread environmental degradation. With this in mind, engaging with relevant stakeholders in identifying the ways water governance can be fostered as well as suggestions on how to improve water resources management can prove relevant in other contexts.

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Bibliography


Table 1. Water demand in the CRV. Source: Jansen et al. (2007)

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<th>Mm$^3$/year</th>
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Table 2. Interviews conducted and classified by stakeholder type.

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Figure 1. Location map of the Central Rift Valley, Ethiopia
Figure 2. Household survey results on main and secondary sources of income in the Rift Valley Lakes Basin. Source: Halcrow and GIRD (2007)