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Revisiting Dominant Notions: A Review of Costs, Performance and Institutions of Small Reservoirs in Sub-Saharan Africa

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Front Cover: The multiple dimensions of small reservoirs in sub-Saharan Africa *(photo credits*: Jean-Philippe Venot, Hilmy Sally and Ernest Nti Acheampong, IWMI)

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Summary

Thousands of small reservoirs dot the rural landscape of sub-Saharan Africa. They have long attracted development and academic interest on the grounds that they make vulnerable and generally little-developed regions 'drought-proof' and allow for small-scale community-based irrigation. On the other hand, concerns have long been raised over the high construction costs, poor irrigation performance, low managerial capacity on the part of communities and little sustainability of investments that seem to be locked in a build-neglect-rebuild syndrome. A common response to these shortcomings has been to improve project designs and organize farmers in Water User Associations (WUAs) to better manage their common resources. This report, however, calls for a different approach based on a renewed understanding of small reservoirs. Drawing information from a cross-country comparative analysis conducted in Burkina Faso, Ghana, Ethiopia and Zambia, this report argues that high costs are not inherent to the technology but are caused by major shortcomings in the planning and implementation processes. Non-standard and corrupt practices throughout the project cycle add to the costs and affect the quality of construction and hence the performance, and the farmers' ability to maintain the reservoir in a workable state. Performance assessments are centered on downstream irrigation activities and universally point to the disappointing results of small reservoirs in these terms. Such assessments are grounded in field observations but remain partial. Small reservoirs support, and enhance synergies between, multiple livelihood strategies. The performance of small reservoirs needs to be assessed against this backdrop of multiple uses/users. WUAs, often externally triggered, have been framed and instituted as the sole and most adequate structure for the management of small reservoirs, with generally disappointing results. This is because decision making on small reservoirs takes place in multiple and overlapping arenas; the concerns of users may thus be best addressed by promoting arrangements that enhance multiple institutional relationships at multiple scales. An integrative approach, both in spatial (the watershed) and temporal (the project cycle) terms, holds the promise of sustainable management of small reservoirs.

Revisiting Dominant Notions: A Review of Costs, Performance and Institutions of Small Reservoirs in Sub-Saharan Africa

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Introduction

Small reservoirs have long attracted development and academic attention worldwide. They are known under multiple names in various regions of the world: *tanks* or *johads* in South Asia, *açudes* in Brazil, *small reservoirs* or *micro-dams* in sub-Saharan Africa, and *lacs collinaires* in North Africa. Defining what 'makes' a small reservoir is, however, not agreed upon, as the criteria and thresholds considered can vary widely among regions and actors.[1] This is not due to a lack of knowledge but rather to the multiplicity of meanings and the inherent tensions that characterize small reservoirs.

Long envisioned as soil and water conservation and drought-proofing measures, small reservoirs have, over the last three decades, been increasingly seen as a way to develop small-scale irrigation, especially in sub-Saharan Africa (Venot and Krishnan 2011). This discursive shift has taken place over the past three decades and echoes several major rural development discourses. First, the growing disenchantment with the costs involved and the social and environmental consequences of large-scale multi-purpose dams (WCD 2000) has led to growing attention being given to small-scale projects (McCully and Pottinger 2009). Second, small-scale projects are made all the more appealing by their compatibility with current 'decentralization' and 'participation' rhetoric. Third, there has been increasing research-based evidence that small-scale, farmer-based, irrigation could indeed have significant positive impacts on livelihoods, as observed in South Asia (see, for instance, Martin and Yoder 1987; Yoder 1994). Fourth, irrigation has been gaining importance once again as a potential driver of agricultural development in sub-Saharan Africa (World Bank 2007), where a concerted effort is taking place to stimulate a home-grown 'Green Revolution'.

As a result, past and current debates on small reservoirs resonate with broader discussions about small-scale irrigation in the developing world.[2] Three interrelated topics stand out: 1) the allegedly high investment costs per hectare irrigated (in comparison to South Asia, in particular); 2) the allegedly low performance of small reservoirs in terms of irrigated production; and 3) the allegedly low level of community organization to ensure proper operation and maintenance. Based on a cross-country comparative analysis conducted in Burkina Faso, Ghana, Ethiopia and Zambia,

[1] For the sake of clarity, we use the generic term 'small reservoir'. We do not engage in definitional debates on what is – and is not – a small reservoir, and instead adopt a multi-dimensional definition of small reservoirs (see Table 1).

[2] See the collection of essays published in 1994 in *Land Use Policy* 11(4) on the topic of small-scale irrigation.

this report probes some common wisdoms related to these three disputed themes. First, we address the question of investment costs (see the section, *From the Onset: Planning and Implementing Small Reservoir Projects*); we specifically look into the consequences of planning and implementation practices, inclusive of corrupt practices, on the costs of small reservoir projects. Second, we question the current understandings and measurements of the performance of small reservoirs (see the section, *Looking at Performance From a Multiple Users/uses Perspective*); they embed efficiency, optimization and productivity concerns that underpin mainstream development paradigms but fail to account for multiple livelihood strategies. Third, we investigate the notion of participation in the form of ‘community governance’, and the related attempts to craft the ‘right institution’ for managing small reservoirs that often fail to recognize multiple decision-making processes (see the section, *Local Arrangements for Management: Questioning the WUA Model*). A short conclusion calls for a shift *away* from the focus on irrigation *towards* the recognition that small reservoirs are sociopolitical entities that serve multiple purposes, at multiple levels for multiple actors.

Small Reservoirs: Some Elements of Perspective

Current Understanding of Small Reservoirs in Sub-Saharan Africa

As agriculture is back on the development agenda as a “vital development tool for achieving the Millennium Development Goals” (World Bank 2007), projects and reforms dedicated to agricultural water management are experiencing renewed interest worldwide. In sub-Saharan Africa, this interest is notably articulated in the Comprehensive Africa Agriculture Development Program (CAADP), formulated by the New Partnership for Africa’s Development (NEPAD), in which water management and irrigation development feature as one of the “*areas for primary action.*” Though the program aims for multiple and integrated answers to the current challenges in agriculture, it clearly prioritizes “*the identification and preparation of investments to support small-scale irrigation*” (NEPAD 2003: 28), including small reservoirs.

Interest in small-scale irrigation (and in small reservoirs, in particular) reflects broad changes in rural development thinking. As early as the 1960s, small farms had been framed as motors of rural development. This paved the way to a participatory and bottom-up rhetoric (for instance, see Chambers et al. 1989) that emerged in the 1980s, and notably underpinned a sustained interest in farmer-managed irrigation schemes, particularly in South Asia (Martin and Yoder 1987; Yoder 1994). More recently, the early 1990s witnessed another boom in academic and development interest in small-scale irrigation, this time in sub-Saharan Africa (Alam 1991; Turner 1994; Vaishnav 1994). Two phenomena, in particular, may explain this interest; first, the droughts of the 1970s that dramatically affected agriculture and livelihoods in sub-Saharan Africa; and second, the controversy around large-scale dams, their costs, and their social and environmental consequences (WCD 2000). These two phenomena coincided with calls for decentralization of decision-making and participation of local users in the management of natural resources. Venot and Hirvonen (Forthcoming) show that this cyclical, yet, continued interest in small reservoirs finds its roots in the instant capacity of the latter to lend themselves to dominant discourses of development, governance, environment, eco-technology and knowledge production alike.

At the core of our current 'understanding' of small reservoirs there appears to be a dichotomy: small reservoirs have tremendous potential but, to date, have largely failed to live up to expectations. On the one hand, small reservoirs are in high demand among local communities, are a priority for national governments and continue to attract funding from development agencies (Venot and Cecchi 2011). They are said to limit rural out-migration, enhance the incomes of the local population (Fromageot et al. 2006) and contribute to food security (Savy et al. 2006) by supporting multiple livelihood strategies such as livestock rearing, small business water use, handicraft activities and, increasingly, small-scale irrigation (Cecchi 2007). Further, they are seen as an option to buffer against extreme weather events and changing climatic patterns (McCartney and Smakhtin 2010).

On the other hand, many studies point to the low performance levels of small reservoirs, notably in terms of little irrigated area, damaged infrastructure and low water or agricultural productivity, and propose technical improvements (Faulkner et al. 2008; Mdemu et al. 2009; Mugabe et al. 2003). Others highlight the governance challenges faced by small reservoir projects, both at the local (participation and empowerment) and national levels (see, for instance, Birner et al. 2010; Venot et al. 2011). In addition, sustainability issues are raised at two levels. First, some scholars question the frequent need for rehabilitation in a process that echoes the build-neglect-rebuild syndrome described by Shah (2009) for public irrigation systems in South Asia. Second, emerging evidence shows that uses of small reservoirs can contribute towards environmental deterioration (erosion of the shoreline due to upstream pumping and decreasing water quality) and have adverse health impacts such as malaria (Ghebreyesus et al. 1999), though adequate management can lead to improved human health (Andreini et al. 2009; Boelee et al. 2009). Table 1 summarizes the conflicting views and perspectives that dominate the debate around small reservoirs.

TABLE 1. Advantages and shortcomings of small reservoirs.

Opportunities/stated advantages	Limitations/stated drawbacks
Planning	
Viable/practical alternatives to large projects	Multiple approaches/lack of benchmarking
Compatibility with local farming systems	Low visibility and limited funding
Easily adaptable to local conditions and allowing involvement of population in the siting/design	Planning processes similar to those of large-scale projects
	Lack of attention to complexity of intervention
Quicker/higher returns than large-scale projects	Lack of involvement of population in planning phases
Infrastructure/Development	
Low costs (absolute value)[‡]	High costs relative to benefits
Simple technology	Inconsistent commitment by governments/donors
Large scope for development (area, region)	Difficulty to replicate (context specificity)
Substantial aggregate areas[†]	Need for/lack of attention to proper feasibility studies
Spread benefits spatially/reach remote areas	Lack of capacity (engineering)/low quality of construction
Management	
Easy to maintain and manage	Low management capacity (community/extension agents)
Compatible with local culture and knowledge	Need for/lack of attention to training
Amenable to participatory management	No sustained interest for participatory management
	Lack of empowerment/ownership
	Complexity of institutional (land and water) arrangements
	Lack of maintenance/low performance
	Local power structures impeding equitable access

(Continued)

TABLE 1. Advantages and shortcomings of small reservoirs. (Continued)

Opportunities/stated advantages	Limitations/stated drawbacks
Impacts	
Multiple uses (irrigation, livestock, fisheries)	Weak forward/backward linkages (market/inputs)
Substantial impacts on economy (diversification)	Conflicts
Generate employment opportunities	Capture by local elites
Buffer against climate variability/change	Sensitivity to extreme events (droughts, floods)
Promote local entrepreneurship	Health (malaria) and environmental (pollution) issues
Limit migration and related negative impacts	May silt-up rapidly
Limited social and environmental externalities	

Source: Adapted from Venot and Krishnan 2011.

Notes: ‡ In sub-Saharan Africa, investment costs for small-scale irrigation are typically evaluated at USD 2,000-5,000/ha compared to less than USD 1,000/ha for inland valley bottom and soil and water conservation, and USD 5,000-10,000/ha and USD 10,000-20,000/ha for rehabilitation and construction of new large-scale projects, respectively (NEPAD 2003; Lankford 2005; Inocencio et al. 2007).

† Small-scale irrigation (less than 100 ha) would account for 44% of all irrigated areas in Africa (Lankford 2005).

Methods: The Need for Interdisciplinarity

This report focuses on four countries in sub-Saharan Africa: Burkina Faso and Ghana in West Africa; and Ethiopia and Zambia in eastern and southeastern Africa. These countries were selected, first, because they are illustrative of diverse settings of sub-Saharan Africa; this enables both context-specific observations and common insights that will be relevant for the continent to be drawn. Second, the four countries have witnessed significant investments (past or recent) in small reservoirs.

The multivalent character of small reservoirs calls for adopting an interdisciplinary approach drawing on multiple methods to generate both qualitative and quantitative data. Table 2 lists the methods, tools and data this report relies on in relation to the different issues/results that are discussed therein.

We collected data in a sequential process between April 2009 and October 2011. First, a baseline inventory of all small reservoirs in Burkina Faso, Ghana, Ethiopia and Zambia was prepared using existing secondary data. Second, a rapid regional appraisal was conducted in specific regions with a high concentration of small reservoirs: the two northern regions of Ghana (the Upper East and Upper West regions; 364 reservoirs); the center-south region of Burkina Faso (249 reservoirs); the region of Tigray in northern Ethiopia (26 reservoirs); and the southern region of Zambia (205 reservoirs). The rapid regional appraisal consisted of organizing working sessions with extension agents of the ministry in charge of agriculture and water at the district level. Detailed information was collected on: (1) the characteristics of the dams; (2) their design purposes and actual uses; (3) their level of performance; (4) the constraints faced by the communities; (5) the benefits derived from using the small reservoirs; and (6) the local institutional arrangements and modes of management. Third, 41 randomly sampled small reservoirs in Ghana (24), Burkina Faso (13) and Ethiopia (4) were studied in detail to gain a qualitative understanding of the multiple uses and perceptions of small reservoirs. In each site, the detailed case studies involved participatory exercises (focus group discussions, transect walks), semi-structured interviews with users of individual small reservoirs (rainfed and livestock farmers, irrigators, fishermen, women) and key informant interviews in the community (elected local representative, head of organizations, customary authorities, representative of WUAs and *Comités Locaux de l'Eau*).

In addition to local-level studies, we also conducted key informant interviews with policymakers (in ministries and bureaus of Water Resources, Agriculture, Irrigation and Environment at the national, regional and local level), donors and technical development partners (such as International Fund for Agricultural Development

Table 2. Methods, tools and data used for documenting small reservoir dynamics in sub-Saharan Africa.

	Methods, tools and data used
Background information on small reservoirs	• Literature review • Technical seminars with resource persons
Historical analysis	• Literature review • Secondary data from relevant ministries
Remote sensing analysis	• Secondary data (from published studies) • Analysis of 2005/2006 Landsat images (unsupervised classification to detect water bodies)
Planning/corruption issues	• Literature review • 30 to 40 key informant interviews (primary data) with contractors, regional and national representatives of line ministries, procurement and public-finance specialists, representatives of development partners and project managers (mostly in Ghana and a few in Burkina Faso) • Technical seminars with resource persons
Investment costs	• Secondary data from line ministries and development partners in Ghana (N= 137 dams), including break-up of costs by post (N=33)
Performance analysis	• Qualitative assessment from rapid regional appraisal (primary data) that took the form of working sessions with extension agents (more than 250 extension agents contributed to document 835 small reservoirs in four countries)
Multiple uses and local perceptions	• Rapid regional appraisal (primary data) that took the form of working sessions with extension agents (N=835; see above) • Detailed documentation (primary data) of 41 small reservoirs: interviews with users of small reservoirs, traditional authorities, elected local representatives and representatives of water committees; focus group discussions; transect walks
Modes of management	• Rapid regional appraisal (primary data) (N=410, see above) • Detailed documentation (primary data) of 41 small reservoirs • Key informant interviews (elected local representatives, traditional authorities, development partners and representatives of line ministries) • Literature review

(IFAD), World Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH), and elected officials of local executive bodies (communes in Burkina Faso; districts in Ghana and *weredas* in Ethiopia) to explore the governance structure and the implementation and planning processes of small reservoir projects. Finally, three technical seminars on "What roles for multipurpose small reservoirs" were organized in Burkina Faso, Ghana and Tigray, Ethiopia. Attendance included representatives from line ministries, international donors, development practitioners, elected representatives, farmers and academics.

A Historical Perspective of Small Reservoirs in Four Sub-Saharan Countries

The first challenge that scholars and development practitioners face when working on small reservoirs is that of definition. Defining what 'makes' a small reservoir is indeed not agreed upon, as criteria (size, type of infrastructure, modes of management, planning approaches) and thresholds (volume, height, number of farmers, irrigated area) can vary widely depending on the vantage point considered and the issues or actors at stake (Venot and Krishnan 2011).[3] We do not embark here upon definitional debates on what

[3] For instance, many Indian tank-based irrigation schemes would be considered as medium-size projects, if seen through the criteria commonly used in most of sub-Saharan Africa (Turner 1994). Similarly, the Ethiopian micro-dams are significantly larger (in terms of height, volume stored, potential irrigated areas) than small reservoirs in the Sahel (but smaller in terms of inundated area), mainly due to topographical differences (deep valley gorge versus flat semiarid areas). In most cases, scholars agree on the fact that small reservoirs 'imply' that farmers – and related local management bodies – have the upper hand in terms of decision making over the allocation and management of the resources and the infrastructure, though capital investments remain externally driven.

is – and is not – a small reservoir. Rather, we adopt a multidimensional approach that takes into account the multiplicity of meanings that small reservoirs can assume.[4] The second challenge is that of inventorying and locating small reservoirs (see Cecchi et al. 2009 for the situation in Burkina Faso), despite significant progress in remote sensing and geographic information system (GIS) techniques (Box 1; see Appendix 1 for country maps of small reservoirs).

Box 1. The promises and perils of remote sensing.

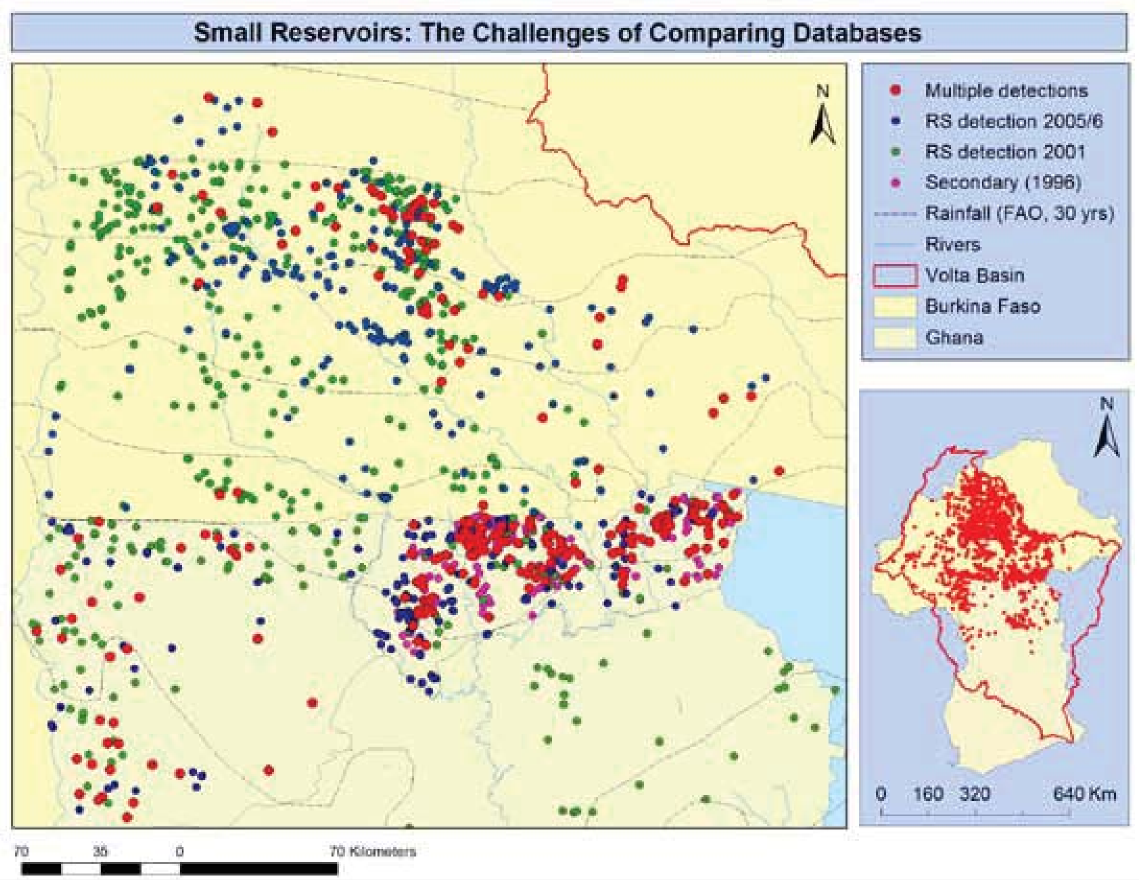
Remote sensing techniques and GIS have long been identified as a step towards improved information (see, for instance, Turner 1994) and scholars have increasingly used these techniques to detect small reservoirs (see, for instance, Liebe et al. 2005, 2009; Annor et al. 2009; such studies use satellite images and identify the specific signals rendered by open-water bodies). However, as for any research activities and results, **remote sensing techniques and outputs are socially mediated**. For instance, in Burkina Faso, the government entrusted a reputable private consultant to prepare an inventory of all small reservoirs in the country. This was carried out through remote sensing on the basis of 2001 Landsat images. Results were questioned as some reservoirs that were detected did not exist on the ground, while others, people claimed, had not been spotted. In 2010, after several groundtruthing campaigns and working sessions, the corresponding database was finally updated and validated by the government authority in charge of water resources information (Direction Générale des Ressources en Eau (DGRE)). Recognizing the inherent uncertainties that remain, the country is engaged in a continuous update of its centralized information system on water resources (the *Système d'Information sur l'Eau (SI-Eau)*).

During this project, inventorying and locating small reservoirs proved to be a challenge in Burkina Faso, Ghana, Ethiopia and Zambia, with inconsistent, dispersed and partial information. The map below illustrates the challenges faced when using satellite imagery to detect small reservoirs (see also Cecchi et al. 2009, for a discussion on the case of Burkina Faso). The map compares two sets of remote sensing information. The first set (green dots) is based on 2001 Landsat imagery (acquired after the rainy season) as presented by the DGRE (for Burkina Faso) and Forkuor (2005) for Ghana. The second set (blue dots) is based on 2005-2006 Landsat imagery (acquired after the rainy season), the analysis of which was commissioned as part of the project. The red dots indicate sites that have been detected both in the 2001 and 2005/2006 images in the south of Burkina Faso and north of Ghana. In Burkina Faso, there are only 73 overlapping records (the DGRE database presents 440 records and the 2005/06 analysis presents 782 records), for the region considered. In the north of Ghana, there are 167 overlapping records (the 2001 and 2005/2006 analysis detected 289 and 321 sites, respectively). **Overall, the multiple remote sensing analyses are only consistent up to 30%**. The inconsistency between the remote sensing analysis and secondary data (purple dots) is even higher. New constructions and ruptures of dams alone cannot explain such differences, nor can rainfall variability and related changes in water surface area. As for any research work, the methods used have tremendous bearing on the results and the maps that are produced, and can often serve to support decisions. In this particular case, differences in datasets can originate in the type of imagery used (low/high resolution), the date of acquisition of the image (rainy/dry season), the sensor used, the georeferencing, the methods used to classify land cover signatures (supervised/unsupervised) and delineate water bodies (digitization or not), the type of atmospheric correction, and treatment for clouds and land covers, which have a similar signature to open-water bodies (burned area and water weed), the quality of groundtruthing, etc.

(Continued)

[4] When presenting the history of small reservoir construction (Figure 1), and for practical reasons, we used criteria that are relevant for national-level decision makers in the countries considered. In west and southeastern Africa, water structures that are classified as small reservoirs (also called small dams) are earth dams, less than 7.5 meters (m) high, that can store up to 1 million cubic meters (MCM). They sometimes have a downstream adjacent irrigated area generally covering less than 50 hectares (ha). Dugouts are smaller rainwater harvesting structures located in depressions that have been further excavated (either manually or with machinery) to impound more water but often dry up during the dry season. Dugouts are not discussed here. In Ethiopia, the term 'micro-dam' is preferentially used in lieu of 'small reservoir'. Micro-dams can be 10 to 15 m high and store up to 3 MCM.

Box 1. The promises and perils of remote sensing. (Continued)



Source: this study.

Our objective here is not a detailed investigation of the underpinnings of the differences observed between the different datasets, nor is it to bring discredit to remote sensing work, which we consider very useful. Rather, we aim at bringing the need to critically assess remote sensing outputs to the reader's attention; this is all the more important as "a picture (a map) is worth a thousand words."

Secondary data collected from several line ministries and rapid appraisals with extension agents at district level yielded a comprehensive inventory of existing small reservoirs in the four countries studied (Appendix 2 provides the number of small reservoirs for some selected countries where they appear to be widespread).

In Burkina Faso, most small reservoirs were constructed between 1974 and 1987 (Figure 1),[5] largely in response to the Sahel droughts of the early 1970s and 1980s. The 1983-1987 period also corresponded to the 'Sankara socialist revolution' when the political leadership of Burkina Faso undertook large infrastructure construction projects, including roads, railways and small reservoirs, while promoting mass mobilization of the Burkinabè population (Sally et al. 2011). Since then, there has been a continuous commitment to build more infrastructure for small-scale irrigation. On average, more than 30 small reservoirs were built annually during the period 1985-2001 in the country, and a department of the Ministry

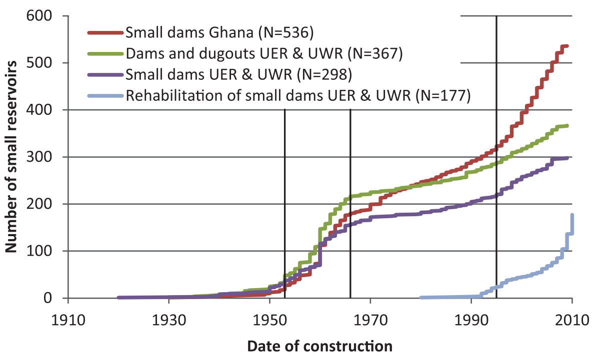
[5] There are differences between the number of small reservoirs presented in the text and those shown in Figure 1. This is because the date of construction is only available for subsets of dams in the secondary databases we used. Admittedly, this only gives a partial view of the history of small reservoirs in the countries studied, but the long-term trends appear very clearly.

of Agriculture and Water was set up in the early 2000s to coordinate the development and monitoring of small-scale irrigation, including small reservoir-based irrigation. Currently, several externally-funded projects[6] invest in rehabilitating and/or constructing new small reservoirs and the total number of small reservoirs and dugouts is evaluated at about 1,200 (DGRE database).[7]

In Ghana, considerable investments were made following independence in the 1960s (Figure 1), after which construction slowed down in the 1970s and 1980s. Since the mid-1990s, there has been renewed interest in small reservoir projects. This is mainly due to large donor-driven investments in the north of the country (see map in Appendix 1), among which

FIGURE 1. History of the construction of small reservoirs in (a) Ghana, (b) Burkina Faso, (c) Zambia, and (d) Ethiopia.

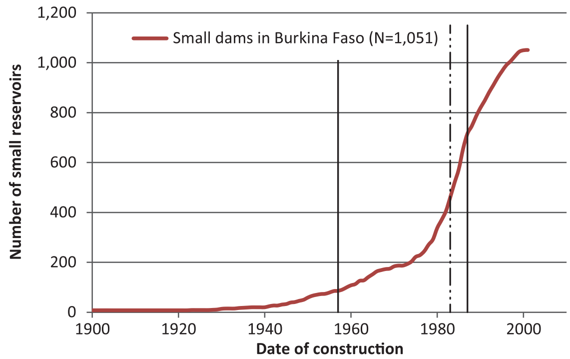
(a)



Source: This study; based on secondary databases of relevant ministries. Construction date is available for 2,445 out of 3,522 dams and dugouts (e.g., about 70%) (536 out of 946 when limited to dams).

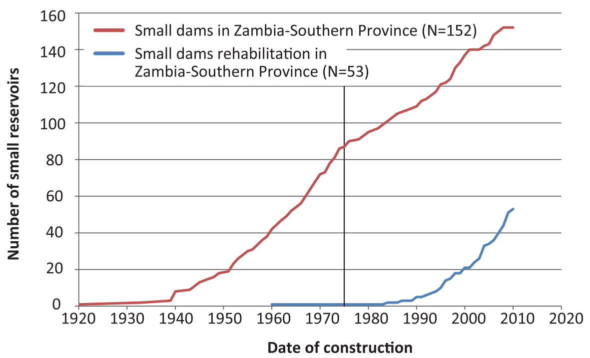
Note: UER - Upper East Region; UWR - Upper West Region

(b)



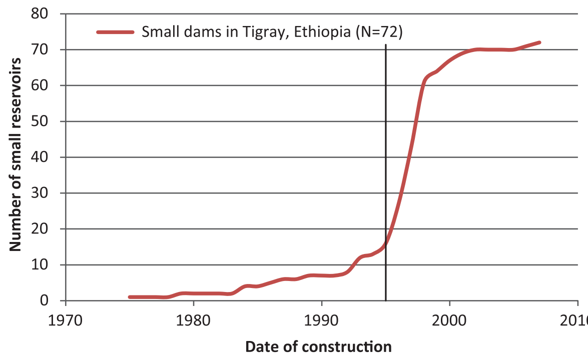
Source: DGRE database. Construction date is available for 1,051 out of 1,190 records (e.g., 90%).

(c)



Source: This study; for the southern region, construction date is available for 152 out of 205 sites that were documented. The database of the Ministry of Agriculture and Cooperatives (MACO) remains incomplete; it shows 820 records even though NCG (2010) talks about 2,000 as being the latest official figure for the number of dams in the country. Regarding rehabilitation, NCG (2010) indicates that 116 dams have been rehabilitated in the country from 2005-2009, of which 29 are in the southern province.

(d)



Source: This study; based on secondary databases of relevant ministries. Construction date is available for 72 out of 111 dams (e.g., 65%).

[6] Donors include the IFAD, the Swedish International Development Cooperation Agency (Sida), the Islamic Development Bank (IDB), the Banque Ouest Africaine de Développement (BOAD) - West African Development Bank), the African Development Bank (AfDB) and the Arab Bank for Economic Development in Africa (BADEA) for a total amount of more than USD 50 million to be invested by 2015.

[7] Their irrigation ‘potential’ would be more than 10,000 ha (i.e., one-third of the total irrigation potential of the country), but this figure is likely to be an underestimate as it does not account for spontaneous irrigation development upstream of the reservoirs (see Ki et al. 2010; Ndanga-Kouali 2011 for a description of this dynamic).

are the World Bank-funded Village Infrastructure Project (VIP), and the IFAD-funded Upper West Agricultural Development Project (UWADEP) and Land Conservation and Smallholder Rehabilitation Project (LACOSREP, phases 1 and 2). Between 1995 and 2009, 222 small reservoirs were constructed in the country, among which 82 were located in the three northern regions. At least another 80 reservoirs in the north of the country were rehabilitated during the same period. IFAD and AfDB plan to invest a further USD 30 million by 2015 to build or rehabilitate an additional 50 small reservoirs (Venot and Cecchi 2011). As at 2010, there are more than 1,000 small reservoirs in Ghana, half of which are located in the three northern regions of the country.[8]

In 1994, the Ethiopian Government engaged in an ambitious plan to build 500 small reservoirs in the Tigray region in the northeast of the country, where small reservoirs make most sense due to intermittent surface water flows and low groundwater potential (see map in Appendix 1). The scheme was funded by the United Nations Economic Commission for Africa (UNECA), together with the Canadian International Development Agency (CIDA) and the World Bank, and implemented by the newly set up Commission for Sustainable Agriculture and Environmental Rehabilitation in Tigray (Co-SAERT). It aimed at developing small-scale irrigation for food security (Annen 2001; Aberra 2004) while generating labor opportunities to the population of a region devastated by decades of famine and political instability (Chris Annen, Helvetas, Ethiopia, pers. comm., August 5, 2010). The program proved challenging to implement, and disappointing results in terms of irrigation development were soon questioned. The program was discontinued (and the commission dismantled in 2002) also because of its high costs and due to lack of further funding (Leul Kahsay, Independent Consultant, pers. comm., September 23, 2010). The government priority shifted to local household ponds and later on to watershed management. By the early 2000s, the government had built 50 small dams. This did not mark the end of investments in small reservoirs as local organizations such as the Relief Society of Tigray (REST) and international donors such as the Agence Française de Développement (AFD) (French Agency for Development) continued to invest in rehabilitating and constructing dams (AFD and REST 2003). By 2010, there were about 110 small reservoirs in the Tigray region and they are seen as pivotal for the development of the region.

Lack of data in Zambia makes it difficult to get an accurate picture of the history of small reservoirs in the country. It appears that the construction of small reservoirs remained limited until the 1940s; during the colonial period, settlements were centered along the railway line with the purpose of feeding mining communities in the Copperbelt and at Kabwe.[9] Between the 1940s and 1975, the drought-prone southern region, where most reservoirs are located (see map in Appendix 1), witnessed steady investments in small dams. Construction seems to have slowed down between 1975 and 1991 (when Zambia was a one-party state), even though the government had ambitious plans to construct 250-300 dams during the period 1988-1994 (as the country engaged in a 'New Economic Recovery Program') as a response to the increasingly frequent droughts that negatively affected the country in the 1980s (Morris 1991; Mbinji 2011). Similarly to other countries, the mid-1990s marked a renewed interest in small reservoirs with external financial support. Several large-scale projects, including the multi-donor effort Zambia Agricultural Sector Investment Program (ASIP) (1995-2001), the World Bank-financed Agricultural Development Support Project (ADSP) (2007-2012) and the Zambia Social Investment Fund (ZAMSIF) (2000-2005) invested in rehabilitating and constructing small reservoirs. Today, there are an estimated 2,000 to 3,000 small reservoirs in the country (NCG 2010). Investments in small

[8] Together, it is evaluated that they have an irrigable potential of more than 5,000 ha (public irrigation in Ghana is evaluated at about 9,000 ha; GoG 2010; Namara and Horowitz 2009) and allows watering more than 1 million of livestock, thus benefiting a population well above 2.5 million persons.

[9] This is different from neighboring Zimbabwe where European settlements and large commercial farming (relying on water storage) was strongly encouraged (NCG 2010).

reservoirs over the period 2005-2008 have been estimated at USD 6.5 million (NCG 2010); ongoing and envisioned projects (FAO 2008c) signify that similar (or higher) levels of investment are to be expected by 2015.

Beyond context-specificities, small reservoirs assume a significant role in the agricultural water management landscape in the four countries focused on for this study. Investments in small reservoirs should be seen in a broader historical perspective and appear closely linked to sociopolitical choices. Three broad trends can be highlighted. First, investment in small reservoirs is grounded in a dual rationale of providing water for drought-relief and developing irrigation activities. Second, despite the recent focus on irrigation, only a minority of small reservoirs in the regions studied were equipped with irrigation infrastructure (thus, calling for revising our understanding of performance; see the section, *Looking at Performance From a Multiple Users/ uses Perspective*).[10] Third, most investments are made 'in bulk' to meet targets and quotas, that is, governments and donors engage in ambitious plans to rehabilitate or build significant numbers of reservoirs, generally, in a short time period, thus raising planning and implementation challenges as described in the following section.

From the Onset: Planning and Implementing Small Reservoir Projects[11]

Planning Shortcomings and Corruption: Perverse Incentives and Circumstances

Identification and planning processes have a tremendous bearing on the outcome and performance of water development projects, yet, they remain largely overlooked (a notable exception is Morardet et al. 2005). This is also true for small reservoirs. Donors, line ministries, local authorities, contractors and communities all face difficulties that result in spiraling costs, delays in implementation, poor construction and the failure of small reservoirs to perform as envisioned.

Our analysis is based on two small reservoir initiatives that have been implemented in Ghana over the past two decades. The first initiative is a government-driven rehabilitation program conducted in 2009/2010 following floods that washed away scores of dams in the north of the country; the second is the continuous involvement of IFAD in the same region since the 1990s through multiple rural development projects that had small reservoir components (see Venot et al. 2011 for further information on these two initiatives). The documented lapses are not confined to Ghana or to sub-Saharan African countries, but can be found in most planning exercises. We present our results thematically and Table 3 provides information on how, what can be best termed '*macro-level deficiencies' or* '*inadequacies*' unfold along the project cycle (Table 3, column 2). We highlight that many of these shortcomings sprout from a tension between formal practices and a de facto logic of action, which constitutes the 'working rule' of development planning and public action in sub-Saharan Africa and beyond (Ferguson 2007; Bierschenk 2010). This tension breeds opportunities for corrupt practices. Based on multiple key informant interviews (see the section, *Methods: The Need for Interdisciplinarity*), we identify these *daily working circumstances* in the third column of Table 3.

[10] That is 18 out of 205 in Zambia; 66 out of 249 in Burkina Faso and 148 out of 364 in Ghana. Ethiopia stands alone with 19 out of the 26 small reservoirs surveyed commanding an irrigation scheme downstream.

[11] This section synthesizes detailed findings that can be found in Venot et al. (2011).

- ***Perverse incentives*** drive investments in small reservoirs as donor agencies continue to value the number of programs and volume of funding over the outcomes of projects (Martinez and Shordt 2008)[12]; they can even see corruption as having a functional role for

TABLE 3. Shortcomings in the conception and planning of small reservoir projects.[13]

	Macro-level inadequacies	Daily working circumstances
Policy-making and regulation	• Non conducive Institutional/legal setting • Two-speed bureaucracy • Lack of transparency/information	• Allow for, and cover up, fraudulent practices as they allow for 'minimal functioning' of projects
Identification, planning and financing	• Big-bang approaches • Pressure to disburse funds • Bias towards capital-intensive options • Weak transparency and accountability - notably towards local communities • Discrepancy between projects and national priorities and strategies	• Individuals are assessed in relation to the volume and numbers of projects rather than their outcomes • Projects buy-in political support • Covering up fraudulent practices (kickbacks) through design, overestimation of costs and complex procedures
Management and program design	• Weak interactions, accountability and information flows between multiple nodes of decision making • Weak transparency and accountability - notably towards local communities • Little attention/low quality of feasibility studies	• Project buy-in political support (influence site selection) • Covering up fraudulent practices (kickbacks) through design, overestimation of costs and complex procedures
Tendering and procurement	• Procedures look good on paper, but are complex and hardly enforced • Absence of downward accountability and low levels of local empowerment • Low quality of design/bidding document • Lack of time/capacity to evaluate bids and manage contracts	• Award of contracts is a political action; not a bureaucratic one (selection of unsuitable contractors; covering up fraudulent documentation) • Tight network of actors, leading to collusion between public servants, contractors and consultants • "A token of our appreciation" is a commonly accepted practice • Bribery ('speed money') allows for decreasing transaction costs
Implementation, construction and supervision	• Weak interactions, accountability and information flows between multiple nodes of decision making • Delays (work and payment) • Little attention to supervision • Failure to comply with contracts specification and clauses • Absence of downward accountability and low levels of local empowerment • Low capacity and knowledge of contractors/ consultants/supervisor	• Allow for, and cover up, fraudulent practices as they allow for 'minimal functioning' of projects • Supervising entities rely on contractors to conduct their work (leniency) • Tight network of actors, leading to collusion between public servants, contractors and consultants (leniency, kickbacks, overbilling, etc.) • Project buy-in political support (influence site selection)
Operation, maintenance and management	• Poor maintenance and low performance • Inactive/nonexistent WUAs • Inequitable/non-respect of land and water allocation rules	• Project buy-in political support (influence users selection) • Opportunistic behaviors (WUAs set up to acquire project benefits) • Local practices favoring local elites

Source: This study.

[12] One of our informants working for a technical cooperation agency in Burkina Faso, for example, stated that they chose to invest in small reservoirs as they were "*looking for spending a lot of money fast, (and well), as some climate change money was available […] it would be given to others otherwise*" (author's translation).

[13] The second column of Table 3 echoes the analysis of Morardet et al. (2005), in which a comprehensive list of failures in planning and implementing processes of irrigation projects is presented on the basis of an analysis (desk review and key informant interviews) of 23 irrigation projects funded by multiple donors.

the delivery of projects (see, for instance, Hobbs 2005). Governments, too, tend to favor 'big-bang approaches' where the objective is to build or rehabilitate a large number of dams in a short period of time to secure political support. This often implies that little attention is given to appraisal and feasibility studies with cursory assessments being the basis for significant investments, as also observed in emergency situations that create a sense of urgency (such as in 2009, when following the floods in 2007, the government engaged in a program to rehabilitate more than 50 dams over a period of 4 to 6 months). The low quality of the feasibility studies often offers room for contractors to raise 'variation orders' (i.e., change in the initial design) as unexpected work may be required. In many cases, these may be warranted, but the situation breeds opportunities for collusion between officials and contractors in the field, sometimes leading to excessive cost overruns (sometimes up to 50% of the planned investment; Venot et al. 2011). Perverse incentives (notably the focus on funds disbursement) mean that 'demand-driven' approaches remain a mere rhetoric most of the time. Communities hardly contribute to project identification; though in later stages they often divert and adapt the project's activities to meet their own ends.

- ***Information flow, transparency and accountability are weak*** and characterized by the absence of the local communities and authorities. Responsibilities are shared among multiple agencies, and within a single agency among multiple levels of decision making. Actors have different interpretations of the same situation; this leads to confusion, challenges accountability structures and opens the door to corrupt practices. Complexity of funding flows when there are multiple donors add to this complexity and further challenges accountability (in the case of Zambia, see NCG 2010).
- ***Procurement processes and guidelines for the management of public funds*** generally look good on paper. However, there are many structural impediments to their actual enforcement, such as the low quality of the bidding documents and the lack of time, resources and capacity to evaluate the bids. The major underpinning of current practices remains the fact that award of contracts is largely perceived and accepted as a political action rather than a bureaucratic one. This affects the willingness and feasibility of enforcing rules in a system where most of the actors know and interact with each other in multiple ways. Contracts can easily be awarded to preferred contractors on any number of outwardly justifiable grounds, in exchange for "a token of our appreciation." Often, but not necessarily always, this means that unqualified or unsuitable contractors are selected with negative impacts on the quality of work. Collusion between contractors and public servants who can be hired as independent consultants by the former (so as to increase their chances of winning a contract or to circumvent policies and procedures) is also common. Finally, political patronage, which is part of the social fabric, underpins the selection of sites and beneficiaries as well.
- ***Implementation*** is commonly delayed due to lack of technical know-how of contractors (see, for instance, World Bank and FAO 2007) and/or cumbersome administrative procedures regarding payments. This is a major threat to the cost and sustainability of rehabilitation and construction work, particularly when small contractors are involved and high inflation is the norm. Unrealistic time demands, procedural complexity and lack of transparency are frequent complaints on the part of contractors who feel they have no choice but to offer 'speed money' to facilitate processes. This adds to the transaction costs of contractors, which offers incentives to recoup these costs by further compromising the quality of work.
- ***Monitoring and supervision*** of works does not receive adequate attention. Again, procedures look good on paper, but there

is a widely shared lack of capacity and willingness to enforce regulations among government and donor agencies. A typical set up is to mandate site supervisors in local offices to conduct on-site monitoring and supervision visits. In reality, few of these offices are properly equipped or staffed to carry out their supervisory roles. Supervisors must, as a necessity, rely on contractors to conduct their work. This is an invitation to 'leniency', but is seen as 'reciprocity' rather than a lack of integrity. Conscientious supervisors can easily find themselves being 'transferred' at the behest of well-connected contractors.

Controlling Investment Costs to Improve Performance

The shortcomings described in Table 3 have serious implications for the investment costs and performance levels of small reservoirs, which are two hotly debated concerns. Our analysis relies mostly on data from Ghana (see the section, *Methods: The Need for Interdisciplinarity*, and Venot et al. 2011 for further information on the data used and methodology followed), but conclusions have a wider applicability. The results indicate that investment costs are highly skewed because a significant number of projects experience anomalies during the planning and implementation processes (Figure 2; see the section, *Planning Shortcomings and Corruption: Perverse Incentives and Circumstances*).

Where contracts are terminated and re-awarded (either due to fraudulent practices or low performance on the part of contractors), investment costs may end up being ten times higher than when contracts are handled without major setbacks regardless of the main financer, government, international donor or nongovernmental organization (NGO).[14] This clearly highlights the importance of the planning

FIGURE 2. Cost of investments in small reservoirs in the Upper East region of Ghana.

Source: This study.

Note: GIDA – Ghana Irrigation Development Authority.

[14] An analysis of a subset of 39 dams (for which data on impounded water volume was available) showed that there was no statistically significant difference in terms of the volume of water (hence size of reservoirs) between the group of dams for which contracts were terminated and re-awarded and the other group of dams (whether they were newly built or rehabilitated). In other words, the reservoir's size is NOT correlated to the termination of contract, which shows that flaws in planning and procurement can affect all small reservoirs alike.

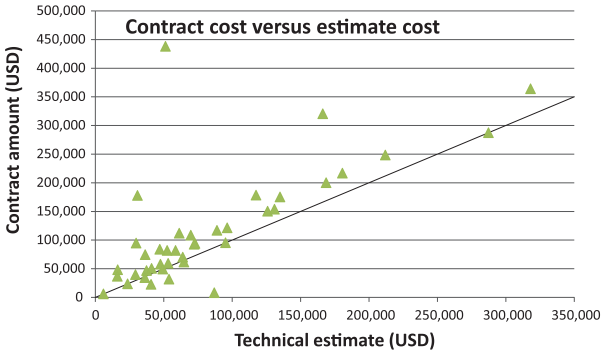
and procurement processes in controlling investment costs. Even when there are no major concerns and contracts hold, lapses in planning cause delays in payment and/or implementation of works and this leads to increased costs, especially in a high-inflation context that is a characteristic of most sub-Saharan economies.

Lack of financial transparency and corrupt behavior also lead to unduly increasing costs. In Ghana, for a sample of 40 recently rehabilitated reservoirs, contract amounts were, on average, 35% higher than technical estimates (Figure 3(a)).[15] This gap is partly due to differences in the rule of thumb adopted regarding contingencies that were fixed at 20% during the feasibility study and increased to 25% in the contract documents. Further changes in design through variation orders (linked to poor-quality feasibility study) may be another reason for such differences. However, this alone falls short of explaining a 35% discrepancy and tends to point towards overvaluation of contracts (see Venot et al. 2011). The case of preliminary payments (i.e., initial payment made to contractors before they start the work) is particularly interesting here. While preliminary payments average 18%, they also vary between 4 and 65% of the total contract amount without any clear pattern or justification (Figure 3(b)). High preliminary payments allegedly conceal various forms of 'kickback'; they also provide a perverse incentive for contractors to do low-quality work, if any (Venot et al. 2011).

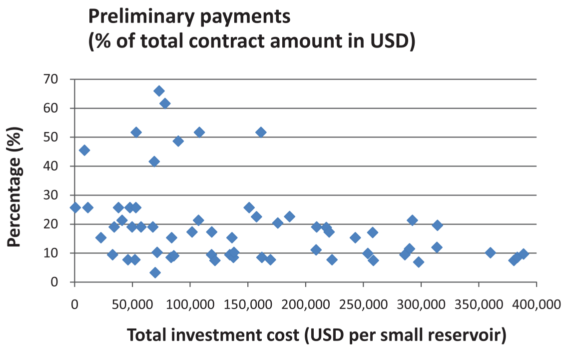
Figure 4(a) highlights that controlling investment costs is not a vain quest. Over the last 10 years, 25% and 12% of the dams that were rehabilitated by the government (under the responsibility of the Ghana Irrigation Development Authority (GIDA)) and development partners (IFAD and NGOs), respectively, cost less than USD 5,000 per irrigated hectare. This proportion increases to 35% and 60% if a USD 10,000/ha threshold is considered. While reducing investment costs is sound in economic terms it seems to also have a beneficial impact in terms of performance. Figure 4(b) shows that the small reservoirs that perform best (according to the views of extension agents)[16] are also those that cost less. This conclusion confirms earlier findings by Inocencio et al. (2007).

FIGURE 3. Misappropriation of funds: (a) technical estimates and contract amounts, and (b) preliminary payments.

(a)



(b)



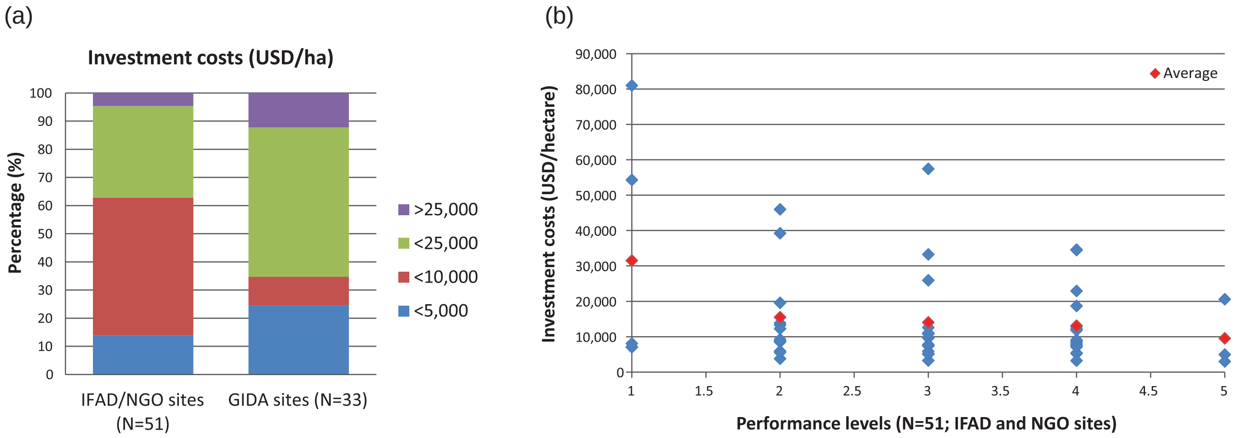
Source: This study.

Note: each dot represents a small reservoir.

[15] Figure 3(a) does not consider 'above outliers' for which contract amounts were 2 to 8 times higher than technical estimates.

[16] Performance of small reservoirs was qualitatively assessed on a scale from 1 (very poor) to 5 (very good) by extension agents of the Ministry of Food and Agriculture, who seemed to especially value the conditions of the infrastructure (damaged or maintained) and the existence and extent of an irrigated area. Though individual extension agents may have considered slightly differing criteria to judge performance, the consistency of the explanations they gave to justify their scoring during our interviews gives us confidence to compare the scores given (see the section, *Looking at Performance From a Multiple Users/Uses Perspective*). We do not present performance assessment levels for the dams rehabilitated by GIDA, as most dams were broken or under rehabilitation at the time of our surveys in 2009 and hence ranked low.

FIGURE 4. (a) Per-unit investment costs (USD/ha), and (b) performance of small dams.



Source: This study.

Note: Figure 4(b): blue dots represents a single small reservoir.

Looking at Performance From a Multiple Users/Uses Perspective

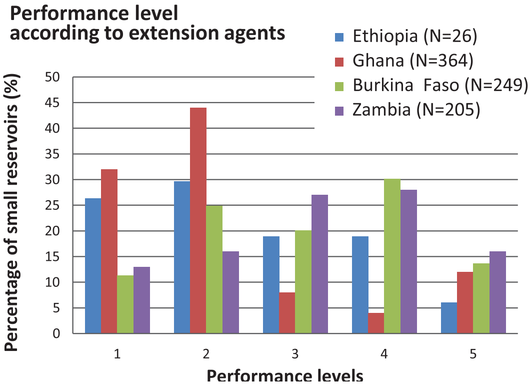
Assessment of irrigation performance is often seen as an important management tool to aid irrigation projects to deliver on their promises (Molden et al. 2007). Performance assessments have long been managerial in nature and limited to hydraulic, agronomic and economic indicators. More recently, they have been broadened to account for multiple uses of water, and environmental and gender dynamics (Bos et al. 2005; Meinzen-Dick and van der Hoek 2001; van Koppen 2002). Institutional economists have also successfully argued for recognizing the institutional dimension of performance, when identifying 'guiding principles' for robust and enduring institutions for common property resource management (Ostrom 1990). This quick review shows that irrigation performance assumes multiple meanings for different people and purposes (Molden et al. 2007; Venot and Cecchi 2011).

In this section, we engage with the meaning and assessment of the performance of small reservoirs for two types of actors – the extension agents of the Ministry/Bureau of Agriculture and the local users. The former act as brokers between policy-making/planning and project implementation: their interpretation of events is passed on to higher levels of decision making through the state apparatus; they are effectively the 'foot soldiers' of national governments that seek rapid irrigation development. Local users, on the other hand, are the final stewards of small reservoirs and projects are implemented in their name. Results of regional appraisals show that agricultural extension agents who were asked to assess the performance of small reservoirs on a scale from 1 (very poor) to 5 (very good), considered that between one-third and two-thirds of the reservoirs performed very poorly (score = 1) or poorly (score = 2; Figure 5). The situation was deemed particularly critical in Ethiopia while Zambia and Burkina Faso have the highest proportion of reservoirs with average and high performance (Figure 5).

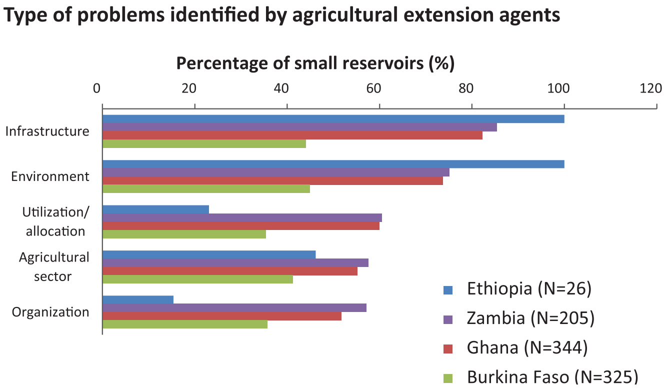
In all the countries, design and infrastructure problems were identified as the main causes for poor performance (in addition to siltation in the case of Ethiopia). Lack of proper planning and design and limited technical knowledge of contractors has not only rendered some

FIGURE 5. Performance of small reservoirs: the point of view of extension agents.

(a)



(b)



Source: This study.

reservoirs unusable but has also proven to be costly. Within a time span of 10 years, some small reservoirs have been rehabilitated twice or thrice due to the poorly executed projects. A support mission by the Food and Agriculture Organization of the United Nations (FAO) on small reservoirs in northern Ghana, confirms the assertion of faulty design and poor quality of work due to lack of technical know-how and inadequate supervision (World Bank and FAO 2007). Finally, the lack of community management in the form of a WUA was identified in all countries as another major cause for the low performance of small reservoirs.

Extension agents assess the performance of small reservoirs through an engineering lens and in line with the objective of irrigation development. By voicing a concern over poor performance while reiterating the potential for irrigation benefits, extension agents provide a rationale for national governments to call upon external donors or their own governmental agency to fund rehabilitation or construction of small reservoirs. It also reinforces a 'build-neglect-rebuild' cycle that characterizes the public irrigation sector of sub-Saharan Africa. The relatively satisfactory assessment of the performance of small reservoirs by extension agents in Burkina Faso and Zambia is due to their explicit acknowledgement of watering livestock as being one of the main objectives and purposes of small reservoirs.[17]

Another level of complexity emerges from investigating the perceptions of local users. In most of the 37 communities studied in northern Ghana and southern Burkina Faso, the local population expressed a level of satisfaction similar or higher than the extension agents (see Table 4).

TABLE 4. Perceptions of local users and extension agents on the performance of small reservoirs (N=37).

	Extension agents	Local users
Average performance	3.1	4.1
Standard deviation	1.1460	0.6117
Variance	1.3570	0.3863
P-value		0.02476

Source: This study.

We then explored the satisfaction of users according to four main aspects: the physical infrastructure, the modes of management, the benefits derived and the equity aspects of small reservoirs. Similarly to the assessment carried out with extension agents, local users also pointed to

[17] Somehow, contradictorily, extension agents in Burkina Faso give a lower-than-average score to reservoirs that do not command downstream irrigated areas; this clearly illustrate their 'irrigation-bias' towards performance.

poor technical and managerial performance. They, however, showed a higher level of satisfaction regarding the benefits they derived and the equity aspects of small reservoirs, showing that the latter are invested with social meaning (for a similar argument on natural resources, see Cleaver 2000).

Populations value small reservoirs for multiple reasons. Table 5 presents the results of a free-listing exercise, during which local users were asked to identify the three main benefits they derived from small reservoirs. Benefits have been categorized into four main groups: basic, social, economic and environmental based on the answers given.

other activities. Limiting floods during the rainy season, improved greenness and biodiversity, and sustaining alternative economic activities (fisheries, brick-making, local breweries and paid agricultural labor) are also perceived as major benefits of small reservoirs. However, rural communities are not homogenous. The surveys revealed that small-scale water users (e.g., the poor, youth, women and fishermen) tend to give higher satisfaction scores when irrigation activities are little developed. Conversely, they face difficulties to reap direct benefits when intensive cultivation becomes the main goal or is the main activity. Performance ratings and satisfaction levels depend on the vantage point of the actor considered and are a reminder of the need (and difficulties) to coordinate and integrate multiple users and social groups around a common resource such as a small reservoir. Recognizing multiple modes of access to, and uses of, small reservoirs calls for reviewing our understanding of their economic performance and modes of governance (Box 2; see the section, *Local Arrangements for Management: Questioning the WUA Model*).

TABLE 5. Multiple benefits of small reservoirs in northern Ghana (N=16 small reservoirs).

Three highest ranked 'benefits' per category	Frequency (%)
Basic benefits	
Improved food security	58
Bathing	58
Improved access to domestic water (drinking/cooking)	55
Social benefits	
Enhance women's position within the household	45
Recreation	41
Reduced migration (for domestic/livestock watering)	40
Economic benefits	
Improved water availability for livestock	70
Enhanced productive activities (fisheries, brick-making, irrigation)	58
Improved income from productive activities	49
Environmental benefits	
Limiting floods	38
Improved greenness and increased biodiversity	38
Improved weather conditions (freshness)	29

Source: This study.

Some benefits are clearly linked to irrigation development (e.g., improved food security; enhanced productive activities; improved income), but the local population also value small reservoirs for other reasons. For instance, small reservoirs are said to (a) improve water availability for livestock and domestic uses, thus limiting migration; and (b) play a positive role on women's position within their household, notably because they can spend less time fetching water and divert that time towards

Box 2. A cursory look at the economic performance and unplanned development of small reservoirs.

The economic benefits of irrigation have been widely documented (see, for instance, Hussain and Hanjra 2004; Hanjra et al. 2009). Small reservoir-based irrigation makes no exception. On average, a small reservoir serves about **2,500 people** (e.g., about 400 households) and, among them, **50 to 100 households** may take up irrigation activities in the downstream irrigated area. A survey of 16 small reservoir sites in Ghana indicate that irrigators can derive, on average, **USD 350/household/year** (with significant differences between households and small reservoir sites); this is equivalent to 5 months of work of a single individual if the minimum daily wage set up by the Ministry of Finance and Economic Planning of Ghana is considered. Small plot size (0.1 to 0.5 ha, depending on the allocation rules set by the implementer) does not allow for significant surplus production and makes irrigation only marginally profitable when compared to other economic opportunities that are generally sought for in nearby or distant urban centers. However, small plots can allow for enhanced equity (with more beneficiaries) and have beneficial impacts on nutrition. Positive impacts of small reservoirs on the revenue of farmers have also been documented in Zambia. NCG (2010) showed that access to small reservoirs induced a significant change in cropping patterns (from staple to vegetable crops) leading to a 70% increase in farmers' income. Similar observations have been found in Ethiopia, where access to small reservoirs is said to induce an increase in income of 12 to 66% (AFD and REST 2003). The trend towards spontaneous development of a private pump-based, small-scale irrigation upstream of reservoirs, as observed in northern Ghana and Burkina Faso (and to a lesser extent, in Zambia), brings about significant benefits as well. It is not uncommon that the 'unofficial' irrigated area around the reservoir is much larger than the official command area downstream. For example, the Korsimoro Reservoir in Burkina Faso officially irrigates a command area of 35 hectares of rice downstream of the dam while more than 1,000 farmers pump water directly from the reservoir to irrigate 250 ha of vegetables upstream during the dry season. Such a practice is highly profitable (up to ten times the profitability of downstream irrigation; Ndanga Kouali 2011) but raises environmental (over-abstraction, resource degradation and pollution from agrochemicals) and governance issues. Economics of other small-reservoir based productive activities (livestock herding, fisheries, brewery, etc.) remain mostly unknown, but are likely to be significant. Katrien Descheemaeker (Assistant Professor, Wageningen University, pers. comm.) identified that small reservoirs can have a significant impact on livestock productivity and health, by limiting the movement of herds and contributing to fodder production.

Local Arrangements for Management: Questioning the WUA Model[18]

To counter problems associated with alleged poor performance, the current blueprint for small-scale irrigation development is one of participatory community-led projects. However, as what can be described as a discursive shift, project implementers have asserted the primacy of WUAs as being the rightful entities for maintaining, managing and enhancing the performance of small reservoirs (see, for instance, IFAD 2009). In most cases, however, these WUAs remain promoted by outsiders rather than being the expression of a collective decision-making process emerging from the community.

[18] This section builds on Venot (2011).

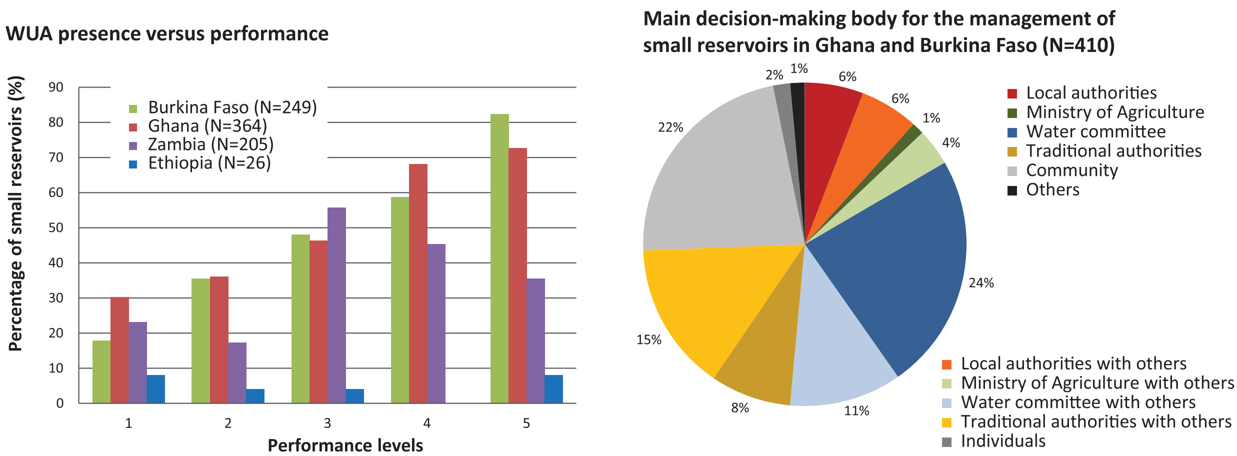
The performance and success of small reservoir projects is now partly determined by the number of WUAs that are set up alongside construction/rehabilitation work. Extension agents articulate this view; they express that the presence of WUAs is positively correlated to good performance (the proportion of WUAs among reservoirs that are performing well is higher than among reservoirs that are performing poorly: Figure 6(a)).[19] Encouraging at first, this assessment and the conclusions that are generally inferred are, in fact, questionable. First, in absolute terms and among the reservoirs that are performing well (a score equal to or greater than 3), there are as many reservoirs with than without WUAs (*not shown in Figure 6*). This entails that the presence of a WUA is neither a prerequisite nor a guarantee for the good performance of small reservoirs. Second, among the 37 detailed case studies carried out, there was no clear correlation between the level of satisfaction of local users and the presence or absence of a WUA. Rather than creating the conditions for collective action and sustainable management, the WUA has become an 'institutional fix', which, by its very presence, is a pledge of the performance of small reservoirs. This 'institutional fix' is drawn from new institutional economics (Ostrom 1990), which highlights the importance of clearly defined user groups, structures of authority, rigorous application of graduated sanctions and transparent decision-making that is codified in written records (Cleaver 2000).

The presence of clear structures of authorities (such as WUAs) is, for example, often considered as a prerequisite to any interventions (see among others, IFAD 2009), which is something local communities are fully aware of. The *raison d'être* of many village organizations in West Africa is indeed, "to wait for an external partner willing to work in the village" (Bernard et al. 2008: 2198); their underperformance then being generally attributed to sociopolitical externalities such as the refusal of elites to relinquish powers, their tendency to corner benefits, and the lack of financial resources and professionalism. However, this framing overlooks the complexity and historicity of institutional formation.

While looking for the 'right institution', development actors have adopted an over-formalized approach to institutional formation (for

FIGURE 6. Performance, WUAs and the main decision makers as perceived by extension agents.

(a) (b)



Source: This study.

[19] Ethiopia stands alone with less than 10% of the small reservoirs having a WUA, irrespective of their performance level. This is linked to a more centralized system giving the primacy to the Bureau of Agriculture and farmer cooperatives over WUAs. In Zambia, the declining proportion of small reservoirs with a WUA (performance level of 3 and more) is not significant; it also shows that the existence of a WUA is neither a prerequisite nor a guarantee for the performance of small reservoirs.

a critique, see Cleaver and Franks 2005). They engaged in, and sustained, a true search for panacea, which has been repeatedly critiqued (see, for instance, Ostrom et al. 2007) notably on the ground that it does not account for the polycentric nature of governance and decision making over natural resources (see, for instance, McGinnis 1999). We suggest here that in their insistence to establish "one-mode-fits-all" (the WUA), small reservoir projects embody narrow visions of the commons and participation. By asserting the primacy of WUAs as the rightful entities for maintaining and managing small reservoirs, projects undermine existing collective action institutions; institutions that may actually contribute to the good governance of small reservoirs.

This is not to say that WUAs do not have a role to play, but that major shortcomings (both procedural and structural) still remain for them to be able to fully contribute to the sustainable governance of small reservoirs. For instance, development partners still consider local actors as being recipients or 'beneficiaries' playing a given role in an overall 'concept' (GTZ 2003) rather than being participants with an agency in a community-led project. When stating that "*the failure to complete the appraisal target [was] partly due to the time wasted 'sensitizing' the communities*" (IFAD 2009: 291), project workers and designers show the little value they give to interacting with communities and considering their priorities over the need to achieve targets that assume what "is good for the communities".

Structurally, WUAs appear to convey the experiences, perceptions and priorities of some segments of the population only. Indeed, 85% of the existing WUAs were centered on irrigators and less than half accounted for other small-scale water users, though the latter appear to derive less benefit when irrigation takes place.[20] Further, only 30 to 50% of the WUA (depending on the country) counted women as members, and rarely were they holding an executive position. Finally, WUAs do not account for the de facto institutional bricolage (Cleaver 2000) and the multiple collective action institutions that contribute to the governance of small reservoirs (Figure 6(b)).[21] These actors assume different and complementary roles along the project cycle (see Figure 6; Table 6). Water committees (e.g., WUAs) were identified as being the main decision-making body on small reservoirs in only about one quarter of the cases, and their main tasks were considered as minor maintenance and daily management (Table 6). Line ministries and government agencies are rarely identified as being the main decision makers, but their role in procurement and construction processes and in supporting farmers (extension, marketing) is seen as crucial (Table 6). Finally, traditional authorities are seen as the most important decision makers regarding the uses and management of reservoirs in about 25% of the cases. They are crucial in settling disputes, resolving conflicts, maintaining social cohesion (when ad-hoc resolution mechanisms have not yielded any results), and overseeing land allocation and redistribution (Table 6). On the one hand, traditional authorities can lend their authority to the members and actions of the WUAs (Table 6). On the other hand, there is evidence that traditional authorities can simply corner responsibilities and associated benefits. Finally, many decisions are reached through consensus building at the community level (extension agents considered the community to be the main decision maker in

[20] For instance, spontaneous irrigators (called 'pirates' in Francophone West Africa) are rarely members, nor do they feel accountable to the WUA (if it exists); typically, they do not contribute to the decision-making process on water allocation, to maintenance activities or meetings, and do not pay water fees.

[21] For the sake of clarity, we only present data for Burkina Faso and Ghana. Analysis for Zambia yielded similar results. In Ethiopia, where little data were collected, results tend to indicate the existence of multiple decision makers, with the Bureau of Agriculture and farmer cooperatives playing the most significant role.

TABLE 6. Repartition of responsibilities in the management of small reservoirs.

	Line ministries	Donors	Contractors	Local government	Traditional authorities	User committees/WUA	Community	Farmers	Others
Construction	**39%**	5%	**30%**	6%	3%	2%	4%	2%	3%
Major maintenance	**41%**	13%	6%	18%	2%	8%	4%	3%	3%
Minor maintenance	4%	0%	0%	5%	4%	**34%**	**46%**	6%	3%
Setting of management rules	4%	0%	0%	4%	23%	**40%**	23%	6%	2%
Implementing, monitoring rules	5%	0%	0%	4%	12%	**47%**	24%	6%	4%
Relation with other actors	14%	1%	0%	10%	11%	**39%**	19%	3%	5%
Conflict resolution	6%	0%	0%	9%	**60%**	22%	13%	1%	2%
Environmental protection	9%	0%	0%	4%	9%	**33%**	**34%**	10%	3%
Extension role	**69%**	2%	0%	2%	2%	5%	2%	0%	6%
Agricultural practices and marketing	12%	0%	0%	1%	4%	12%	13%	**49%**	6%

Source: This study.

Note: † Extension agents sometimes identified several actors as having some sort of responsibility for a specific task, thus the sum of percentages exceeds 1 for any specific task. Data was collected for 197, 205 and 321 small reservoirs in Burkina Faso, Zambia and Ghana, respectively; we do not present data for Ethiopia, where only 26 sites were surveyed.

22% of the cases) without a specific organization being singled out. This is especially true in Zambia where most daily management tasks (maintenance, oversight of water delivery) were seen as being the responsibilities of the 'community' as a whole rather than those of a management committee.

We do not suggest that attempts at institutional building are doomed to failure. Rather, we fully share the views of Cleaver and Franks (2005) who, diagnosing that institutions partly elude design, argue that attempts at institutional intervention should be based on a much better understanding of social relationships, existing processes of decision-making and resource allocation. Small reservoir projects prove indeed to be the object of "*competing forms of institutionalization: one backed by projects, the State and its bureaucracy, encoded in official language and often exercised with the propos of modern statehood; the other the institutionalization of informal practices more or less grounded in ideas and values embedded in institutions seen as distinct from colonial and post-colonial state. The competition often unfolds as one form of practice undercuts the other and offers ways of circumventing and replacing the other*" as highlighted by Benjaminsen and Lund (2002: 2) in the case of land and water rights. The issue is to understand these overlapping dynamics that define a true, but de facto, polycentric governance regime (McGinnis 1999) rather than assuming that an imposed and ostensibly apolitical organization can convey local dynamics and priorities. In the context of sub-Saharan Africa, understanding the institutional relationships that govern small reservoirs, and the way they link to broader political trends such as decentralization and IWRM policies, becomes crucial (Box 3).

Box 3. Structuring space: The importance of small reservoirs in IWRM policy in Burkina Faso

The case of Burkina Faso clearly illustrates that small reservoirs are more than irrigation infrastructure; they are sociopolitical constructs and can act as conduits for policy moves. Small reservoirs have long been seen as key elements of an active irrigation development policy (MAHRH 2006). At the same time, the country has been engaged in the framing and implementation of an IWRM policy since the late 1990s. Central to this policy framework is the establishment of water management entities on the basis of hydrological boundaries, notably the *Agence de Bassin* (five basin agencies have been set up in the country) and the *Comité Local de l'Eau* (CLE) (local water committee) at the local level (the CLE are meant to oversee watersheds of 2,000 to 5,000 square kilometers (km^2)). To date, about 30 CLE have been set up (Petit and Baron 2009; Sally et al. 2011). Initially envisaged as consultation platforms that would bring together multiple water stakeholders to drive water management at the watershed level, most CLEs were actually set up to oversee the management of a specific small reservoir, thus acting as a dam or water user committee (Sally et al. 2011). This shows the 'reworking' that global policy models, such as IWRM, go through to meet local (in this instance, national) priorities and concerns (ensuring productive and sustainable small reservoir-based irrigation), and also the role that small reservoirs can assume as vehicles of policy choices (far beyond irrigation activities).

Conclusion

Donors and national governments have long invested in small, communally managed reservoirs in rural sub-Saharan Africa. Investments have mimicked broad changes in rural development thinking, and were grounded in a dual rationale of providing water for drought relief and developing irrigation activities. Over the past decade, there has been a renewed interest in small reservoirs due to concerns over climate change and the related uncertainty of water supplies to people, crops and livestock. In regions where other sources of water (groundwater, perennial rivers) are not easily accessible, small reservoirs play a crucial role in providing water and supporting multiple livelihood strategies such as livestock rearing, small business water use, handicraft activities and, increasingly, small-scale irrigation. Though most small reservoirs were not constructed and are not being used for agricultural purposes per se, the development and academic discussions around further investments have progressively shifted towards irrigation. Because of this emphasis towards productive uses, a different set of issues has emerged.

Donors and governments started questioning the high investment costs and disappointing performance of small reservoirs. Further concerns are raised over the ability of communities to properly operate, manage and maintain their water infrastructure (i.e., the dam, reservoir, canals and other irrigation infrastructure). A common response to such problems has been to call for 'more' user participation; such calls have led to the creation, and sometimes training, of WUAs that have been heralded as the rightful entities for managing and maintaining small reservoirs at the local level.

Based on extensive fieldwork in Burkina Faso, Ethiopia, Ghana and Zambia, this research study critically assessed the claims of high costs, underperformance and usefulness of WUAs. First, the claim of underperformance is not shared universally among those involved in small reservoirs. Various groups rate performance differently, using different criteria. Government officials and extension agents of line ministries, for example, point to limited irrigated area, low yield and damaged infrastructure; they rate the performance of small reservoirs much lower than local users, who put a high value to multiple uses and equity aspects. Second, the report concludes that high construction costs are not inherent to the small reservoir 'technology' and hence not inevitable. The main cause of high investment costs appears to be poor planning and implementation practices, often underpinned by corrupt behavior. This research study reinforces earlier studies (Inocencio et al. 2007) which highlighted that badly planned and 'underperforming' irrigation projects are, generally, an order of magnitude more costly than well-planned projects. Poor planning and implementation is also a cause for low-quality construction; hence making it difficult for communities to properly operate and maintain infrastructure later on. Small reservoir projects have been 'locked-in' a similar 'build-neglect-rebuild' cycle, as explained by Shah (2009) for the public irrigation sector in South Asia. The most common answer to these challenges to date, forming WUAs, may not be the most appropriate response to the alleged lack of the ability and willingness of communities to manage and maintain water infrastructure. In practice, an institutional bricolage of formal and informal arrangements underpins various aspects of the management of small reservoirs. For example, traditional authorities (such as village chiefs and land priests) often play a crucial role in conflict management while government officials play a key role in construction, procurement and agricultural extension. Imposing a new structure as the only legitimate decision-making body may be counterproductive, particularly because one type of user (irrigators) tends to be overrepresented in WUAs. Further, in all countries, the governance of small reservoirs needs to be thought within broader policy trends such as IWRM and decentralization.

This report calls for a fresh look at issues pertaining to small reservoirs. Performance needs to be assessed from different vantage points that consider multiple uses, outcomes and perceptions. Irrigation is only one of many uses of these infrastructures; not necessarily the one that dominates or is most sought after by the population. WUAs are not the only legitimate decision-making bodies for the management of small reservoirs. Before introducing newly formed water committees, small reservoir projects would do better to explore how they could build on existing institutional arrangements. There is room to improve planning and implementation processes to achieve positive outcomes. This is, maybe, the main lesson of this study. Greater transparency and more open discussions about malpractices would be a good starting point. This is not an easy task because many actors along the planning and implementation chain are involved in an intricate web of small lapses of integrity and oversight. However, stakes are high: lowering investment costs, improving construction quality and ultimately enhancing the multiple benefits of small reservoirs for villagers in water-scarce rural areas of sub-Saharan Africa.

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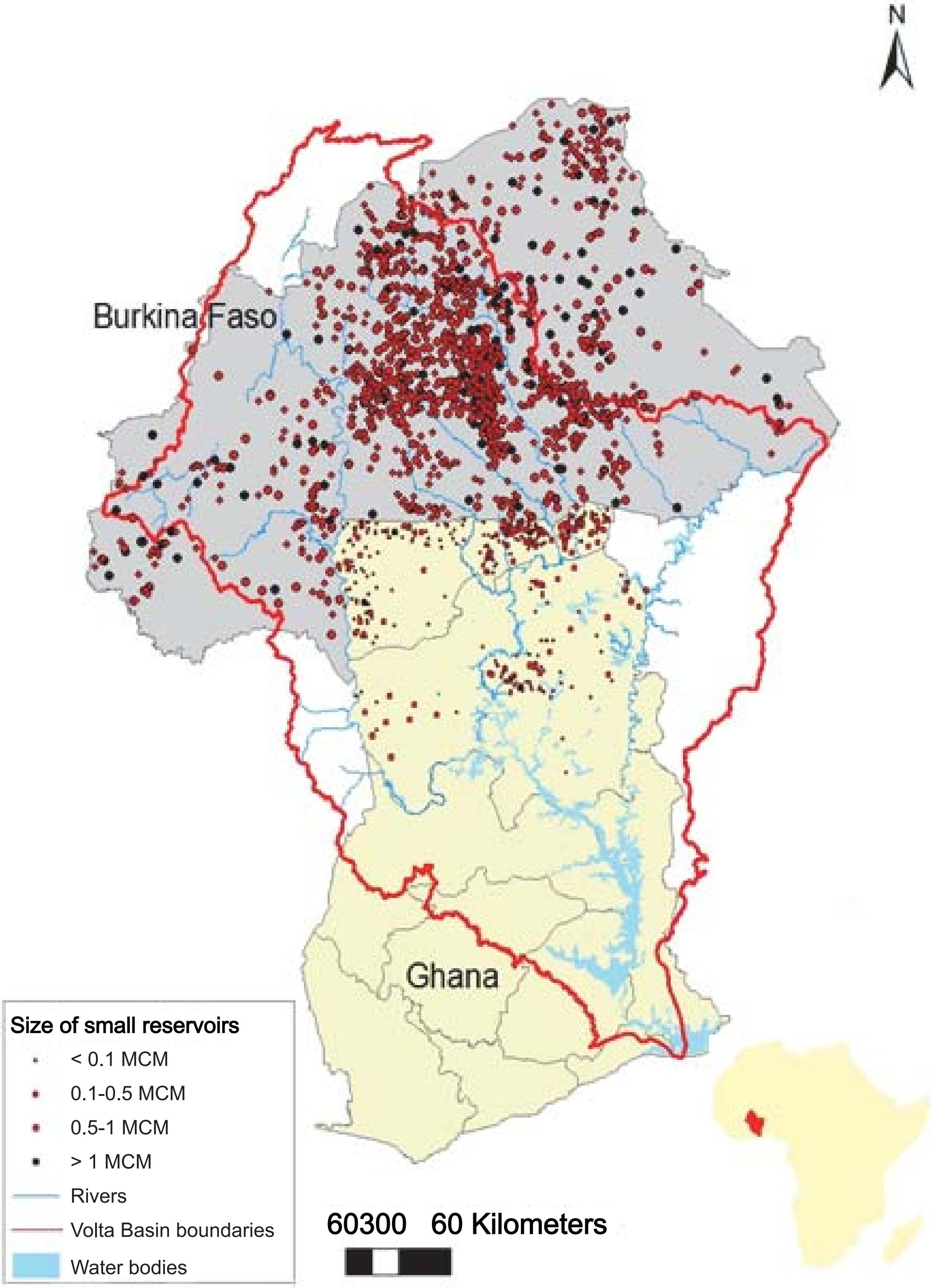
Appendix 1. Country Maps: Locating Small Reservoirs.

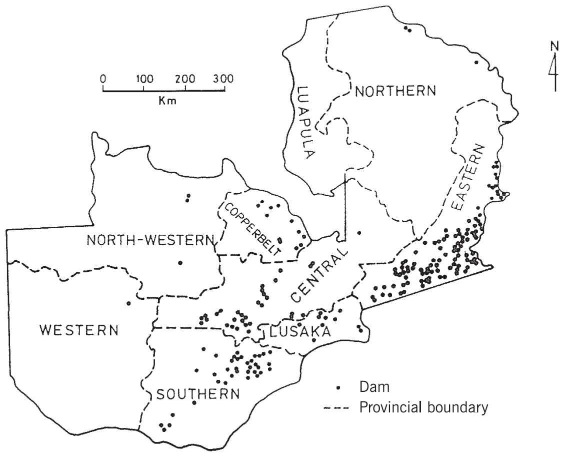
Small reservoirs in Ghana and Burkina Faso



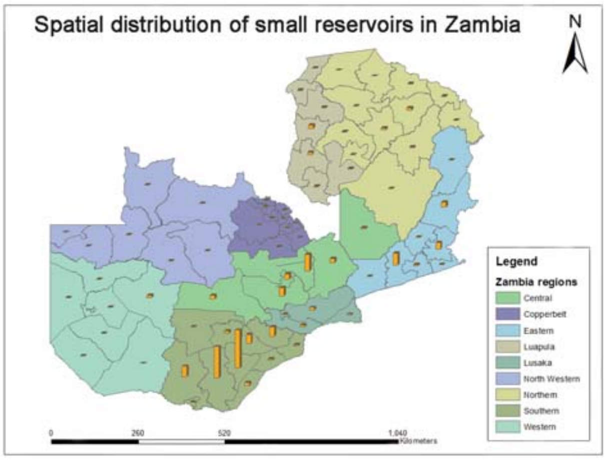
Source: This study; based on data from the Direction Générale des Ressources en Eau (DGRE) for Burkina Faso, and Forkuor (2005) for Ghana.

Small reservoirs in Zambia

(a)

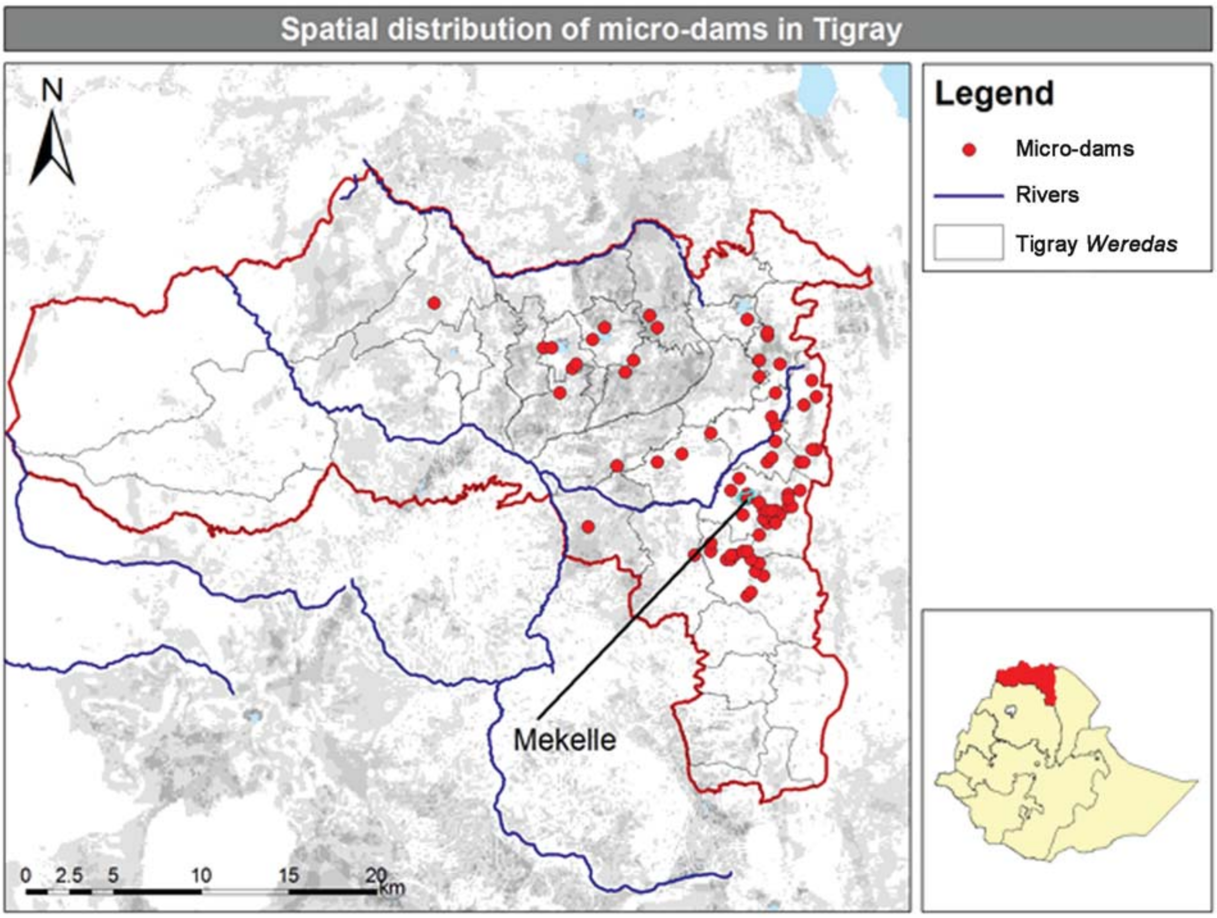


(b)



Source: (a) Sichingabula 1997, and (b) this study.

Small reservoirs in Tigray, northern Ethiopia



Source: This study; based on data from the Bureau of Agriculture, Tigray, Ethiopia.

Appendix 2. Small Reservoirs in Selected Countries.

Country	Number (source)	Country	Number (source)
Sub-Saharan Africa		*Middle East and North Africa*	
Burkina Faso (as per 2003)	> 1,700 (Andreini et al. 2009)	Algeria (in the 2000s)	> 1,000 (Morsli et al. 2007)
Ethiopia (Northeast) (as per 2005)	> 110	Morocco (as per 1997)	> 120 (Laamrani et al. 2006)
Ghana (as per 2009)	> 1,000	Tunisia (in the 2000s)	> 610 (Boufaroua et al. 2003)
Ivory Coast (as per 1996)	> 600 (Cecchi 2007)	Syria (as per 2005)	> 50 (Albergel et al. 2007)
Mali (as per 2008)	~ 800 (FAO 2008b)	*Rest of the world*	
Mauritania (in the 2000s)	~ 350	Brazil (Nordeste) (as per the 1990s)	> 70,000 (Molle and Cadier 1992)
Mozambique (in the 2000s)	> 600 (World Bank 2008)	India (as per the 2000s)	> 208,000 (Palanisami 2008)
Niger (as per 2008)	~ 100 (FAO 2008a)	Mexico (as per the 1990s)	~ 12,000 (Sugunan 1997)
Uganda (as per 1997)	> 425 (Bashar et al. 2003)	Thailand (as per the 2000s)	~ several thousands (Sanguan 2000)
Zambia (as per 2010)	2,000-3,000 (NCG 2010)	Sri Lanka (as per the 1990s)	> 15,000 (Sakthivadivel et al. 1997)
Zimbabwe (as per 1997)	~ 10,000 (Sugunan 1997)		

Source: AgWater Solutions Project (2011) unless otherwise indicated; in the context of definitional challenges, estimates are based on locally (i.e., country or region) relevant criteria.

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