Corruption risks, management practices and performance in Water Service Delivery in Kenya and Ghana

Thesis

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Contents

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To Toni, Ella and Neva

1. Introduction

Low access to Water Service Delivery (WSD) is a common characteristic of urban areas in Sub-Saharan countries. Wutich (2007) describes how low efficiency and access in WSD determine social vulnerability: the poor who are 'disconnected' from water networks depend on informal water providers (such as water vendors, tankers, etc.). Such informal water providers are usually not regulated and charge above public utility rates for water (Cavill and Sohail, 2007).

One of the main challenges jeopardizing access to water for large segments of the population in Sub-Saharan countries is corruption (TI, 2008; Trop and Stålgren, 2005). The rent-seeking theory (Repetto, 1986) acknowledges a relation between performance and corruption where the implementation of performance-oriented reforms in the water supply sector, such as regulation, private sector participation or new forms of public management, would reduce corruption, increasing the efficiency of WSD. However, in spite of the major reforms underway in developing countries to increase the performance of urban WSD, high levels of inequity and inefficiency persist, affecting urban areas populated by marginalized and poor residents, and questioning the rent-seeking theory. Furthermore, the relation between low quality of services provided by water utilities, and corrupt practices seems to be affected by mismanagement of water utilities as it appears that poor management may justify new investments whilst at the same time maintaining an influential 'hydrocratic elite' in the sphere of water control (Mollinga, 2008).

The present research aims to understand how the relationship between management and corruption affects the performance of WSD, where performance involves not only efficiency but also access to the service. The research arises from a societal concern shared by scholars and development organizations in the water sector: what can be done about performance, corruption and mismanagement in WSD, specifically in the urban areas of Sub-Saharan Africa? The author expects that the results of the research in these two countries will provide more general insights in the understanding of the management-corruption-performance relation and how the approach can be used elsewhere.

To understand the complexity of the management-corruption-performance relationship, the research uses a combined methodological approach of case studies with the development of a deterministic Agent-Based Model (ABM) build up on the empirical findings of the case studies. The case studies were carried out in Kenya and Ghana by Transparency International (TI) within the project 'Transparency and Integrity in Service Delivery in Sub-Saharan Africa (TISDA)'[1]. These two countries exemplify very well a situation plagued with corruption problems, mismanagement and low performance in terms of efficiency and access to water supply. What makes the case studies carried out in Kenya and Ghana interesting is that each country represents a different water governance model from an institutional and organizational point of view, the governance models being the result of the implementation of water sector reforms aiming to improve WSD performance. Case studies were Old Town (Mombasa), Migosi (Kissumu) and Kangemi (Nairobi) in Kenya, while Nima and Madina (Accra) were the case studies in Ghana.

The thesis is organized as follows. The second chapter of the thesis gives the research outline including the main and sub-research questions. Therefore it revisits the understanding of corruption in the water sector and its causes, as well as the failure of the water sector reform to address the issue and the possible corruption-management links. Chapters 3, 4, 5 and 6 present four research articles which address the sub-research questions and the main research question. The third chapter deals with the performance of WSD in the case study areas. Chapter Four looks at the integrity of WSD in policy and regulation, provision and consumption and points out corruption risks. The fifth chapter identifies management practices in relation to the previously mentioned corruption risks. Finally, Chapter Six consists of two research articles; the first paper develops the ABM that attempts to reproduce the situation in the case studies, simulating management practices, corruption risks and performance in WSD, and the second paper complements the first research article by explaining how the model was developed. The thesis closes with the conclusions.

[1] The author was Senior Project Coordinator of the TISDA project conducting the field research together with the TI Kenya and GII research teams.

2. Research outline

This chapter gives an overview of the research organized according to the Situation, Problem, Question and Response (SPQR) method (Barker and Manji, 2000). The SPQR method is used to write short summaries such as research proposals. However, the reason why this method was chosen is because it provides a logical structure for developing the main elements of this research. The research outline addresses the SPQR elements as follows:

- What is the Situation in which my research is set?

  The understanding of corruption in the water sector as a socioeconomic and cultural phenomenon is complex.
- What is the Problem I want to address?

  Rent-seeking theory fails to explain the permanent patterns of low WSD and their relationship to corruption in WSD in Kenya and Ghana. Corruption may be influenced by management practices but the relationship is unknown.
- What is my Question concerning this problem?

  How does the relation between corruption risks and management practices explain low performance of WSD in Kenya and Ghana?
- What is my Response to that question?

  Based on the findings of the case studies, to build an ABM that provides an explanation regarding the relation between corruption risks, management practices and performance of WSD in Kenya and Ghana.

The next sub-sections develop the research outline. The first sub-section presents an overview on corruption according to its different causes. This is followed by the development of the rent-seeking theory that is central for this research. The literature acknowledges there is an inverse relationship between corruption and low performance of WSD. However, theory has failed to explain this relationship because of the permanent patterns of low performance and corruption. Besides, it seems that management plays an important role in the relation between corruption and

performance. The third sub-section develops the main research and sub-research questions. The final sub-section explains how the main research question is answered through the development of an ABM.

2.1 The Situation: understanding corruption in the water sector

Corruption is defined in different ways. Kaufmann (2005, p. 3) defines corruption as the '*abuse of public office for private gain'*. The UNDP (2004, p. 2) makes reference to the private sector in its definition, '*the misuse of public power, office or authority for private benefit – through bribery, extortion, influence peddling, nepotism, fraud, speed money or embezzlement. Although corruption is often considered a sin of government and public servants, it also prevails in the private sector'*.

Brown et al. (2004) stress that corruption is not purely a public sector issue but rather that most corruption occurs at the interface between the public and private spheres. Similarly, Rose-Ackerman (1997) in *The Political Economy of Corruption* points out that corruption occurs at the interface of public and private sectors. Plummer and Cross (2007) proposes a corruption framework structured around *interactions* placing the public or entrusted official at the core of the interaction framework and notes that the public officer or agency interacts with three types of actors: other public actors and agencies; private actors and companies; and consumers, civil society, and their representative organizations. Butterworth (2009) locates corruption in the interactions between public officials and public actors, public and private sphere and public and consumers/citizens. In these interfaces, it is possible to distinguish two main forms of interaction between the actors: *collusive* corruption, where both the bribe-taker and the bribe-giver gain from the exchange and the 'price' is paid by a third party, or *extortive* corruption where the bribe-taker is being exploited by the bribe-giver. In this research the adopted definition of corruption is *'the abuse of entrusted power for private gain'* (TI, 2009, p. 14).

The water supply sector is prone to corrupt practices because it involves different actors with a complex network of relationships. These relationships include many transactions in water supply service development (water allocation, licencing, financing, construction etc.) and provision (selection of provider, management, tariff setting, metering etc.). Thus, multiple opportunities for corruption exist ranging from taking a part of 'project funding' to circumventing rules and regulations in service delivery (speed-up money, misreading meters, illegal connections, including assignment of service management contracts, corporate governance issues…) (Davis, 2004). Bellaubi and Visscher (2010) enumerate four main reasons for social actors in the water sector to engage in corruption:

- For economic benefit: the bribe is greater than the potential cost of breaking the rule and risk of being caught;
- Because it is systemic in the organization to, for example, pay for a job or to use a company asset for personal means;
- Because of nepotism and/or patronage, doing a favour for a relative or friend based upon relationship;
- As a response to unequal resource distribution in which the availability of goods and services are out of balance with needs.

In order to position the research, this sub-section revisits corruption in the water sector according to different scholars following the rationale of Bellaubi and Visscher (2010) on why social actors get involved in corruption in the water sector (Table 2.1).

Table 2.1 Causes of corruption in different areas of the water sector according to different authors.

Wade (1982)	***Repetto (1986)***	***Theesfeld (2001)***	***Rinaudo (2002)***	***Davis (2004)***	***Huppert (2005)***	***Domanski (2007)***
Irrigation	*Irrigation*	*Irrigation*	*Irrigation*	*Water supply*	*Irrigation*	*Water supply*
Organized corruption	Budget maximization	Ineffective institutional and political settings	Uncertainty in water supply	Service provision approach	Incomplete contract	Dysfunction in modes of organization

Corruption as systemic phenomena

In his study on canal irrigation in south India, Wade (1982) points out how corruption can be part of a larger system governed by well-established rules. According to the author, one of the main reasons for illicit payments in irrigation water systems lies outside the irrigation sector and is related to political campaigning. In this way, the linkage between top-level and bottom-level corruption and between administrative and political corruption constituting a larger system of corruption is made obvious. His work also constitutes an interesting case in tracking funds derived from corruption activities thus further illustrating the systemic character of corruption.

Also Domanski (2007) presents corruption as systemic phenomena. In this case, the author explains corruption as the dysfunctions between modes of organization when not aligned with regulation, resulting in poor performance of the utilities. Nevertheless, this assumption reduces the concept of corruption to that of regularization between public and private sectors.

Corruption as a response to unequal distribution of resources

In his work on corruption in the public canal irrigation system in Pakistan, Rinaudo (2002) states: '*corruption arises from a context of scarcity of the resource, which is priced below its marginal value and shared out between users through an administrative quota system*[2]*. The under-pricing of water generates a demand for this resource that exceeds the available quantity in the system, thus creating economic incentives for the farmers to resort to illegal means for obtaining more water than their official quota based on the equity principle*' (Rinaudo, 2002, p. 407).

Repetto (1986) reinforces the view of corruption as a response to unequal distribution of resources when individuals try to gain control of the allocation mechanisms as a

[2] The benefits of corruption are linked to the marginal value of water in its agricultural uses: the higher this value, the stronger the incentive to resort to illegal means to get more water. The marginal value mainly depends on the production system of the farm, e.g. on the type of crops cultivated, the level of inputs used, the availability of labour and machinery, etc.

consequence of disparities between a chronic excess of water demand and low irrigation charges. This situation affects investment decisions and the design and operations of public irrigation systems. Nevertheless, the author 'simplifies' the problem of corruption to that of the failures of the *'financial system, which creates huge rents from those who are able to obtain water from public systems'* (Repetto, 1986, p. 1).

Corruption for economic gain

Lamsdorff (2007) identifies the condition under which a business person will pay a bribe. The condition states that the benefit of corruption is: $V \geq (rP+B+T)/(1-r)$, where V is the value of the corruptly provided service, r the probability of detection, B is the value of the bribe, P the penalty in case of detection of the bribe and Tthe transaction costs.

The explanation of Lambsdorff on the individual's choice contrasts with the more institutional approach of Huppert (2005). Huppert (2005) uses a principal-agent model, originating in institutional economics, to analyse service provision in irrigation. Huppert (2005) notes that an incomplete contractual agreement between the agent (e.g. irrigation department) and the principal (e.g. farmer) when there is a lack of accountability and transparency in the coordination mechanisms of their relationship. As a result, the agent may not be held accountable (moral hazard), the principal may not optimally select the agent (adverse selection), or the principal depends on the agent's service (hold-up).

In the same line linking corruption to an economic gain and through different case studies and data collection in South Asian localities, Davis (2004) looks at the actor's interactions in water and sanitation service provision in terms of multi-actor relationships. Her work shows that corruption goes beyond bribes to falsify meter readings or speed money to expedite new connections but it is also present in contracting in the form of side payments from contractors to water and sanitation institution staff (kick-backs) and in the use of favours for the promotion and transfer of staff

Corruption as part of the social networking

As mentioned in the previous section, a bureaucrat's decision will be to break the rules if the bribe is greater than the expected costs. However, in the so-called Briber's Dilemma (Lambsdorff, 2007), the user–bureaucrat relations can be such that the bureaucrat's decisions are conditioned by the interaction with a particular user (e.g. what is cheaper in my interaction with that particular user: to break the formal rules or to break the reciprocity rule?).

Fábrega (2008) focuses on the bureaucrat-user interaction and how they agree on sustaining illegal and secret interactions. Fabrega (2008, p. 28) states: '*In 'face to face' societies, bureaucrats cannot fully separate their role as public servants from their role as member of networks (friendship, kin, partisan, etcetera). Their corruption is not simply a result of their abuse of their discretionary power to extract user's surplus. Instead, sometimes they need to bend rules to remain a participant on networks of reciprocity (even at his own risk and without immediate retribution).*

An interesting approach to corruption in this context is that of Theesfeld (2001), based on the work of Della Porta and Vannucci (2005) analysing the governance mechanisms of corruption and its pervasive nature due to vicious circles and path-dependence (North, 1992). Theesfeld (2001) explains how individuals use their power to inhibit collective action: '*through the combination of the formal political settings, the effective institutional settings, the local rules-in-use, actor group characteristics and the resource and resource system characteristics a milieu exists where opportunistic behaviour persists'* (Theesfeld 2001, p. 14). These dimensions modify the individual actor's decision for or against new institutional rules of collective action as a solution.

The present research is framed taking forward the understanding of corruption in relation to the inequality of distribution of resources and the role of social networks in the scope of the rent-seeking theory presented in the next sub-section.

2.2 The Problem: The unknown performance-corruption relationship

To establish a relation between corruption and performance is a challenging task. According to Tropp and Stalgren (2005), corruption may play an important role affecting access to water supply. However, the magnitude of its effects is difficult to quantify (De Asis et al., 2009). Another point is that low performance of WSD may have other causes rather than corruption.

The rent-seeking theory assumes that measures to enhance performance will reduce corruption. However, the theory does not establish to what extent corruption causes low performance in WSD or if there are other causes of low performance and their relation with corruption. Ostrom (1998) defines rent-seeking as non-productive activities directed towards creating opportunities for profits higher than would be obtained in an open, competitive market. The rent-seeking theory implies that resources are removed from the balance, which has an impact on performance[3]. Rent-seeking has been associated with incompetence of the state to ensure efficiency as well as to assign the real value of water (usually highly subsidised) and according to Repetto (1986, p. 27) *'... water use efficiency, as well as the operation and maintenance of systems ..., will be substantially improved if financial incentives reflect the true scarcity value of water and rent-seeking is reduced…'*. In this way, the rent-seeking theory assumes that 'incentives' provided by Private Sector Participation (PSP), institutional reform (regulation and decentralization) and New Public Management (NPM) will increase the performance of water utilities and help to reduce corruption.

Nevertheless, institutional reform, PSP and NPM have failed to address this situation (Boehm, 2007) evidenced by permanently low levels of efficiency of water utilities, lack of water access for vulnerable populations and persistent corruption in the sector.

[3] From this point of view rent-seeking has the same effect as free-riding and is considered as such by Ostrom (1998). Free-riding results from the inability to exclude non-payers (or 'free riders') from receiving the same services as payers (Huppert et al., 2001).

Kenya and Ghana are two Sub-Saharan countries where the reforms in the water supply sector have not improved the performance of WSD or reduced corruption. The following discussion finds that problems of corruption and low efficiencies in WSD may be influenced by mismanagement. Not knowing the relationship between corruption, mismanagement and performance is an impediment to instituting remedial action.

Finding solutions: reforming the water sector

Rent-seeking theory acknowledges a simple causal relationship between low performance of water service provision and corruption where rents are captured, affecting the efficiency of water utilities. According to rent-seeking theory, reform in the public water sector is a solution that introduces competitive pressures to increase performance and will reduce corruption (Repetto, 1986; Rinaudo, 2002).

However, the impact of reform needs to be questioned. From an institutional point of view, regulation involves the active intervention of the government in order to augment social welfare but problems in the public sector such as production inefficiencies, social inequities, and corruption scandals, have raised questions about the capacity of the state and led to suggestions of a so-called 'government failure' (Boehm, 2007). In its turn decentralization has been regarded as a way of achieving a more equitable water service provision; however, *'the alternative to a large centralized public sector is sometimes a weak local government that is captured by strong local players'* (Lambsdorff, 2007).

Privatization has been seen as a way to increase performance of water utilities and a way of decreasing corruption by reducing political interference and introducing competition. Yet the privatization of infrastructures and services has not been exempt from corruption.

How water sector reform has failed not only in improving performance, as evidenced by low WSD performance indicators, but also in fighting corruption is given by

Kenyan and Ghanaian water sector examples at the time of this research. In these two Sub-Saharan African countries, the water sector was subject to reform in order to improve the quality of service provision. The reforms started in the late 1990s and involving the creation of regulation bodies, commercialisation of urban water services and PSP or NPM.

In Kenya, the water sector reform stated a clear separation of regulatory functions, asset ownership and operation of water services. The Ministry of Water and Irrigation (MWI) in Kenya was responsible for all aspects of water supply, policy development, regulation formulation, overall monitoring and sector co-ordination. Service provision was devolved to regional Water Services Boards (WSBs) through independent Water Service Providers (WSPs) as municipal private corporations.

In Ghana, a private operator (Aqua Vitens Rand Limited - AVRL, a private joint venture between a Dutch utility company and a private South African company) was given a five-year management contract (2006-2011) funded through a $500 million World Bank grant to the Government of Ghana. The task of this joint venture was to supply water to customers as well as to improve performance, and to rehabilitate and extend the infrastructure serving 87 towns across the ten regions of Ghana. The Public Utilities Regulatory Commission (PURC) was one of the regulatory commissions created in 1997 as part of the reforms to regulate the sector.

In terms of performance, failures in water system performance were obvious after the reform took place. At the time of this research, the period between 2010 and 2011, Non-Revenue Water (NRW)[4] in urban areas in Ghana stood at approximately 55% of the produced water (personal communication from AVRL to author, 2009). In Kenya, NRW was estimated in the three biggest urban areas at approximately 42% by Nairobi City Water and Sewage Company, at 35% by Mombasa Water and Sewage Company and at 50% in Kisumu (author's field notes, 2009). In addition, NRW was accompanied by low performance indicators in terms of technical efficiency

[4] NRW can be considered one of the main elements expressing the performance of water service provision and which constitutes one key aspect in water demand management. NRW losses in the systems can be physical or real losses as a result of leakages, or commercial such as illegal connections and falsified meter readings, unbilled authorized consumption such as free public standpipes, and water used for fire-fighting or other utility operational uses.

(coverage, access, affordability) as well as financial efficiency (balance of expenditures and income, collection ratio, staff ratio) especially in urban areas populated by the most economically vulnerable.

As regards to corruption, Kenya and Ghana faced a number of potential corruption situations. At the regulation level regulators had weak autonomy in both countries with a consequent problem of opportunism from the respective ministries. The corporative governance of utilities in Kenya suffered from patronage and clientelism. In Ghana, on the other hand, there was no proper monitoring of the provider by the regulator. Users were free-riding the service by tapping and illegal connections and in their turn providers were offering suboptimal service in both countries (TI Kenya, 2011; GII, 2011).

The criticism of the rent-seeking theory

The rent-seeking theory presupposes that measures to increase performance such as reform of the water supply sector will reduce corruption. However, there are two points that need to be considered about rent-seeking theory regarding its attempt to establish a relation between performance and corruption.

1) A review of literature suggests that management of water utilities affects the performance of WSD and plays a significant role in its relation with corruption, but how this relation works is unknown.

   Indeed, a number of scholars (Kingdom et al., 2006; Baietti et al., 2006; Braadbaart et al., 2007) suggest that lack of technical and managerial skills amongst other issues such as governance, autonomy, and accountability relate to the low performance of WSD provided by water utilities in developing countries. However, such statements do not provide a plausible explanation for how management may affect the performance of WSD.

   Water utilities in developing countries have addressed the low performance of WSD by improving levels of technical and financial efficiency in

management, but not without difficulties (Kingdom et al., 2006). Improvement requires high maintenance levels and managerial effectiveness[5] involving skilled and dedicated staff. However, little attention has been paid to the causes of these inefficiencies considering that '*efficiency deficits may be well in the interest of most of the influential stakeholders involved*' (Huppert and Wolff, 2002, p. 1). This consideration, also taken forward by Wade (1982) when referring to the irrigation sector, acknowledges that public officials create an environment of uncertainty in the water supply side even when there is enough water in the irrigation system. On the one hand, for farmers, illicit payments comprise a small part of the total cost of production and the potential gains from the crops because increased water outweighs the cost of the bribes. On the other hand, canal managers have no incentive to manage and maintain the systems well, and the illicit payments supplement their small salaries. Along the same lines, TI Kenya (2011, p. 25) states that '*the technicians create artificial water shortages and get payments to release water to particular areas…*'

The fact may be that improving the technical efficiency of water utilities may not be attractive for either politicians or engineers who are more interested in new projects or in justifying increasing budgets for Operations and Maintenance (O&M). It also directly benefits a well-developed informal water market that seeks the rent of NRW that is paid by users/consumers, especially amongst the most vulnerable part of the population. Another reason why politicians and public-private utility managers may not engage in efficiency improvement programs is the fact that out of the two options, increasing production capacity or improving efficiencies, they will choose the least costly in terms of management and risk, even when it does not make very much sense in terms of the financial, technical or even equitable point of view (Kingdom et al., 2006). For whatever reason, such kinds of decisions may be based on the continuance and safeguarding of a 'hydrocratic elite' (Mollinga, 2008), because a better performing water utility involves a higher level of

[5] Management effectiveness refers to the use of the capacities in management in order to provide a good service quality in WSD and not only in terms of technical or financial efficiency (internal efficiency) of a specific management, usually referred to as management efficiency.

transparency, accountability and the participation of all the stakeholders involved in the service provision.

2) The rent-seeking theory focuses on the efficiency of water utilities without considering the broad picture of the water supply situation. Krause (2009) acknowledges whilst PSP contributes to higher internal efficiency of water providers, good political governance has a significant positive impact on the access to water supply services.

   The point is that looking at the performance of WSD goes far beyond water utilities and includes the whole WSD situation in a specific location because performance of WSD is not only about internal and allocation efficiencies of water utilities but also about equity in access (Krause, 2009). The same author points out how internal efficiency is a necessity but not a sufficient condition for reaching allocative efficiency and allocative efficiency situation is not necessarily equitable[6]. This is because allocative efficiency does not consider the distribution of the good within society.

Summarizing, the rent-seeking theory tries to provide a plausible explanation for how measures to increase performance will reduce corruption. However, the theory has a number of limitations: the failure of water sector reform to accomplish its objectives, the disregard of the role of management and the restriction that WSD performance focuses on water utilities without considering a broader and equitable access to water. Furthermore the rent-seeking theory does not provide an understanding of how corruption relates to (or contributes to) the low performance in WSD. Therefore, it would be interesting to rethink the relation between corruption and performance and what is the role of management. This can be formulated in terms of the research problem:

'the relation between corruption, management and the performance of WSD is unknown'.

[6] The equitability in a given water system (not utility) occurs when the water distribution across the system reaches all the users, matching the water allocated to each of them in order to cover their needs.

2.3 The Question: Unpacking the corruption-management puzzle

The present research has used the following as its principal research question regarding the problem:

'How does the relation between corruption risks and management practices explain the low performance of WSD in Kenya and Ghana?'

To be able to answer the main research question, three research sub-questions were formulated around the possible links between corruption, management and performance (Figure 2.1):

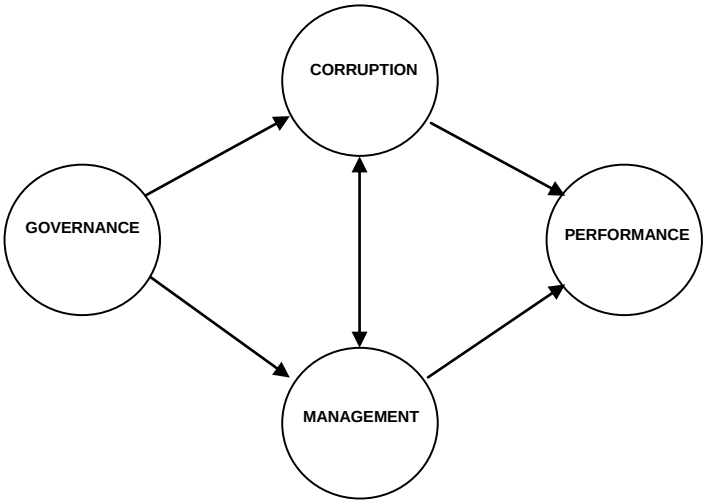

Figure 2.1: Possible relationships between corruption, management and performance in WSD**.**

1. What is the performance of the urban WSD in Ghana and Kenya?
2. What is the integrity of urban WSD in Ghana and Kenya in relation to governance mechanisms and what are the corruption risks?
3. What are the management practices related to WSD corruption risks in Kenya and Ghana?

The first sub-research question characterizes the WSD performance in the case study locations. The second sub-research question explores in detail the existing corruption risks in terms of low integrity between the actors involved in WSD in these locations. The third sub-research question identifies management practices in WSD in relation

to the corruption risks. The three sub-research questions are answered in each one of the research papers that constitute the different chapters of the thesis.

To answer the three sub-research questions a participatory case study methodology was adopted. Case studies are well suited to analysing complex interactions in real-life human situations (Cavill and Sohail, 2007; Yin, 1989). The case studies bring together quantitative and qualitative data from different sources including interviews with key informants, focus group discussions, household interviews and desk research. A participatory case study approach was used which includes triangulation of data from different sources as well as a check of the findings with the actors to enhance the validity of the results.

Based on the answers to the sub-research questions, an ABM was built up. Each one of the answers to the three sub-research questions constitutes an element of the ABM. The model answering the research question is also organized as a research paper and represents the WSD situation of the case study areas in Kenya and Ghana exploring the relationship between corruption, management and the performance of WSD. The performance in terms of quality of WSD in the case study locations constitutes the output of the ABM modelling. Corruption risks expressed as integrity variables and relation between actors involved in the WSD representing the social networks are the inputs of the ABM. Management practices result from different strategies followed by the actors involved in the specific WSD situation.

2.4 The Response: An explanatory Agent-Based Model (ABM)

In order to answer the main research question, the research develops an ABM. The ABM is built on the answers to the specific sub-research questions based on the findings of five case studies in Kenya and Ghana. The ABM is a deterministic model that reproduces the situation found in three case studies carried out in Kenya and in Ghana. By doing this, the ABM provides an understanding of the corruption-management-performance relationship.

The reason for using ABM is that it enables a representation of how the actors involved in WSD interact amongst themselves in a complex social network and within an environment determined by institutional rules and corruption risks. As opposite to simple systems that can be captured by deterministic linear casual analysis, complex systems are made up of units with a certain degree of hierarchy that relate to each other through processes (Funtowicz et al., 1999).

The ABM represents the main actors' relationships in the social network found in the case studies. The ABM uses the principal-agent theory where actors relate to each other as agents and principals (Huppert, 2005). The relationship involves a transaction between an agent offering a service to the principal and the principal paying its return to the agent. This transaction sets up a game between coupled pairs of actors. The game is defined according to a payoff table, the values of which take into consideration the transparency, accountability, participation that defines corruption risks, and the social cost of the transaction. Actors decide between cooperation (to follow the rule of law) or defection (to break the rule of law) to maximize the expected utility according to the social cost of their decision and their learning capacity. Values of the payoff table determine the different social dilemmas according to game theory.

Through ABM, it is possible to test which factors (e.g. social cost and learning capacities) determine an actor's decisions with respect to different management practices. Furthermore, it is possible to observe how management practices affect the quality of the service delivered.

Similar experiences using ABMs can be found in the field of natural resources management (Barreteau, 2003; Bousquet et al. 2001) and behavioural theory and social dilemmas (Janssen, 2005). ABMs have also been used in the context of social learning and adaptive water management (Pahl-Wostl et al., 2007). ABMs have been used more specifically with respect to corruption by Guerrero (2009) and Situngkir (2003). Nevertheless, to the best knowledge of the author, ABM has not been applied to assess the impact of corruption and management on the performance of WSD.

3. ‘Water Service Delivery in Kenya and Ghana: An area-based assessment of water utility performance’

Paper published in Water International 09 Dec 2014:

Chapter 3 contains a published paper, co-written by the author, which explores the quality of WSD in a part of the service area of water utilities operating in the case study locations in Kenya and Ghana. The paper gives an overview of two main performance indicator systems (IBNET, IWA) used by water utilities pointing out some of its limitations. The paper shows how performance indicators used by water utilities and regulatory bodies do not consider the differences in terms of quality of the service provided inside the utility service’s area. The paper proposes a Water Service Delivery Approach (WSDA) redefining coverage, quantity, quality, continuity and affordability to assess performance in the case study locations. The paper concludes that the case study locations, being low and medium income areas, are characterized by low quality in WSD.

The innovative character of WSDA to analyse the performance within specific locations of the water utility service’s area confirms the discrepancy existing between the data provided by water utilities to the regulatory agencies for the whole service area and the real situation. The paper suggests that it would be relevant to further explore in detail what the reasons could be for the poor performance.

Water Service Delivery in Kenya and Ghana: An area-based assessment of water utility performance

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Abstract

This paper explores through case studies the quality of water service delivery (WSD) in four different water utilities in Kenya and Ghana. The research confirms that the utilities' current performance indicators by themselves are insufficient to assess the access of users to good quality WSD. The case studies show that low-income populations receive a poor quality of WSD. The paper concludes that benchmarking needs to be complemented with a more in-depth analysis of the WSD by water providers.

Key words: performance, utilities, water service delivery

1. Introduction

Access by the population to safe drinking water is limited in Kenya and Ghana as illustrated by the data provided by the Joint Monitoring Programme (JMP) of UNICEF and WHO, although several authors (Onda et al., 2012; Goff and Crow, 2014) raise doubts about the reliability of the JMP statistics. Nevertheless it is interesting to see that the data show that in Kenya both household connections and access to improved urban water supply decreased from 92% to 82% between 1990 and 2010. The main reason for the reduction in access is that piped systems may not have been sufficiently extended and not able to cope with the considerable population growth. Another important problem is the high level of Non-Revenue Water (NRW) or the difference between system input volume and billed authorized consumption (Lambert, 2003) which for example reaches 42% in Nairobi (WASREB, 2011), partly as a result of illegal connections and poor maintenance of the existing systems constructed more than 40 years ago.

In Ghana the situation is different from Kenya. Access to urban water supply increased between 1990 and 2010 from 84% to 91% (WHO/UNICEF, 2010), but the percentage of household connections has gone down from 41% to 33%, which may be due to system extensions not being able to cope with the population growth. Moreover, in absolute numbers more city dwellers lack access to an adequate water supply today than in 1990. Also in this case important problems exist as service levels are low and characterized by intermittent water supply and a high level of NRW (e.g. 50 % in Accra according to AVRL, the water utility operating the piped water system).

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These data show that in recent years the situation has not really improved and even more problematic is that, as pointed out by Schouten et al. (2011), the data may provide a picture that is too positive as these statistics do not include the quality of the service that is provided. Furthermore, the data are averages and hide important differences between areas in terms of access to the service and equity. This makes it important to learn about the water supply situation and we therefore formulated the following research question. What is the quality of the Water Service Delivery (WSD) by urban water providers in Ghana and Kenya?

The case study approach that was taken is presented in Section Two. The third section briefly reviews the two main benchmarking approaches that are commonly used to benchmark water utilities in terms of WSD. Furthermore, we introduce the Water Service Delivery Approach (WSDA) in order to assess the quality of WSD in a specific service area of a water utility. Section Four presents the results of five case studies which are compared in Section Five. The paper ends with a conclusion about the case study findings and the need to combine benchmarking with WSDA to better understand water utility performance.

2. Methodology

The results presented in this paper rely on survey data collected under supervision of the authors as a part of Transparency International's *Transparency and Integrity in Service Delivery in Africa (TISDA) program* in Kenya and Ghana. These data served among others to calculate the indicators regarding the quality of the water service provided by the utilities in the case study locations presented in this paper. Other data used in this paper include public information available from regulators and water utilities and this was cross-referenced with information published by other scholars.

To answer the research question about the quality of WSD a case study approach was adopted and five case studies were conducted as a part of the TISDA program: three in Kenya involving three water utilities and two in Ghana involving one water utility. The case studies look at the performance of these utilities in specific parts of their service area. The case study methodology is well suited to analyse complex interactions in real life human situations (Yin, 1989; Cavill and Sohail, 2006; Visscher, 2006). The case studies bring together quantitative and qualitative data from different sources including interviews with key informants, focus group discussions, household interviews and desk research. Data were provided by area managers and technical staff during our interviews, or they are extracted from official reports and in some cases confidential internal reports. Together this information enables the analysis of the actors' relationships in the local water supply situation (adapted from Ruf, 2004). These techniques are combined with field observations (transect walks), and mappings of the water supply systems. The participatory case study approach that was used includes cross-reference of data from different sources as well as a check of findings with actors to enhance the validity of the results.

Case studies in both countries were done in areas with medium to high population density, including low and middle income families, which are comparable to several

other parts of the service area of the providers. Well-off neighbourhoods as well as completely deprived areas were not included. The study focused on case studies of larger utilities in main cities, which makes them somewhat comparable, although this comparison can only be indicative and does not have statistical validity. The selected case study areas are Old Town in Mombasa, Migosi in Kissumu, Kangemi in Nairobi in Kenya, and Nima and Madina in Accra in Ghana.

3. Defining the performance of water utilities

To measure the performance of water utilities is not an easy task. Estache and Kouasi (2002) point out that the measurement of efficiency in the water sector is complicated by the nature of the production process. Another problem is that the efficiency of the sector looks at the cost and transactions (allocative efficiency) but it should also consider equity issues supported by the fact that water is recognized as a basic human right. Instead, the performance of water utilities is only about financial (internal) efficiency (Krause, 2009). In addition, Schwartz (2006) argues that performance depends on utility specific conditions and that therefore an absolute comparison between utilities is not possible. In this section, we take a look at two main benchmarking approaches that are used to measure water utility performance and highlight some limitations.

Benchmarking approaches can be divided into two main groups, those using metric benchmarking as the comparison of numerical indicators of different utilities, and those using process benchmarking, the identification and adaptation of best practices to improve performance (Cabrera, 2008). In this section we briefly reflect on these two approaches pointing out some of the challenges they face and the need to take local conditions into account. The most comprehensive and widely applied example of the first approach is the International Benchmarking Network for Water and Sanitation Utilities (IBNET) developed by the World Bank. IBNET was funded by the UK Government and operated in collaboration with the World Bank and the Water and Sanitation Program (De Asís et al., 2010).

The IBNET Toolkit provides a set of financial, technical and process indicators for the assessment of utility performance in the provision of water and sewerage services. This set of indicators is used by the Water and Sanitation Program, WB and other international organizations as well as by the water utilities themselves to compare performance between utilities within and between countries.

The intrinsic problem when comparing utilities is that results need to be put into perspective according to the local situation. For example, the average figure for NRW levels in utilities in developing countries covered by IBNET is around 35% (Kingdom et al., 2006), well above the 20% indicated by Tynan and Kingdom (2002). The question arises whether these utilities should be considered as poor performers as they do not meet the target levels of 20% indicated by Tynan and Kingdom (2002). Perhaps these target levels are not realistic, as suggested for example by Schwartz (2006). Hence it seems more appropriate to use the indicators not for absolute qualification (good or poor) but to accept that utilities work in different situations and contexts that make absolute benchmarking impossible (Cabrera, 2008).

A different benchmarking approach aiming to develop procedures and methodologies to provide decision makers with an overall perception of the utility performance is the IWA Benchmarking initiative. IWA has established performance indicators in six categories: water resources indicators, personnel indicators, physical indicators, operational indicators, quality of service, and financial indicators (Mwanza, 2006).

When looking at the IWA benchmarking approach in relation to IBNET, a noteworthy point is that benchmarking indicators may have the same name but different definitions and be measured differently (Parena and Smeets, 2001). For example, IBNET defines NRW as the difference between water supplied and water sold expressed as a percentage of net water supplied. In other words, NRW represents the water that has been produced and is "lost" before it reaches the customer. NRW is calculated by IBNET as the volume of water "lost" per km of water distribution network per day (m^3/km/day) or as volume of water "lost" per water connection per day (m^3/conn/day). According to WB (Kingdom et al., 2006), this approach is not very useful to compare water loss performance between utilities because it does not differentiate between physical and commercial loss. IWA (Lambert, 2003) adheres better to the orientation of the WB as it defines NRW as the combination of physical or real losses as a result of leakages, apparent or commercial losses due to illegal connections, falsified meter readings and metering inaccuracies and it also refers to unbilled authorized consumption such as free public standpipes and water used for fire-fighting or other utility operational uses. IWA (Lambert, 2003) expresses commercial losses as the percentage of the annual authorized consumption (the annual volume of metered and/or non-metered water taken by registered customers and others authorized to do so).

An important limitation that appears from the utility benchmarking approaches that are exposed above is that they only look at performance in terms of efficiency but not in terms of equity and equal opportunity for users. Furthermore all reported performance data are averages for the system as a whole and may hide considerable differences between different service areas.

Being aware of these limitations and in order to answer the research question, we decided to explore the water service situation in a specific part of the service area of a provider. IBNET performance indicators used by many water utilities were revisited considering equity aspects, meaning equal opportunity and avoidance of absolute deprivation of the service (Krausse, 2009). We call this the Water Service Delivery Approach (WSDA). Previous experiences assessing water service delivery (WSD) can be found in Moriarty et al. (2011), WHO/UNICEF (2010) and WaterAid (2008). We also compared our findings with the overall performance data of the specific utility comparing where feasible their own data with data reported in other sources.

Table 1 shows the key indicators and definitions used in our WSDA, which are: coverage, quantity, continuity, quality and affordability. We also present the "equivalent" indicators used by the water utilities: coverage, consumption, availability of supply, quality, NRW, tariff and connection fee.

Table 1: Indicators and definitions that assess the quality of WSD

WSDA	Utility indicator (IBNET)
Coverage (percentage of population in the areas which uses the piped supply as its main water source through house or yard connections)	Coverage (population with access to water services, either with direct service connection or within reach of a public water point) as a percentage of the total population under utility's nominal responsibility)
Quantity (litres of water consumed per household)	Consumption (litres per person per day); NRW (difference between water supplied and water sold)
Continuity (uninterrupted hours of supply)	Availability of supply (hours of supply over the day)
Quality (taste, colour, smell as perceived by the users)	Quality (the percentage of samples tested for residual chlorine that pass the relevant standard)
Affordability (users' restriction in consumption because of cost)	Tariff connection and fee: cost to a household per month of 6 m^3 water plus total amount of the connection. However, because the 6 m^3 volume is not standard, we took the price per m^3

4. Assessment of WSD quality in the case study areas

4.1. WSD in Kenya

Water Service Providers (WSPs) are the water utilities responsible for the day-to-day operation of water supply systems in urban areas in Kenya. Because of limitations in the performance of these WSPs, there are also a considerable number of informal actors who provide water to people using the water supplied by the WSPs through illegal connections. These informal providers may serve as the only water provider to some users or as a complementary water source in areas where the main WSPs are rationing their supply.

Table 2 summarizes the water situation in the case study areas. The table shows the percentage of people using a specific provider to satisfy their water needs. The total coverage is higher than 100% because several households take water from both formal and informal providers. Data show that important differences exist in the percentage of households that take water from the utility-managed piped water supply: this ranges from 27% to 82%. Important differences also exist in the use of water vendors and the purchase of water from kiosks.

Table 2: Providers supplying water to the population in the case studies

Location	Old Town (Mombasa)	Migosi (Kisumu)	Kangemi (Nairobi)
Water utility	MOWASCO	KIWASCO	NCWSC
Population (HH)	28,000 (4,600 HH)	22,000 (3,650 HH)	90,000 (17,904 HH)
Provision by water utility[1]	26%	20%	82%
Provision by water vendors (push carts)[1]	25%	66 %	8%
Provision by private or community kiosks[1]	90%[2]	50%[3]	83%[4]

1. Percentage of population taking water from this provider either as main source or supplementary source.
2. In Mombasa kiosks are connected to boreholes owned by the entrepreneurs, around 38% of the population is connected to boreholes in clusters of 12 HH.
3. In Migosi most kiosks are connected to wells owned by entrepreneurs and some to a piped system.
4. In Kangemi some kiosks are connected to the piped supply, but 3 large kiosks are community managed with their own borehole.

References: TISDA Survey 2010 based on own estimations from water utility data and HH interviews

4.1.1 Cases studies in Kenya

Case study of Old Town in Mombasa

Old Town is an urban community located in Mombasa Island comprising an area of 0.8 km^2. The area is densely populated with narrow streets and consists of old buildings (two to four floors), some dating back 500 years. Old Town is connected to the piped water supply of Mombasa that was constructed during the colonial era in 1926 and extended successively in 1955 (Musingi et al., 1999). The piped water supply is operated and managed by Mombasa Water and Sewerage Company (MOWASCO). The system is old and dilapidated, experiencing frequent cases of breakdown and also cases of cross-contamination with sewage effluent from the old sewer system (Kinya, 2010). The assessment of the overall WSD of MOWASCO and the specific situation in Old Town is shown in Table 3.

Table 3: Assessment of the WSD in Old Town (Mombasa)

Case study of Old Town in Mombasa: population 28,000 (4,600 HH) (N=50 households)		
Indicator	**For system as a whole (WASREB, 2011)**	**For case study area (authors' calculation based on Transparency International survey 2011)**
Coverage	72% with 37% dormant connections.	Out of 1,200 active connections (from a total of 3,100) in Old Town, only 26% of the HH have a connection; however, in the survey only 10% of the HH indicated the piped system was their main water source.
Quantity	Average consumption level 4.8 m^3/HH/month (taking into account a NRW of 35%).	Average consumption level by users of MOWASCO system is some 9 m^3 /HH/month, but users complement with water from water vendors.
Continuity	8 hours a day three days a week.	Water is available 12 hours per day three days per week and less for tail enders.
Quality	Only 29% of the water samples have sufficient residual chlorine.	Residents complain about taste and bad smell.
Affordability	An incremental tariff system exists; a consumption of 6 m^3/month costs 200 KSh; the connection fee is 100 KSh plus 35% of the cost of materials, which seems quite affordable. Water kiosks and water tankers pay a flat rate of KSh 35 per m^3.	On average users pay bills of KSh 350 per month per connection for some 9 m^3/month The interviewed HH with connections from MOWASCO indicated that they ration the water to reduce the amount of water they have to buy from vendors at some 5 KSh per 20 litres as total supply is insufficient.

Case study of Migosi in Kisumu

Migosi is a low-to-middle income area close to the centre of Kisumu with a growing population (Wagah et al., 2010). The area of 1.7 km² comprises detached houses and houses with apartments and it has paved main streets. It comprises three zones: Migosi lower, Migosi upper and Kenya Re estates. The case study is primarily concerned with Migosi upper and lower zones, which are more densely populated and have a higher percentage of lower income groups; Kenya Re is a better-off estate comprising mansions and bungalows of middle income earners. Table 4 shows the overall WSD assessment of Kisumu Water and Sewerage Company (KIWASCO) and the situation in Migosi.

Table 4: Assessment of the WSD in Migosi (Kisumu)

Case study Migosi: population 22,000 (4,360 HH) (N=50 households)		
Indicator	**For system as a whole (WASREB, 2011)**	**For case study area (authors' calculation based on Transparency International survey 2011)**
Coverage	48% with 8% dormant connections	509 active connections (out of 597) in Migosi. 14% of the houses have a house or yard connection that are partly shared as according to the survey 20% of the population have the piped system as their main source of water.
Quantity	Average consumption is 2.3 m³/HH/month (taking into account a NRW of 50%)	The total supply to the area is not known but the users with house or yard connections in the HH interviews receive on average 7.6 m^3 per HH.
Continuity	The water is supplied 24 hours a day	The water supply in the area is intermittent, but most HH have at least four hours of water supply per day.
Quality	96% of the water samples have sufficient residual chorine	Some users prefer to treat the water before drinking, others rely on bottled water.
Affordability	HH pay the same incremental tariff. They pay KSh 200 for the first 6 m^3 per month (even if use is lower). Connection fee is around KSh 1,800 for materials, water meter and labour. Commercial rate is 40 KSh per for first 6 m^3	On average users pay bills of KSh 437 per month per connection for 7.6 m³/month. Some users indicated that the connection fee is high for them, and so they buy either from the kiosks or the well owners or at a higher price per m^3 from push carts (KSh 35 per m³).

Case study of Kangemi in Nairobi

Kangemi is a peri-urban neighbourhood located about 15 km west of Nairobi city centre. The area of 4.5 km² is densely populated, but still has some open ground. The population density is increasing and some multi-storey houses have been built, which is illegal because the area does not have a sewerage system. Nairobi City Water and Sewerage Company (NCWSC) operates a 60-year old system (NCWSC, 2012) with frequent cases of breakdown, which provides a piped water supply to different areas of Nairobi including a part of Kangemi (Bellaubi notes, 2010).

Table 5 provides an overview of the assessment of the overall NCWSC and the quality of WSD in Kangemi.

Table 5: Assessment of the WSD in Kangemi (Nairobi)

Case study Kangemi: population 90,000 (17,904 HH) (N=75 households)		
Indicator	**For system as a whole (WASREB, 2011)**	**For case study area (authors' calculation based on Transparency International survey 2011)**
Coverage	63% with 100% active connections.	Some 9% of the HH own an active water connection. NCWSC indicates 1,610 active and registered yard and house connections in the area; many are shared by more than one HH, which means that 82% of the population has direct access to the system.
Quantity	Consumption of HH is 10 m^3/HH/month (taking into account a NRW of 42%).	The survey showed that an average consumption level is 2.36 m^3/HH/month in Kangemi taken from (shared) house or yard connections.
Continuity	11 hours/day.	Water is available three times per week.
Quality	91% of the samples have sufficient residual chlorine.	Quality of the water is good according to consumers.
Affordability	Rates for HH are incremental: KSh 187.1 for first 10 m^3 (irrespective of volume used). Connection fee goes from KSh 2,500 to 15,500 depending on the diameter of the pipe.	Users pay from KSh 120 to KSh 2,000 per month. Average consumption of 2.36 m^3/month. Many users do not know how much they pay as their rent includes water consumption where it seems that landlords make a profit on the water. Some 37% of the interviewed HH taking water from a house or yard connection indicated that they ration the water to save cost.

4.1.2 Comparison of case studies in Kenya

From the tables of the previous section we observe that in two of the three cases, coverage is lower than the average data provided by the Regulatory Water Services Board (WASREB) for the whole utility service area. Only in Kangemi does a larger part of the population (82% against 63%) obtain water directly from the system because they share the connection with neighbours. Yet in Kangemi as well as in the other case studies, many that obtain water from the piped system also take water from water kiosks and water vendors. One problem concerning the official coverage data is the size of the population, and the number of active connections that are used in the calculations, as these data differ considerably between different reports (Mugo, 2010; Kinya, 2010; WASREB, 2011). Another important point to be raised is whether coverage figures in fact should not be downgraded as it does not seem appropriate to indicate people as covered if their main source of water is not the piped system. All the case study areas receive an intermittent water supply, and at less supply hours than reported by the utilities for the system as a whole. As indicated by Mugo (2010), rationing covers the deficit that most of the utilities are facing (production against demand). On the other hand, sharing a piped connection (yard tap) among different users, as is common in all the case study areas, seems a good approach to enhance coverage provided that users can get enough water and do not have to revert to buying water from vendors. The fact that we find lower consumption levels in Kangemi may imply that either a lower service level is provided to this area or that more users share a tap in this area than in other parts of the system. In the other two cases we find the opposite situation, implying that more water is used per household in Old Town and in Migosi than in the rest of the system. A higher service level seems an unlikely explanation so perhaps coverage levels are overestimated by the companies (which contributes to meeting the Millennium Development Goals), but in practice fewer

active connections exist than actually estimated, an issue that clearly requires further analysis.

No specific data about NRW exist for the specific case study areas, but all providers report high NRW levels. The WASREB (2011) report shows differences with other sources (Muema, 2008; Mugo, 2010; Kinya, 2010; Owuor and Foeken, 2009; Wagah et al., 2010). Also the consistency between different WASREB reports raises a question as we found an increase in NRW whereas a decrease would have been more logical because of new investments. Another important limitation is that current data do not allow differentiation between physical and commercial losses.

In terms of water quality, all the systems entail a risk as water supply is intermittent. Residents of Old Town complain about bad smell and taste and only 29% of the water samples have sufficient residual chlorine. In Migosi and Kangemi more than 90% of the samples have enough residual chlorine and there are fewer user complaints about water quality.

Tariffs vary considerably between the case study areas, charging between KSh 18.7 to 33.3 (0.22 to 0.40 USD; conversion May 2011) per m^3 for the first consumption level of 6 to 10 m^3. Also connection fees vary ranging from KSh 700 to 15,000. Many users indicate that they restrict their water use because of cost. This may be partly due to incremental tariffs which punish people that share a connection, but also because people may need to complement their piped supply by buying water at higher prices from water vendors.

4.2. WSD in Ghana

Ghana Water Company Limited (GWCL) is responsible for the planning, financing, construction, rehabilitation, and management of all urban water supplies in 82 urban water supply systems and offices in 26 cities across Ghana. In 2006 GWCL signed a five-year contract with Aqua Vitens Rand Limited (AVRL) to manage all these 82 water supply systems on their behalf.[8] These systems however do not cover the total population in their service areas and as a result there are also many informal providers that serve water to people who do not have access to house or yard connections from the water utility (e.g. water tankers take water from service points in the piped system and serve this to consumers or local water vendors in areas with limitations in supply (GII, 2011).

Table 6 summarizes the water situation in the case study areas and presents the different water providers.

[8] In Ghana, Water and Sanitation Development Boards (WSDB) are responsible for the management of small town water systems. They can contract private companies to manage the system through a service management contract.

Table 6: Providers supplying water to the population in the case studies

Location	Madina (Accra)	Nima (Accra)
Water utility	GWLC-AVRL	GWLC-AVRL
Population (HH)	80,000 (4,000 HH estimated)	70,000 (2,385 HH)
Provision by water utility[1]	30%	80%
Provision by water vendors (push carts or private connections)[1]	40%	35 %
Provision by water tankers[1]	30 - 40% [3]	
Provision by self-supply (rainwater) [1]	14%	
Other community-managed systems[2]	10%	

1. Percentage of population taking water from this provider either as a main source or supplementary source.
2. This refers to mosques providing water and managed through the Council of imams.
3. There are 13 Water Tanker Associations active in Madina. Private hydrants erected by AVRL and connected to the piped system are the sources of water for water tankers and these are operated and managed by a private individual through three employed staff. Water tankers also supply water to push carts.

References: TISDA Survey 2010 based on own estimations from water utility data and HH interviews

4.2.1 Case studies in Ghana

Case studies of Madina and Nima in Accra

Madina is a low income urban community and a commercial centre located ten miles north east of the centre of Accra on the Dodowa road. The area of 4 km^2 is fairly densely populated and consists of mostly unplanned compound houses occupied by large families and/or tenants. Nima is also a low income urban slum settlement in the northeast of Accra Metropolitan Area. The area of 1.6 km^2 is very densely populated and consists of largely unplanned compound houses narrowly separated by paths and filthy drains. The communities mostly depend on the old piped water supply operated by AVRL, water vendors and water tankers. Rainwater is harvested in the rainy season for domestic use and a large number of households have rainwater tanks. The poorest households who cannot afford to pay the connection fee or to buy in bulk from water tankers, or households with connections but that are affected by rationing or low pressure, buy water per bucket from water vendors with large storage tanks (Bellaubi, field notes 2010).

Table 7 provides an overview of the assessment of the overall water service provision in Accra based on data from literature, as well as of the quality of WSD in Madina and Nima based on the case study findings.

Table 7: Assessment of the WSD in Madina and Nima (Accra)

Case study Madina (population 80,000 – 4,000 HH) and Nima (population 70,000 – 2,385 HH) in Accra) (N=50 households)			
Indicator	**For the system as a whole (several sources)**	**For Madina case study area (authors' calculation based on TI survey 2011))**	**For Nima case study area (authors' calculation based on TI survey 2011)**
Coverage	80 % according to Van Rooijen (2011). Nevertheless there are few other sources of water in Accra, hence also a considerable part of the remaining population depends indirectly on the water supply system (illegal connections, reselling etc.).	840 active connections (30% of HH) out of 2,800 registered connections (70% HH) in Madina. However, in the HH survey only 5% of respondents indicated that the piped connection was their main water source. Illegal connections could be around 10% according to AVRL.	Some 1,930 registered connections exist (80% of HH) but unclear whether these are all active. From the household survey only 65% of respondents indicate that the piped connection is their main source of water. AVRL estimates approximately 10% use illegal connections.
Quantity	The average theoretical consumption is 10 $m^{3/}$HH/month (taking into account a NRW of 55%[1]).	The HH survey indicated a consumption level between 2.4 and 3.4 m^3/HH/month, which is lower than the average theoretical consumption.	
Continuity	Water is rationed (the system has considerable leakage and illegal connections).	Water supply is intermittent (there is a great variability: low-lying areas may receive more water and high-lying areas less), but in general 1-3 times per week for no more than 12 hours.	
Quality	The production site is meeting WHO standards.	The quality seems quite good. Hygiene risk (bacteriological contamination) is low in areas where there are no water logging problems.	
Affordability	Domestic rate GHC 80 for the first 20 m^3 and 1.2 GHC/m^3 over 20 m^3. Commercial rate is GHC 1.2 per 1 m^3 also for water vendors and tankers. Flat rate per month GHC 11 to GHC 35 (depending on number of persons in the house, taps, toilets, lawn, and garden). Connection fee GHC 150 (materials, water meter and labour)	We estimate that the average water bill for a household of six for the piped supply may be between GHC 2 and 8 per month for approximately 2.4 – 3.4 m^3/month, but they do need to buy water from tankers or vendors as supply is not daily. In Nima although precise figures are not available it seems that a considerable part of the population rations its water supply because of cost.	

1. AVRL estimates NRW at approximately 50% (Bellaubi field notes, 2010). Lieverts (2009) suggests that 45% of the NRW is caused by physical losses and 55% due to commercial losses, but this cannot be confirmed as the system has no bulk water meters and only part of the system is metered. Van Rooijen (2011) estimates NRW at 55% with physical losses at 30%.

4.2.2 Comparison of case studies in Ghana

The two case studies conducted in Accra show discrepancies with the performance indicators of the water utility. In Ghana fewer data than in Kenya were available regarding the performance indicators of the water utility and some data were not accessible. Therefore the information on performance indicators was complemented with data from different authors (Ainuson, 2010; Lieverts & Barendregt, 2009; Van Rooijen, 2011; WaterAid, 2008), although part of the data reported in literature shows considerable disparity.

Clear differences exist in the coverage reported by users (indicating that the piped supply is their main water source) between Nima (5%) and Madina (65%). At the same time Nima has more active connections (30%) than Madina (80%) although as indicated in Table 7, it was not clear whether these connections are indeed active and how often water is provided. However, in both cases it is clear that the real coverage is below the average figure of 80% given by Van Rooijen (2011) and particularly in Nima almost the whole population depends on water sellers to fulfil their water need.

Another point is that the consumption per household found in the case studies is lower than the average consumption estimated by the utility. This seems to suggest that the actual number of users of yard connections is larger than the number estimated by the utility but it may also imply that more water is lost before it reaches the users.

NRW is estimated at around 55% according to Van Rooijen (2011) but this figure could not be verified with data from AVRL, GWLC or the Public Utilities Regularity Commission (PURC). The fraction due to physical and commercial losses differs between authors (Lieverts and Barendrecht, 2009; Van Rooijen, 2011). Commercial losses could be considerable as AVRL acknowledges a high number (approximately 10%) of illegal connections (Bellaubi, field notes 2010).

Water supply is rationed in all the service areas of Accra and especially in the case study locations where water is only available a few days per week. In fact the overall problem is that Accra suffers from a deficit of water as shown by Van Rooijen (2011) and Ainuson (2010). This situation is aggravated by high NRW. Commercial losses drain financial resources from the provider that otherwise for example could be used for system improvement with users paying a higher price to informal vendors. Providing intermittent supply is then taken as the quickest solution for the provider, with an additional benefit that when pipes are not under pressure they do not leak. Therefore in fact rationing reduces physical loss.

Water quality meets WHO standards at the point of treatment (Bellaubi, field notes 2010) but because of the intermittent supply a risk of contamination exists particularly as several water-logged areas were observed in both case study areas.

Tariff per household varies from GHC 2 to 8 (0.13 to 0.53 USD; conversion May 2011) for the first 20 m^3 with a connection fee of GHC 150. Levels of metering in the case study areas are very low at around half of the total active connections but this is similar to the overall level of metering in Accra as reported by Lieverts (2009). When not metered, users pay a flat rate based on the number of persons in the house, taps, toilets, lawn, and garden.

5. WSDA benchmarking in the case studies of Kenya and Ghana

This section benchmarks the water utilities in the case study locations following the WSDA described in Section 2 and using the findings from our research (tables 2, 3, 4, 5, 6 and 7). This is done by assessing the performance of the water utilities against targets (benchmarks) that we consider relevant for the quality of the service to be provided. A related point is that applying the WSDA in different locations of a service area of a water utility may show considerable differences between these locations and this may encourage providers to take the necessary steps to enhance equity in WSD.

Indicators defining the quality of WSD are clustered in technical and access criteria. For each indicator used in the WSDA, target levels have been established based on literature as well as benchmarking efforts carried out in Kenya by WASREB, and to a more limited extent in Ghana by PURC (Table 8).

In Kenya, WASREB produces an Impact Report each year which is presented as a tool to enhance competition among utilities by showing annual data for all utilities and ranking them, with the aim of improving their performance (WASREB, 2011). WASREB also sees this report as an accountability tool to the public, shareholders and directors of the WSPs and Water Services Boards (WSBs), as well as other decision makers in the sector. The impact report provides clear benchmarking against specific targets at national level for nine key indicators: water coverage, NRW, hours of supply, staff per thousand connections, Operations and Maintenance cost coverage, metering ratio, revenue collection efficiency, water quality, and sanitation coverage. The nine key indicators used by WASREB are included in the list of IBNET indicators.

In Ghana, PURC has set up a performance contract with the main urban provider GWCL which includes monitoring of NRW and coverage (GII, 2011). As a result of the contract signed with AVRL to manage 82 water supply systems, GWCL monitors the performance of AVRL who operates the systems and undertakes routine maintenance. This management contract stipulates some specific service standards (benchmarks), and that not meeting them may lead to penalties. The standards include: water quality, pressure and flow rates of treated water, reduction in NRW, treatment works, production capacity, customer complaints/inquiries response and interruptions (GWCL, 2005). The quality standards set by GWCL over AVRL are also in the list of IBNET indicators with the exception of the pressure and flow rates of treated water that are exclusive to the contract between GWCL and AVRL.

Table 8. Performance criteria, indicators and targets in a utility location considering a WSDA

Criteria	Indicator	Scoring levels
Technical efficiency	▪ Continuity ▪ Quality	0 = < 4 h/d; 1 = 4 – 10 h/d; 2 = > 10 h/d 0 = < 90%; 1 = 90 – 95%; 2 = > 95% test
Access	▪ Coverage ▪ Affordability ▪ Quantity	0 = <50%; 1 = 50-90%; 2 = > 90% 0 = >10% people restrict water; 1= 5-10%; 2 = < 5% 0 = <20 l/c/d; 1 = 20 – 100 l/c/d; 2 = > 100 l/c/d

The following arguments were used to establish the thresholds we used in the benchmarking:

- Continuity: the maximum performance of a utility is a continuous supply over 24 hours; nevertheless 10 hours during the day is likely to be enough to allow fairly normal water collection at houses and yard taps, particularly if water is provided in the morning and afternoon. Less than 4 hours during the day is too restricted as people will need to establish part of their routines around the water and may even leave taps open to collect water whenever it comes, with the risk of spillage.
- Quality: according to WASREB (2011) and in line with IBNET indicators, the quality of drinking water is satisfactory when 95% of tests carried out are in compliance with the residual chlorine standards.

- Coverage: international maximum threshold accepted is 100% but WASREB accepts higher than 90%.
- Affordability: this is a complex issue and can sometimes be indicated as a maximum percentage of the average income; we decided to adopt a different approach by asking people during household interviews whether they were restricting their consumption because of the cost of the water supply. Restrictions of water use because of cost should in fact not occur, but as the service area includes low income families, it seems reasonable to expect that nevertheless some users will face difficulties in meeting these costs. However this number should be low and we therefore established a minimum threshold of 5%, but further research is needed to discover if this is indeed a fair threshold.
- Quantity: Reed (2005) gives 20 litres/capita/day to cover minimum needs, and WASREB (2011) mentions an average of 100 l/c/d according to developing countries.

The results of the assessment of the WSDA benchmarking in the case study areas are shown in Table 9.

When comparing the results of the WSDA approach by different providers in Kenya, we see that in terms of technical efficiency, all the providers have limitations but KIWASCO is doing better than the others, especially because of the quality of water and continuity. Concerning access, even when coverage is low for all of them, only users in Migosi seem to limit the quantity due to cost and in Kangemi the quantity is below the minimum needs.

Table 9: Performance score in Kenya and Ghana case study locations following a WSDA

Criteria	Variables (indicator)	Old Town (Kenya) MOWASCO	Migosi (Kenya) KIWASCO	Kangemi (Kenya) NCWSC	Madina (Ghana) AVRL	Nima (Ghana) AVRL
Technical efficiency	▪ Continuity	0	1	0	0	0
	▪ Quality	0	2	1	2	2
Access	▪ Coverage	0	0	0	0	1
	▪ Affordability	2	0	2	0	0
	▪ Quantity	1	1	0	0	0

Table 9 shows that KIWASCO is doing better in the case study area than MOWASCO and NCWSC, except for affordability. This is in fact in line with the ranking in the impact report (WASREB, 2011) (2009/10 data) where KIWASCO was among the 10 best water service performers and meanwhile MOWASCO and NCWSC were in the 27th and 32nd position respectively. Nevertheless, our research (tables, 3, 4 and 5) shows that the average benchmarking numbers reported to WASREB are masking differences inside the systems. Hence additional case studies are needed for example in better-off neighbourhoods to benchmark these differences within systems.

The two case studies in Ghana show similar results concerning technical efficiency but not in access. Technical efficiency remains low because of the high levels of NRW and intermittent water supply. In terms of access there is a big difference in

coverage with better coverage levels in Madina than in Nima thus illustrating the relevance of the WSDA. Affordability and consumption remain low in both areas.

In Ghana there is no benchmarking in place between the different water systems managed by AVRL. AVRL is acting on behalf of GWCL as the operator of the water system under a service management contract and GWCL has not been able to establish a baseline for AVRL on which to measure performance targets (Ainuison, 2010). However GWCL has a performance contract with PURC. The benchmarks agreed under this contract included: a collection rate of 95%, NRW not exceeding 45%, publication of the consumer charter and publication of the rationing programme in the media to enable consumers to store water (Bellaubi field notes, 2010). A review of technical, financial and audit reports of GWCL and AVRL proved that "during the management contract period (2006-2011), the level of performance in almost all the systems was poor especially in respect of reduction in non-revenue water, treatment plant operations, a customer response plan, customer accounts receivable, customer collection, chemical usage, power consumption and public water consumption" (GWCL, 2012).

6. Conclusions

This paper shows that the quality of WSD in specific locations of the service area of water utilities in Kenya and Ghana, which are characterized by medium to high population density, and a population of low and middle income families, is in general lower than the service level reported by the water providers for the system as a whole. This is in line with the findings reported by a number of authors (Ainuson, 2010; Rooijen & Dechsel, 2008; Ombogo, 2009; Owuor & Foeken, 2009; K'Akumu, 2006; WaterAid, 2008; Ainuison, 2010). The low quality of WSD in the case study areas could be explained by the fact that the water systems are quite old and the system extensions have not been able to cope with population growth. Here it is important to take into account that in Kenya and Ghana the utilities are only responsible for management and not for system extension. The age of the system but also lack of quality in repairs is an important factor for a high NRW but also other factors seem to play a role as an important part of the NRW does not concern technical but financial loss (e.g. illegal connections). Besides, with the large volume of NRW it is not surprising that rationing is one of the coping strategies for the water providers, without any compensation for the users who in fact over the years are facing a gradual deterioration in service level.

The consequence of the low quality in WSD in the studied locations is a dependence on informal service providers. Because of water rationing and pressure problems, consumers with a piped connection at times need to buy water from the informal providers that serve consumers without connections.

Another point for reflection relates to the fact that we observed that there is a considerable difference between the overall performance of the water utilities and the actual performance data found in the case study areas in terms of quality of WSD both in Kenya and Ghana. This indeed shows that differences exist within the service area, but it also raises some doubt about the way in which some performance variables are calculated by the water utilities and reported to regulatory bodies and other

international organization for benchmarking purposes. Differences observed amongst data open up a broader discussion on whether government administration and public utilities managers could have an interest in not providing empirical data. On the one hand, reporting lower efficiencies could justify new investments in system extensions. On the other hand, government and water utilities providing performance data that show progress and improvement over time, especially regarding the Millennium Development Goals (MDGs), can justify funds from the donor community. Hence it seems very relevant to further explore in detail what the reasons could be for the poor performance whilst also looking at who may be benefitting from the situation.

Ultimately, this paper shows that the WSDA is a good approach to analyse the performance of water utilities as it provides insights into the quality of the WSD in specific locations of their service areas. These insights do not emerge from current benchmarking approaches that do not address performance differences within systems. Assessing the WSDA in different parts of the service area of a water utility is an attempt to consider equity issues, showing differences within the service area. Our suggestion to adopt the WSDA is in line with Cabrera (2008), who suggests that water utilities could improve their benchmarking efforts including relevant context information to enhance the analysis stage of many projects and give further meaning to those benchmarking efforts limited to collecting performance data.

7. Bibliography

Ainuison, K. G. (2010) Urban Water Politics and Water Security in Disadvantaged Urban Communities in Ghana. African Studies Quarterly, Vol. 11, Issue 4 (p. 24). http://www.africa.ufl.edu/asq/v11/v11i4a4.pdf Accessed 18.11.2011.

Cabrera, A. (2008). Benchmarking in the water industry: a mature practice? Water utility Management International. June 2008 (pp. 5-8), London: IWA Publishing.

Cavill, S., & Sohail, M. (2006). A note on research methodology for combating corruption. Accountability arrangement to combat corruption (p. 20), Loughborough University, Loughborough: WEDC.

De Asís, M., O'Leary D., Butterworth J. and Ljung P. (2010). Improving Transparency, Integrity and Accountability in the Water and Sanitation Sector. Washington: World Bank Institute (p. 177).

Estache, A., & Kouasi, E. (2002). Sector organization, governance and the inefficiency of African Water Utilities. Policy Research Working Paper 2890 (p. 26). Washington: World Bank Institute.

Goff, M. and B. Crow (2014). What is water equity? The unfortunate consequences of a global focus on 'drinking water'. Water International, Vol. 39, Issue 2 (pp. 159-171).

GII (2011). "Ghana's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Ghana. Source:

http://www.tighana.org/giipages/publication/TISDA%20LAUNCH%20REPORT%202011.pdf accessed 30.07.2012

GWCL (2005). Management contract for urban water Draft 13 June 2005 Final. Source: web page no longer exists, accessed 30.08.2010.

GWLC (2012). Private sector participation in urban water delivery in Ghana. Source: http://www.gwcl.com.gh/pgs/privatesector.php Accessed 12.12.2012.

K'Akumu, O. A. (2006). Privatization model for water enterprise in Kenya. Water Policy 8 (pp. 539–557). IWA Ed.

Kingdom, B., Liemberger, R., & Marin, P. (2006). The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries. How the Private Sector Can Help: A Look at Performance-Based Service Contracting. Water supply and sanitation sector board discussion paper series. Paper No. 8 (p. 52), Washington: World Bank.

Kinya, M. (2010). Experience of MOWASCO in Staff Training. Mombasa Water and Sewerage Company Ltd. Kenya. Presentation during the 15th African Water Association Congress 2010. Kampala, Uganda. 17 March 2010.

Krause, M. (2009)."The political economy of water and sanitation" (p. 252), New York: Routledge.

Lambert, A. (2003). Assessing non-revenue water and its components: a practical approach. Water Loss. IWA task force. Water 21 (pp. 50-51).

Lieverts, C., & Barendregt, A. *(*2009*). Implementation of intervention techniques to decrease commercial losses for Ghana. 5th IWA Water Loss Reduction Specialist Conference (pp. 490–496), Cape Town, South Africa. London: IWA.* Accessed 13.01.2013.

Moriarty, P., Batchelor, C., Fonseca, C., Klutse, A., Naafs, A., Nyarko, K., Pezon, C., Potter, A., Reddy, R., and Snehalatha, M. (2011). Ladders for assessing and costing water service delivery. WASHCost Working paper No. 2. The Hague: IRC (p. 28).

Muema, P. (2008). "Promoting consumer accountability mechanisms in Mombasa". Presentation at the 13th International Anti-corruption Conference in Athens, Greece. 30 October – 2 November 2008 Source: http://iacconference.org/documents/PhyllisMuema_ppt.pdf Accessed 07.02.2009.

Mugo, F. (2010). Managing Water and Sewerage Utilities amid Global Challenges: Experience of Nairobi City Water & Sewerage Company (NCWSC). Presentation at the CEOs' Forum at the 15th African Water Congress Kampala, Uganda.

Musingi, J., Mulei Kithha S. and Nzuve Wambua B. (1999). The urban growth of Mombasa coastal town and its implication for surface and groundwater resources. Impacts of Urban Growth on Surface Water and Groundwater Quality (Proceedings of IUGG 99 Symposium HS5, Birmingham. July 1999). IAHS Publ. No. 259, 1999.
Mwanza, D. (2006). Benchmarking of Utilities for Performance Improvement. Water and Sanitation Program 8 December 2006 (p. 23). Source:

http://sustainabledevelopment.un.org/content/documents/1457dennisDM.pdf. Accessed 14.10.2012.

NCWSC (2012) Water sources for Nairobi Water and Sewerage Company, Nairobi: NCWSC. Source: http://www.nairobiwater.co.ke/water_quality/?ContentID=4 Accessed 07.11.2012.

Ombogo, P. (2009). Presentation Water Sector Reforms. Status of Water Sector Reforms in Kenya. Challenges and Lessons. World Water Week, Stockholm, 2009. Source http://www.worldwaterweek.org/documents/WWW_PDF/2009/wednesday/T3/Patrick_ombaga_Situation_analysis_and_lessons_learnt_Water_Sector_reforms_in_Kenya.pdf Accessed 14.01.2012.

Onda, K. et al. (2012). Global Access to Safe Water: Accounting for Water Quality and the Resulting Impact on MDG Progress. Int. J. Environ. Res. Public Health, Vol. 9, (pp. 880-894).

Owuor, S., & Foeken, D. (2009). Water reforms and interventions in urban Kenya. Institutional set-up, emerging impact and challenges. ASC Working Paper 83 / 2009 (p. 86). Leiden, The Netherlands: African Studies Centre.

Parena, R., & Smeets, E. (2001). Benchmarking initiatives in the water industry. Water Science and Technology. Vol. 44, No. 2–3. (pp. 103–110). IWA Publishing.

Reed, B. (2005). Technical Notes on drinking water, sanitation and hygiene in Emergencies Note No. 9: Geneva: WHO. http://www.who.int/water_sanitation_health/publications/2011/tn9_how_much_water_en.pdf Accessed 15.05.2011.

Ruf, T. (2004). Le système irrigué comme territoire. In: Ruf T., Honegger A. (Ed. scientif). Gestion sociale de l'eau, concepts, méthodes de recherche et applications. Territoires en mutation, No.12, November 2004 (pp. 51-62).

Schouten T., Fonseca C., Lockwood H. & Moriarty P. (2011). Taking a service delivery approach to monitoring water supply in low income areas and implications for the Joint Monitoring Programme. In: World Health Organization and UNICEF, First consultation on developing post-2015 indicators for monitoring drinking water and sanitation. Berlin, Germany, 3, 4 and 5 May, 2011. The Hague: IRC International Water and Sanitation Centre. Source: www.washcost.info/page/1321 Accessed 10.12.2012.

Schwartz, K. (2006). Managing Public Water Utilities. An assessment of bureaucratic and new public management models in the water supply and sanitation sectors in low- and middle-income countries. PhD thesis, Erasmus University, Rotterdam. Delft, the Netherlands: UNESCO-IHE Institute for Water Education.

Tynan, N., & Kingdom, B. (2002). A Water Scorecard. Public Policy for the Private Sector. Note 242, April 2002. The World Bank Group Private Sector and Infrastructure Network. Source: http://rru.worldbank.org/documents/publicpolicyjournal/242Tynan-040802.pdf Accessed 07.11.2012.

Van Rooijen, D. & Dechsel, P. (2008). Domestic Water Supply in Accra: How Physical and Social Constraints to Planning have Greater Consequences for the Poor. 33rd WEDC International Conference, Accra, Ghana, 2008. Reviewed paper.

Van Rooijen, D. (2011). Implications of Urban Development for Water Demand, Wastewater Generation and Reuse in Water-Stressed Cities. Case studies from South Asia and sub-Saharan Africa. PhD thesis. WEDC (Water Engineering and Development Centre), Loughborough University.

Visscher, J. T. (2006). Facilitating Community Water Supply Treatment. From transferring filtration technology to multi-stakeholder learning. PhD thesis (p. 256), Wageningen University. Vitens Evides International. Management Contract 2006-2011 for urban water supply in Ghana. A Partnership – *in and for* – development. Source: http://www.vitensevidesinternational.com/projects/ghana/ Accessed 13.10.2012.

Wagah, G., Onyango, G. & Kibwage, J. (2010). Accessibility of water services in Kisumu municipality, Kenya. Journal of Geography and Regional Planning, Vol. 3(4), pp. 114-125.

WASREB (2011) IMPACT. A performance Report of Kenya's Water Services Sub-Sector, Issue No. 4 of Impact.

WaterAid (2008). Urban Sector Assessment Report (p. 47).

WHO/UNICEF (2010). Joint Monitoring Programme for Water Supply and Sanitation - Estimates for the use of Improved Drinking-Water Sources and Improved Sanitation Facilities. Source http://www.wssinfo.org/ Accessed 10.03.2012.

Yin, R. K. (1989). Case study research: design and methods. Newbury Park, CA: Sage.

4. ‘Integrity and corruption risks in Water Service Delivery in Kenya and Ghana’

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Chapter 4 contains a paper co-written by the author and submitted to the International Journal of Water Governance 09 Oct 2014. The paper explains how Kenya and Ghana began water sector reform aimed at increasing performance while reducing corruption. However, after reform, corruption still largely affected the water supply sector (TI Kenya, 2011; GII 2011), and as shown by the previous chapter, performance has remained low in certain locations of the service areas of the water utilities. The paper builds on the principal-agent theory to explore corruption risks in the case study locations. The methodology considers the transactions between principals and agents involved in WSD, identifying corruption risks where transparency, accountability and participation are weak (TAP integrity model). The TAP model is applied at the three WSD levels: policy and regulation; service provision; and water consumption, and points out corruption risks identified in the literature (Boehm, 2007). The paper concludes that at the policy and regulation level, regulatory opportunism risks exist in Kenya and Ghana. At the provision level, Kenya presents political opportunism risk, while Ghana shows state capture risk. At the consumer level, both countries show moral hazard and free-riding risks.

The methodology developed by the paper contributes to a better assessment of integrity in WSD while at the same time the TAP model identifies corruption risks in the collaboration between stakeholders.

Integrity and corruption risks in Water Service Delivery in Kenya and Ghana

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Abstract

This paper introduces a methodology to explore corruption risks in Water Service Delivery (WSD) which is applied in case studies of three water utilities in Kenya and one in Ghana. The methodology builds on a principal-agent framework in assessing the integrity of the relationships between the actors involved in WSD at three levels: policy and regulation, service provision and water consumption. Integrity of the relation between the actors is analyzed by a practitioners' approach to transparency, accountability and participation (TAP) in order to identify corruption risk. . The definitions used in this paper enhance the clarity of the methodology and facilitates actor involvement in the analysis. Case study results show that important corruption risks exist in WSD in Ghana and Kenya. These risks are presented in relation to corruption theory.

Key words: water service delivery, transparency accountability, participation, corruption risks

1. Introduction

Kenya and Ghana are two Sub-Saharan countries that went through a reform of institutions, organizations and governance starting in the 1990s. The main aim of the reform was to improve Water Service Delivery (WSD) performance by looking at institutions, organizations and governance of the sector (Batley, 2004; COWATER, 2008; Schwartz, 2008; WSP, 2007). The reform, which was supported by international agencies, development banks and other donors, did not address integrity or corruption issues. However, according to Repetto (1986), performance-oriented reforms such as regulation or private sector participation would by themselves reduce corruption and increase efficiencies of WSD. This seems not to be the case in the Kenyan and Ghanaian water sector as corruption has been reported at different levels of WSD (GII, 2011; TI Kenya, 2011). The reform did not achieve its objective to improve performance in WSD either, as, for example, particularly poorer sections in society in both countries still lack access to water (Bellaubi & Visscher, forthcoming).

Part of the problem of dealing with corruption relates to: differences in the definition of corruption (Kaufmann, 2005; Klitgaard, 1988; Wegerich, 2006); the complexity and sensitivity of measuring corruption (Andersson and Heywood, 2009) because it is socially complex and anthropologically grounded (Della Porta, 2005; Plummer and Cross, 2007; Rose-Ackerman, 1997; Theesfeld, 2001; Wade, 1982;); and the confrontational approach of some anti-corruption tools (Galtung, 2005).

The limitations in sector reform to address corruption in combination with its prominence are a clear invitation to learn more about the situation and have triggered the research question that is addressed in this paper: what is the integrity of urban WSD in Ghana and Kenya in relation to institutional governance mechanisms and what corruption risks exist?

Section Two of this paper presents the methodology and gives the rationale for the analysis of integrity in WSD, describing the method used in the research. Sections three and

four apply the methodology in different case studies in Kenya and Ghana describing the relationships between actors and the integrity of these relationships in terms of transparency, accountability and participation (TAP). This is done at three levels: policy and regulation, water provision, and water consumption. Section Five proposes an integrity-benchmarking framework and presents the advantages of this approach for water utilities, regulators and users. Section Six concludes by exploring the reasons for low integrity of the WSD in our case studies.

2. Methodology

This research looks at integrity defined for this research in terms of Transparency, Accountability and Participation (TAP) in the governance mechanisms (rules and institutions) of WSD, assuming that when TAP is weak or absent then corruption is more likely to occur (TI, 2009).

There are two main points that suggest that this integrity approach may be more successful than looking for corruption. Corruption is difficult to identify and measure (Galtung, 2005) and trying to improve the integrity situation seems less complex and far more productive in stopping future corruption by looking at the causes rather than the effects. Exploring integrity is a positive approach which facilitates working with stakeholders in order to improve the situation both in terms of identifying corruption risks and implementing tools to deter it. Furthermore, the case study approach that is used allows best practices to be identified.

Several experiences exist in assessing corruption risks and developing corruption risk mapping (Stålgren, 2006; Transparency International, 2010 and 2011; Warner et al., 2009). Transparency International (2010) defines corruption risks as practices that are the most likely to occur and have the greatest impact on governance. Transparency International (2011) considers that corruption risks decrease with integrity mechanisms in place.

In this paper the concept of corruption risk builds on the assessment of the integrity of governance mechanisms presented by Huppert and Wolff (2002, Huppert et al. (2001) and Huppert (2005) in the field of irrigation. These authors used the principal-agent model to explain corruption and rent-seeking. In the principal-agent model, the agent provides a service and the principal pays for it in return. This transaction is ruled by a governance mechanism (e.g. a contract or law). The possibility exists of information asymmetry between agents and principals where the agent (service provider) can take advantage in exploiting the principal (client of the service). Information asymmetry is manifested in "deficiencies related to contracts and agreements between the provider (agent) and the client of a service (principal)" (Huppert et al., 2001:143).

In the case of information asymmetry, principals may not have access to the information on the efforts made by the agent to provide the service and may face a situation where the agent claims that he cannot be held accountable for suboptimal service provision because of factors beyond his control. In this case, "the service provider and the client have an incomplete contractual relationship, which can lead to opportunistic behavior on the side of the service provider or the service receiver" (Huppert, 2005:7).

An important limitation of the principal-agent model proposed by Huppert is that it falls short of considering the asymmetry of information from the agent toward the principal. For example, the agent may not be aware of users manipulating water meters, where principals thus show a lack of accountability towards the agent. Another example is when water utilities (principals) do not follow quality standards provided by a regulatory body (agent). Besides,

both transparency and accountability relate to asymmetry of information, and as a result it is difficult to discern between transparency and accountability-related problems.

Another limitation is that the model does not consider the possibility that the agent and principal collude. Collusion can be defined as an agreement between parties to commit actions aimed to deceive or commit fraud with the objective of illicit financial gain (Transparency International, 2009). Examples of collusion in WSD include the agreed establishment of illegal connections by staff from the water company and users or a water company and a regulator jointly agreeing on a higher tariff than necessary and sharing the surplus that is being generated. One of the main elements in reducing the risk of collusion is independent oversight by third parties that can monitor the transactions between principals and agents.

To overcome these limitations we revisited the principal agent model as defined by Huppert (2005) as well as the definitions of transparency and accountability as presented in literature (Cavill and Sohail, 2006; TI, 2009; WIN, 2013). We decided to add the issue of participation to be able to address the issue of collusion. This approach allowed us to establish a clear transparency, accountability and participation (TAP) integrity model (Table 1) considering that these three components are playing a central role in supporting good governance (Bakker, 2003; Rieu-Clarke et al., 2008).

The TAP integrity model facilitates the analysis of the mechanisms (contracts, regulations etc.) that govern the relationships and the transactions in terms of services and returns (payments, fees, taxes, etc.) between the actors (agents and principals). It is important to note that WSD entails numerous relationships and actors may be the principal in one relation and agent in another.

Three levels of transparency, accountability and participation (TAP) are defined and are given a score to facilitate the analysis (Table 1). The assumption is that a low score implies that a higher risk of corruption exists and therewith the issue needs more attention and possibly remedial action. It means that corruption is more likely to occur, but not that it actually takes place.

Table 1 Integrity components, definitions and scores

Component	Definition	Score
Transparency (T)	Existence of clear written rules and regulations defining relationships between actors.	Low (0) = non existing; medium (1) = existing but unclear; high (2) = fully comprehensive.
Accountability (A)	Availability and application of control mechanisms for holding actors responsible for their actions based on the rules and regulations.	Low (0) = non existing; medium (1) = existing but not enforced; high (2) = enforced by applied sanctions, incentives or anticorruption measures.
Participation (P)	Accessibility of information to third parties with a possibility to influence rules and regulations.	Low (0) = no access to written information; medium (1) = access to written information; high (2) = parties able to redress failures in rules and control mechanisms.

The TAP integrity model was initially developed and tested by the authors in the scope of the '*Transparency and Integrity in Service Delivery in Africa program'* of Transparency International (TI) (Bellaubi and Visscher, 2010). The model was applied in different case studies in Kenya and Ghana taking into consideration all the actors intervening in the WSD for the selected part of the service area of the water utility. The TAP definitions used in this study were established after a broad review of definitions on transparency, accountability and participation (Bakker, 2003; De Asis et al., 2009; Huppert, 2005; TI, 2009). Particularly the definition of transparency differs from other definitions available in literature where it includes access to information whereas in the TAP model used in this paper, Transparency is

restricted to the clarity of rules, regulations and contracts governing the relationship between actors and information is taken into account in the dimension of participation. Moving information to Participation is a logical choice from a practitioner's perspective as third parties need access to information to be able to supervise transactions of the actors involved. The field tests that were conducted showed that participants easily grasped the definitions and were able to make a quick analysis of the integrity situation based on the scoring levels that were provided.

The following steps were used to apply the TAP model in the case studies:

1. **Selection of a case study area:** The case study locations were chosen to include the most representative water supply systems in each country serving medium-low economic vulnerable urban areas.

2. **Selection and preparation of the research team:** A team was set up in each of the countries to conduct the case studies. This team comprised members with experience in water companies, other water providers existing in the area, and users as well as members of NGOs active in the case studies location. The team received specific training in the application of the TAP integrity model.

3. **Data collection** (first visit to the case study location): For each case study the research team identified actors (users and other main actors such as senior staff of water utilities, other water providers, public officials etc.) involved in WSD and the type of interview technique that was to be used (Table 2). Information was then cross-checked with users, informal providers, community members and associations, staff from development agencies as well as NGOs and complemented with information from non-published reports and confidential information such as service management contracts, water utilities' strategic plans, technical and financial audits and internal reports of the regulator. Some of this information however could not be used because of non-disclosure clauses.

4. **Definition of actors, governance mechanisms and scoring:** The research team established the main actors and the governance mechanisms that are put on a flipchart. The actors (organizations, groups or individuals) are linked by a line with arrows symbolizing the services and returns (as a Venn diagram). Coordination mechanisms between two actors (i.e. the way in which the relationship is governed) are indicated for each of the relationships that are included in the diagram. An important point is that only observed direct relationships between actors involving a service and a return (legal or illegal) were represented in the diagram. Then for each of the relationships a TAP score was established, first individually by the research team members, and results were then discussed with a larger group of actors involved in WSD in the case study location collectively resulting in minor adjustments.

5. **Aggregation:** This step was conducted to get an overview at country level based on several case studies. The aggregation of different case studies was done by the research team eliminating those relations between actors that were only specific to a specific case study and keeping the ones which were common. For the latter the mean TAP scores were calculated for each relationship.

6. **Report writing:** The report writing was done while being in or close to the case study area to solve possible problems in case the team realized the information that had been recorded was incomplete or further clarification was required this can be easily solved.

7. **Validation of results** (second visit to the case study location): Findings were reported back to the main actors for confirmation of the integrity issues.

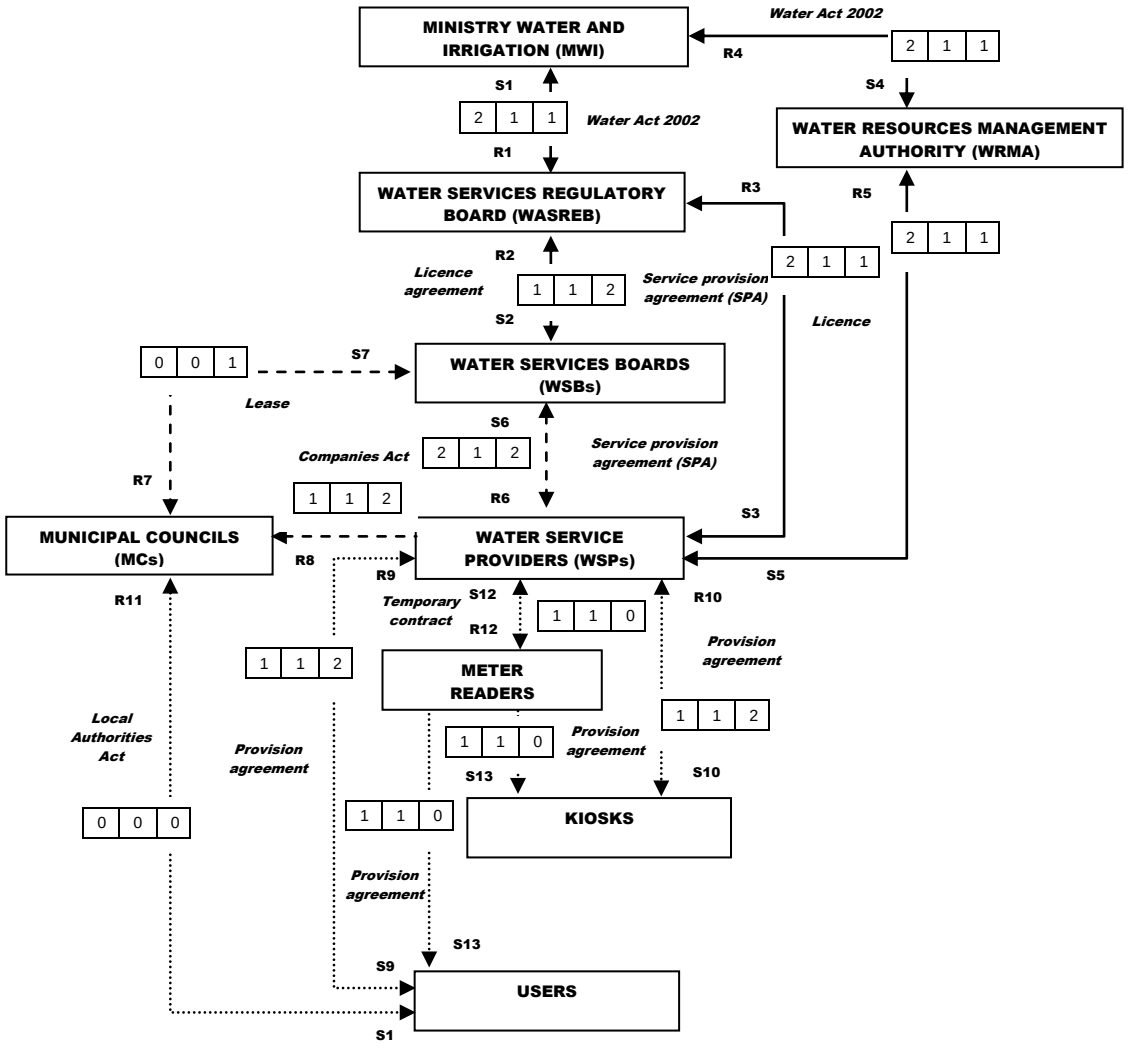
Table 2. Research methods

Methods	**Informants**	**Sample**
General information questionnaire (to get the basic data of the study area and make local arrangements)	Community leaders Possibly key actors from government / CSO that have been involved with the area	One group for each of the approximately 12 case studies
Village walk to look at the components of the systems	Key staff of the 'providers' and possibly users of the systems	A maximum of three main types of supply systems will be assessed in detail
Village map to get an overview of the situation	Community leaders	One group per community
Venn diagram to establish the different relationships that exist	Community leaders and water providers	Different maps may be developed per research area for each of the main providers
Water provider questionnaire	Management and leading technical staff of the provider	1 questionnaire per provider
Water committee questionnaire	Management and leading technical staff of the water committee	1 questionnaire per water committee
Water tanker questionnaire	Often the driver will be the main informant that will be available	Some two or three drivers (often these will be organized in an association)
Local water vendor questionnaire	Local water vendors mostly with fixed assets	Some two or three water vendors interviewed at different locations in the survey area
Household questionnaire	Preferably head of household	30 households in rural communities and 50 in urban
Checklist utility manager (to obtain management perception of the situation)	Utility manager of large utilities	Only for larger utilities which may be only some in each country
Checklist for leader of water tanker association	Leader of water tanker association	At least one, but a minimum of two if there are more associations in the area
Focus group discussions, to check study result and encourage action	Preferably combination of leaders, providers and users in the study area; subsequently more detailed sub group discussions can be arranged to establish more detailed action plans	One or more per research area depending on local situation

Sections 3 and 4 present the results of the integrity analysis in Kenya and Ghana respectively, looking at policy making and regulation, water provision, and consumption, as used by Krause (2009). For each level, TAP is discussed and related to corruption risk as suggested in literature (Boehm, 2007; Huppert and Wolff (2002).

3. Application of the transparency, accountability and participation (TAP) model in Kenya

This section presents the TAP integrity analysis applied in three case studies in Kenya: Mombasa Water Supply & Sanitation Co. Ltd (MOWASCO) in Mombasa; Kisumu Water and Sewerage Company Limited (KIWASCO) in Kisumu; and Nairobi City Water and Sewerage Company (NCWSC) in Nairobi. The specific relationships between the actors, services (S) and returns (R) and their governance mechanism and TAP scores are depicted in Figure 1.



S1	Regulation in water service provision (regulation of tariffs and approval of WSPs)	R1	Financial resources to implement MWI policies according to the Water Act 2002
S2	Licensing WSP and WSB to develop water and sanitation services. Tariff approval according to proposal submitted by WSBs	R2	WSB pays for the license fee (or arranges for direct payment by WSP to MC)
S3	Supervision of performance standards	R3	Levy (1% percentage of billing)
S4	Funding from MWI	R4	Water resource management through issuance of licenses on behalf of the ministry
S5	Protection of the water source against over-abstraction with issuance of water abstraction permits	R5	Payment of abstraction fees
S6	Management of service provision	R6	Profit (income - 4% monthly cost of administrative fee to operate the system - abstraction fee)
S7	Rights (leases) to use the piped system	R7	Lease fee (in the case of KIWASCO is paid by KIWASCO itself)
S8	No service	R8	Dividends (paid by KIWASCO to shareholders but only if company makes a profit)
S9	Water provision	R9	Monthly payment of water bills
S10	Water provision in bulk for reselling at a subsidized cost (pro-poor approach)	R10	Monthly payment of the special commercial tariff (lower)
S11	Users vote for political leaders according to promises of improving services	R11	Improvement of services
S12	Meter reading and billing	R12	Payment of wages
S13	Meter reading and billing on behalf of the provider	R13	No return

Figure 1 Overall TAP integrity analysis of WSD in Kenya (showing services (S) and returns (R), governance mechanisms between the actors, and TAP scores (in transparency, accountability, and participation order) for each relationship. Solid lines show relationships at policy making and regulation level, dashed lines are for provision level and dotted lines for consumption level.

3.1 Integrity analysis and corruption risk at policy and regulation level

Table 3 describes the TAP scores for each relationship at policy and regulation level. Transparency is high due to the fact that most of the relationships between actors are well defined in regulations such as the Water Act (2002). Main weaknesses that were identified include lack of clarity about tariff setting, establishment of water access criteria and water quality monitoring. Accountability presents lower scores because control mechanisms are in place for most of the relationships between actors but their application is unclear. Participation is shown to be the biggest challenge because information is not easily accessible and most transactions cannot be verified by independent third parties.

The low accountability between the Ministry of Water and Irrigation (MWI) and the Water Services Regulatory Board (WASREB) as well as between MWI and the Water Resources Management Authority (WRMA) may allow politicians to obtain private gains by abusing regulatory powers, which Boehm (2007) defines as regulatory opportunism. The two main reasons are that the Water Act 2002 divests the minister of regulatory powers but retains in him/her absolute appointment authority over WASREB and WRMA, and the financial dependence of these organizations on MWI.

Table 3 TAP scores for the relationships at policy making and regulation level

TAP	Score	Explanation
Relationship between the Water Services Regulatory Board (WASREB) and Ministry of Water and Irrigation (MWI)		
T	2	Relation between the MWI and regulatory body are well defined by the Water Act 2002.
A	1	WASREB is accountable through its BoD. It has an annual audit and publishes its annual report online. WASREB is not a fully independent body as its funding depends on the MWI and the Director is appointed directly by the MWI.
P	1	The information is accessible on the WASREB, MWI website, but cannot be rejected by third parties.
Relationship between WASREB and Water Service Boards (WSBs)		
T	1	License agreement form clearly stipulates the payment of their license fee but it is not clear how the tariff is set or the license is approved because a copy of the license was not available.
A	1	WASREB can reject the license with WSBs (Water Act, sections 68 & 69) but it is not clear how this sanction is enforced and how a WSB can operate without a license.
P	2	The information is written and available to third parties such as the MWI who can influence decisions.
Relationship between Water Service Providers (WSPs) and WASREB		
T	2	Described and documented in a service provision agreement (SPA).
A	1	The SPA spells out the rules of engagement between the WSPs and the regulator. This includes the type of information the WSP must furnish to the regulator (such as a Business plan, WSP profile) and also performance targets, penalties and incentives but sanctions are not clear if parties fail in their commitments.
P	1	Third parties can access information in reports published by WASREB about the providers, but it is not clear what happens when standards are not met.
Relationship between the Water Resources Management Authority (WRMA) and MWI		
T	2	Relation between the MWI and regulatory body are well defined by the Water Act 2002.
A	1	WRMA is accountable through its Board of Directors. WRMA is not a fully independent body as its funding depends on MWI. It is not clear how WRMA is accountable for received funds.
P	1	This information is accessible on the WASREB, MWI website, but cannot be questioned by third parties.
Relationship between WRMA* and WSPs		
T	2	Written rules are described and documented in the Water Act 2002.
A	1	The control mechanism is the bulk water meter; sanctions can be applied if WSPs do not pay the charges, but it is not clear what the sanctions are if parties fail in their commitments.
P	1	This information is accessible by WASREB, but it is not clear if it has influence if the parties fail in their commitments.

* In the case of Mombasa Water Supply & Sanitation Co. Ltd (MOWASCO) there is no relation with WRMA. Instead MOWASCO buys water in bulk from the WSBs who abstract the water.

3.2 Integrity analysis and corruption risk at provision level

Table 4 describes the TAP scores for each relationship at provision level. The scores show that transparency is low in the relationship between Municipal Councils (MCs) and Water Service Boards (WSBs) mainly due to the fact that transfer of assets from the MCs to the WSBs is not regulated, nor do protocols or procedures exist to transfer these assets. Accountability scores low for all the relationships. The main weaknesses that have been identified relate to control over payment for assets between MCs, WSBs and WSPs. Furthermore, MCs are the main chair holders of WSPs and are strongly represented on their Board of Directors, which entails an important influence on the management of the water utilities (e.g. appointment of the Managing Director). The low transparency and accountability in the relationships involving the MCs means that they have the possibility to abuse their power in influencing decisions of the water companies and WSBs for their own benefit. This situation is defined by Boehm (2007) as political opportunism.

Table 4 TAP scores for the relationships at provision level

TAP	score	Explanation
Relationship between Water Service Providers (WSPs) and Water Service Boards (WSBs)		
T	2	A model of a service provision agreement (SPA) is duly documented and available on the internet (in the case of Kisumu Water and Sewerage Company Ltd, the specific SPA was expired and not available).
A	1	Annual and financial reports are submitted to WSBs. Performance targets are spelt out in the contract involving sanctions. According to the Water Services Regulatory Board (WASREB) a grace period exists for WSPs to build their capacity, so it seems that performance failures do not result in sanctions. The fees are also spelt out but it is not clear if they are enforced.
P	2	Service provision agreement is available and authorized by the Water Services Regulatory Board (WASREB). WASREB has the possibility to address issues and suspend the SPA.
Relationship between MCs and WSBs		
T	0	According to the Water Act, assets should be transferred to WSB but this has not been done. The lease contract between the municipal councils (MCs) and WSBs were not available.
A	0	Not clear what control mechanisms exist as the lease contract was not available.
P	1	Payment for the lease is shown in the annual reports of WSPs but third parties seem to have no option to influence it.
Relationship between WSPs and MCs		
T	1	The conditions of the Companies Act are clear under Kenyan law, but it was not possible to check if the Company Act has been adapted according to the corporate governance guidelines made available by WASREB.
A	1	WSPs are accountable to the Board of Directors (BoD). MCs are the only shareholder but they have no direct control over WSPs. There are Annual General Assemblies where financial reports are presented to MCs, WSBs, WASREB and the Ministry of Water and Irrigation (MWI), but it is not clear what sanctions apply if WSPs do not provide the financial reports. In the same way, it was not possible to check if the corporate guidelines are fully implemented and how conflicts of interest amongst BoD members and MCs are avoided and users' interests represented.
P	2	Information available to third parties (MWI through WSBs).

3.3 Integrity analysis and corruption risk at consumption level

Table 5 specifies the TAP scores for each relationship at consumption level. Transparency is weak as most of the contracts involving the Water Service Providers are in their favor (water provider-sided) by only including sanctions for users but not for the company. The contracts also lack clarity in terms of procedures such as metering and available complaint mechanisms. Accountability is also weak because control mechanisms and sanctions are not applied in most of the relationships: users do not check up on meter readings, water providers are not sanctioned if they do not provide the stipulated service, and meter readers cannot "protect" the rights that they have from the water provider). In terms of participation, some of the reports are available to the public but mechanisms to redress problems are virtually absent, making real participation low.

Due to the fact that WSPs are publicly owned, users should have access to the governance mechanisms of the water company. Nevertheless, there are no mechanisms to reinforce this except for the very remote control through the Local Authority Act where the users as citizens vote for political leaders according to promises to improve services. Furthermore, promises made by the politicians are not written and there are no control mechanisms to verify that promises will be kept. As a result, transparency, accountably and participation between municipal councils and users are low.

With low transparency, accountability and participation, water utilities may benefit from their relationship with the users. This is known as moral hazard (Huppert and Wolff, 2002), which is the risk of insufficient service provision due to opportunistic behavior by the provider. One cause of this problem arises from water companies mainly inheriting staff from

local authorities where positions are kept based on patronage rather than the ability to perform a job (Mugo, 2010). Thus, water utilities do not have a business culture towards customer satisfaction and they are not client-oriented in spite of providing a public service. Another problem is that users may free-ride the service provided by the water utility by illegal connections manipulation of meters. Free-riding results from the difficulty to exclude non-payers (or "free riders") from receiving the same services as payers (Huppert et al., 2001). The main reason for free-riding is users claiming bad quality of the service received (rationing, smell and taste, pressure, high connection fees) from the Water Service Providers (WSPs).

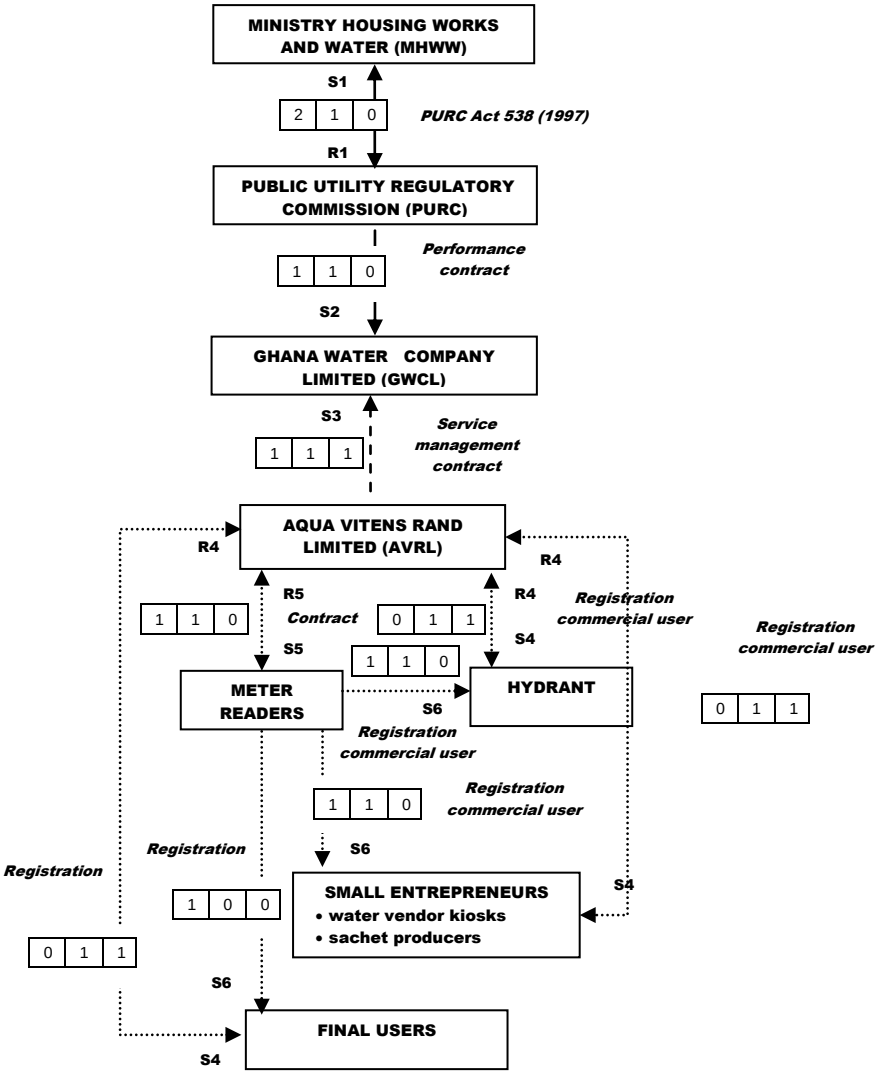
Table 5 TAP scores for the relationships at consumption level

TAP	score	Explanation
Relationship between Water Service Providers (WSPs) and users		
T	1	The consumers' agreement is not clear on measures to take when WSPs do not provide water or when the users are overcharged - a one-sided contract (in the case of MOWASCO the agreement is clear on measures to take when Mombasa Water Supply & Sanitation Co. Ltd (MOWASCO) does not provide water or when the users are overcharged, SPA clause 12 p. 33).
A	1	The control mechanism is "meter reading" and billing which can be enforced by users complaining; sanctions are applied to users but not to WSPs if they do not provide water as stipulated in the agreement form.
P	2	Billings are accessible to third parties (WASREB) that can redress the situation if billing is incorrect or if needed through court. However users are not necessarily aware of this mechanism and failures are not addressed.
Relationship between WSPs and water kiosks (water consumer agreement form).		
T	1	The agreement is not clear on measures to take when WSPs do not provide water or when the users are overcharged – a one-sided contract.
A	1	The control mechanism is "meter reading" and billing which can be enforced by users complaining; sanctions are applied to users but not to WSPs if they do not provide water as stipulated in the agreement form.
P	2	Billings are accessible to third parties (WASREB) that can redress the situation if billing is incorrect or if needed through court. However users are not necessarily aware of this mechanism and failures are not addressed.
Relationship between users and MCs*		
T	0	Electoral processes are defined by law but promises are not written down.
A	0	There is no control mechanism to verify that promises will be carried out.
P	0	There is no written information so third parties cannot verify it.
Relationship between WSPs and meter readers		
T	1	There is no clarity on contract duration or payment of wages (in the case of Kisumu Water and Sewerage Company Limited (KIWASCO) most of the meter readers are permanent staff with clear staff conditions).
A	1	Due to the existing control mechanism of supervision of meter readers, the mechanisms can be enforced (e.g. meter readers may be fired if they do not perform), but workers do not sign a code of conduct. Besides there are no incentives for the workers and they cannot enforce their labor rights.
P	0	Meter reading records are internally available but not to third parties.
Relationship between meter readers and users		
T	1	There is a written agreement between WSPs and users but the role of the meter reader is not clearly stipulated in the agreement.
A	1	Meter readers exist and are functional but users have no control over the meters. WSPs involve users in meter reading and the sign-off on the readings but only some of the users in the case studies indicated that they actually do so.
P	0	Third parties cannot access any information from the service provided by the meter reader (e.g. the meter reader's logbook).

*Due to the fact that the WSPs are publicly owned companies, users are concerned by the governance of the company. Nevertheless, there are no mechanisms to reinforce this except for the Local Authority Act where users will vote for political leaders according to promises to improve services.
A specific situation in the case of Nairobi City Water and Sewerage Company (NCWSC) is that of the landlords. These landlords provide water for domestic use from yard taps to the tenants as a fixed part of the rent and as a part of a verbal agreement in the rental contract.

4. Application of the transparency, accountability and participation (TAP) model in Ghana

This section presents the TAP integrity analysis applied in two case studies in Ghana exploring three levels: policy and regulation, service provision and water consumption. The specific relationships between the actors, services (S) and returns (R) as well as their governance mechanism and TAP scores are depicted in Figure 2.



S1	Regulation in service provision and reporting	R1	Financial resources to implement water polices
S2	Supervision of performance and tariff setting	R2	No return
S3	Operations and maintenance through a management contract and reporting	R3	No return by GWCL (payment of management fee is done by the WB)
S4	Provision of water	R4	Payment of water bills
S5	Payment of wages	R5	Meter reading
S6	Meter reading on behalf of the provider	R6	No return

Figure 2 Overall TAP integrity analysis of WSD in Ghana (showing services (S) and returns (R), governance mechanisms between the actors, and TAP scores (in transparency, accountability and participation order) for each relationship. Solid lines show relationships at policy making and regulation level, dashed lines are for provision level and dotted lines for consumption level.

4.1 Integrity analysis and corruption risk at policy and regulation level

Table 6 explains the TAP scores for each relationship at policy and regulation level. The transparency of the relationship between the Ministry of Housing Works and Water (MHWW) and the Public Utility Regulatory Commission (PURC) is clear through the PURC Act (1997) but less clear through the performance contract between the PURC and the Ghana Water Limited Company (GWLC) because the process for the setting of the tariff remains unclear. Accountability has low scores because control mechanisms are nonexistent or partially applied. Participation is nil because information is not accessible to third parties or not duly updated.

The fact that five out of nine of the PURC commissioners are government appointees may jeopardize the accountability between PURC and the Ministry of Housing Works and Water because the application of the control mechanisms can be one-sided. This is worsened by the fact that the relationship cannot be supervised by third parties. As in Kenya, Ghana shows a risk of regulatory opportunism, where politicians and bureaucrats may abuse regulatory powers to obtain personal or collective gains for their positions at the Ministry.

Table 6 TAP scores for the relationships at policy-making and regulation level

TAP	Score	Explanation
Relationship between the Ministry of Housing Works and Water (MHWW) and the Public Utility Regulatory Commission (PURC)		
T	2	The relation between the MHWW and PURC is well defined by the PURC Act (1997).
A	1	PURC is accountable to MHWW, but is not fully independent as its funding depends on MHWW and the director is appointed by the MHWW.
P	0	Information is not accessible to third parties.
Relationship between PURC and Ghana Water Co Ltd GWCL		
T	1	The rules of engagement in the regulatory framework and performance contract were not available during the research. Besides it was unclear how the tariff is set up.
A	1	Financial and technical audits are being carried out but with considerable delay and sanctions are not effectively enforced.
P	0	The information on the performance is not accessible to third parties. Some information is on the PURC website but this is very dated and therefore not really relevant.

4.2 Integrity analysis and corruption risk at provision level

Table 7 explains the TAP scores for each relationship at provision level. Transparency is low because of the service management contract between GWCL and Aqua Vitens Rand Limited (AVRL); only an unsigned template copy for a five-year contract was made available on the internet. Accountability is also low since it is not clear if the control mechanisms such as the performance targets stipulated in the management contract (e.g. non-revenue water – NRW-reduction) have been achieved because targets are not effectively monitored. Although access to information exists, participation is equally low due to the fact that there is no possibility to rectify or amend the contract. The existing weak transparency and accountability between AVRL and GWCL indicates a risk of state capture. According to Boehm (2007), that would imply that a water company is trying to take advantage of the unclear situation by shaping the design of the "rules" in their favor before they come into effect.

Table 7 TAP scores for the relationships at provision level

TAP	Score	Explanation
Relationship between Aqua Vitens Rand Ltd (AVRL) and Ghana Water Co Ltd (GWCL)*		
T	1	The management contract (unsigned copy) clearly stipulates the regulations and responsibilities of each party but at the time of the research only an unsigned copy was available on the internet.
A	1	Contract regulations are clearly stated and clear performance conditions exist to make the contract accountable but these are not effectively monitored and sanctions are not applied.
P	1	The contract template is available on the internet and PURC monitors the performance of the system based on the information provided by GWCL and discusses it in a meeting with GWCL and AVRL, but there are no third parties that can influence or amend the contract.

*In June 2006 AVRL won a competitive bid from the government of Ghana under a grant from the World Bank to manage 87 urban water systems on behalf of GWCL for 5 years. The sponsorship was for the Urban Water Development Program at a cost of $120 million. Under the terms of the contract, among other things, AVRL was required to manage the system including monthly revenue collection, improving the commercial operation of the water system, reducing the NRW, connecting new users and extending a reliable water supply especially to low-income areas. According to the draft contract AVRL had to submit a plan in the first year to reduce NRW by at least 5% per year and indicate how this could be measured and the capacity of the treatment plants could be maintained. The management contract also stipulated specific service standards, for which penalty reductions or incentive compensation apply including water quality and pressure. The operator was also expected to propose capital investments to GWCL each year (Uwejamomere, 2007).

4.3 Integrity analysis and corruption risk at consumption level

Table 8 specifies the TAP scores for each relationship at consumption level. Transparency scores are low due to the lack of a formal contract between AVRL and users. Also the role of the meter reader is not specified and therefore not formally known to the users. In terms of accountability, AVRL has a strict code of conduct but this is poorly implemented. Also the meters that serve as control mechanisms are largely malfunctioning. In terms of participation, the regulator is not overseeing what the follow-up is to users' complaints.

As in Kenya with low transparency, accountability and participation, there is also a risk in Ghana of moral hazard. Most of the AVRL staff have come from state organizations such as GWCL and have low motivation in spite of the efforts of AVRL to improve customer care services and training to the staff as well as implementing control mechanisms (e.g. meter readers have supervisors who cross-check readings every month and if 15% are found to be in error, staff are suspended without salary). The risk of free-riding is also present with users making illegal connections and manipulating meters.

Table 8 TAP scores for the relationships at user level

TAP	Score	Explanation
Relationship between AVRL and users*		
T	0	No contract exists with customers. There is only a registration form for the request of connection and monthly billing.
A	1	Control mechanisms are billing against a "meter reading" which can be enforced by users complaining and sanctions being applied, but there was no proof that sanctions are applied. Besides it seems that sanctions are not applied if Aqua Vitens Rand Ltd (AVRL) does not provide a service.
P	1	Complaints are channeled to the AVRL customer service department through a toll-free line and detailed complaints reports are provided to GWCL and PURC. Complaints can also be filed by consumers at PURC, but there is no evidence whether PURC follows them up.
Relationship between AVRL and meter readers		
T	1	A staff contract exists but the conditions of this contract could not be reviewed because the contract was not made available by AVRL.
A	1	AVRL supervises meter readers and has sanctions for false readings and all staff are signatory to codes of conduct, but sanctions are poorly applied. Meter readers have supervisors who cross-check readings every month.
P	0	Information seems to be reported internally every month, but it was not possible to obtain information whether this is available to third parties.
Relationship between meter readers and users		
T	1	The role of the meter readers is not stipulated in the registration between AVRL and the users.
A	0	Although meters exist many still have problems and do not register consumption. Also users have no control over the meter readers, do not sign off on the reading and may not know how to read the meter (in the case of water vendors and hydrants there are water meters but they may not be accurate).
P	0	Third parties cannot access information (e.g. meter readers logbook).

*In the case of the small entrepreneurs and hydrants this registration is a commercial registration form, with the only difference that AVRL sells the water more cheaply but the TAP scores remain the same.

5. Integrity benchmarking of water utilities in Kenya and Ghana

From the literature it seems that there is little experience of direct integrity benchmarking of water service delivery (WSD). Use of indirect indicators is mentioned for example by De Asis et al. (2009:65) who suggest that performance benchmarking indicators can be used as "red flags" or corruption warning signals. This includes indicators such as high levels of NRW and a high number of staff per 1000 connections that may show governance problems, especially if they are used to compare similar utilities in a country. Nevertheless, the use of these indicators can be ambiguous. The same authors mention that while high levels of unaccounted-for water are a warning signal, a low level of reported losses does not necessarily mean that there is no problem with corruption.

The TAP integrity model used in the previous sections allows the development of integrity benchmarks in WSD. This is done by establishing TAP scores at different WSD levels, then taking the sum of the components of each relationship and dividing this by the number of relationships at that level (Table 8). In this approach all relations are taken as having the same importance[9] in order to facilitate the comparison of situations which involve a different number of relationships. Table 9 gives a quick overview. Such an overview can be used to identify where the highest risks are and priority efforts are needed. It can also be used to compare different providers and may be a useful monitoring tool that can be quickly established in a participatory manner.

[9] To measure the "importance" of the relationships would require in-depth, causal analysis of the mechanisms at work which go beyond the scope of this paper.

Table 9 TAP scores in WSD levels in Kenya and Ghana case studies

Level	Component	Old Town (Kenya) MOWASCO	Migosi (Kenya) KIWASCO	Kangemi (Kenya) NCWSC	Madina-Nima (Ghana) AVRL
Policy and regulation	T	1.8	1.6	1.8	1.5
	A	1	1	1	1
	P	1.2	1.2	1.2	0
Provision	T	0.6	0.6	1.3	1
	A	0.3	0.6	1	1
	P	1.6	1.6	1.6	1
Consumption	T	1	1	0.7	0.5
	A	0.7	0.8	0.7	1
	P	0.5	0.6	0.5	0.4
TOTAL		1	1	1	0.8

At ***policy making and regulatory level***, transparency scores are fairly similar and relatively high for Kenya, particularly reflecting the result of the strengthening of water legislation. In the case of KIWASCO the score is somewhat lower because in this case the relationship with the Water Services Regulatory Board (WASREB) is not described in the Service Provision Agreement. In Ghana, the transparency score is slightly lower because of the unavailability of the performance contract between the Public Utility Regulatory Commission (PURC) and GWCL. Accountability is at the same medium level in both countries, but these bodies still lack sufficient autonomy and financial resources to comply with their task. Participation is slightly better in Kenya because the efforts of WASREB (the regulator) in making information available. It is very low in Ghana because access to information is almost zero.

At ***provision level*** transparency and accountability scores are low due to the fact that the municipal councils (MCs) and water service boards (WSBs) do not have any arrangements in place to regulate the lease of the assets. Also MCs interfere in the management of the water providers. Mombasa Water Supply & Sanitation Co. Ltd (MOWASCO) presents a lower accountability due to the fact that at the time of the research there was no board of directors. In contrast, the higher integrity scores of the Nairobi City Water and Sewerage Company (NCWSC) are due to the existence of a tripartite agreement that regulates the lease of the assets from the MCs to the WSBs as well as the fee paid to the MCs by NCWSC. In terms of participation, the Water Services Regulatory Board has a role in supervising the Service Provision Agreements.

In Ghana, the medium level scores of transparency for Aqua Vitens Rand Ltd (AVRL) stem from the fact that clear contracts or legal arrangements between several actors in the system seem to exist but could not be accessed or checked by the authors. In terms of accountability, control mechanisms are established between Ghana Water Co Ltd (GWCL) and AVRL but their application could not be verified. Participation scores low because the Public Utility Regulatory Commission (PURC) holds regular meetings with GWCL and the board of AVRL, but does not directly supervise or monitor.

At ***consumption level***, transparency scores are similar in Kenya because many of the agreements are well supported by legislation though contracts are one-sided. That is not the case in Ghana where only a registration form exists. In terms of accountability, sanctions are not applied, although AVRL has put in place broad measures to fight petty corruption and bribery from local staff transferred from GWCL, making accountability slightly better. Water utilities have put effort into improving customer care relations but access to information is not always easy, making participation low in all cases.

6. Conclusions

This paper looked at the integrity of WSD in three water utilities in Kenya and one in Ghana applying the transparency, accountability and participation (TAP) integrity model established for this research, pointing out a number of integrity weaknesses that result in corruption risks. There are three main contributions of this approach to the principal-agent theory helped by the redefinition of transparency and the addition of participation. The model is suitable to assess the integrity in water service delivery (WSD) in a participatory way even when a considerable number of actors are involved, although with more actors the analysis may require slightly more time. The model provides clear steps to analyze the complexity of the TAP in the relationships between actors involved in WSD. The approach proves suitable (TIl, 2009) for practitioners working in the field of water governance and anti-corruption, being used as a participatory method (e.g. validating and scoring TAP by different stakeholders) and stimulating dialogue which can also provide a basis for integrity improvements.

The second contribution is that the definitions of TAP as used in this paper are easy to understand by stakeholders, practitioners and the public in general as demonstrated in the TISDA project (TI, 2009) and proved very practical for the analysis of the integrity of actor relations in WSD. The experience of Transparency International Kenya (2011) in applying the TAP integrity model indicates that it could be used to develop agreements[10] between stakeholders to fight corruption and improve WSD because the approach also fosters attitudinal change. In this sense, the TAP model has not only been used as an assessment tool in order to identify risks of corruption due to weak TAP, but also as a learning and advocacy tool. Stakeholders involved in the analysis did not feel threatened as the process does not point to those involved in corruption. Recently, the Water Integrity Network has adopted and recognized the approach presented in this paper (Water Integrity Network, 2013).

Another possible application of the TAP model could be to use it for WSD integrity benchmarking as an element to enhance the integrity of the sector. Integrity benchmarking may have a big impact on customer care and service quality improvement i.e. water companies can improve their image thus increasing their trust amongst the users, and as a consequence users may be more willing to pay the bill or reduce their level of complaints, which in turn will increase the financial efficiency of the water company.

7. References

Andersson, S. and Heywood, P. (2009). The Politics of Perception: Use and Abuse of Transparency International's Approach to Measuring Corruption. Political Studies, Vol. 57, pp. 746–767.

Asis de, M. et al. (2009). Improving Transparency, Integrity and Accountability in the Water and Sanitation Sector, p. 177. World Bank Institute.

Bakker, K. (2003). Good Governance in Restructuring Water Supply: A Handbook, p. 44. Published jointly by Federation of Canadian Municipalities (FCM), and the Program on Water Issues (POWI) at the University of Toronto's Munk, accessed 02.02.2010. Source: www.powi.ca/pdfs/governance/goodgovernance.pdf

Batley R. (2004). The Politics of Service Delivery Reform. Development and Change 35 (1), pp. 31-56.

[10] This is the case with the development pact between MOWASCO and users at Old Town Mombasa under TISDA (2011): http://tisdakenya.wordpress.com/2011/05/23/the-mombasa-mou-pact-for-impact/

Bellaubi, F. and Visscher, J.T. (2010). Enhancing integrity to improve service delivery in water service supply provision. Pumps, Pipes and Promises: Costs, Finances and Accountability for Sustainable WASH Services, IRC Symposium. *Butterworth*, J. (Ed.). IRC, The Hague, p. 19. Accessed 15.05.2014. Source: http://www.irc.nl/page/55907

Bellaubi, F. and Visscher, J.T. (forthcoming). Water Service Delivery in Kenya and Ghana. An area-based assessment of water utility performance.

Boehm, F. (2007). Regulatory Capture Revisited – Lessons from Economics of Corruption Working Paper No. 22, p. 30. University of Passau. Accessed 23.01.2010. Source: http://www.icgg.org/corruption.research.html

Cavill, S. and Sohail, M. (2006). A note on research methodology for combating corruption. Accountability arrangement to combat corruption, p. 20. WEDC Loughborough University.

COWATER International Inc. (2008). African Development Bank Study on Water Sector Governance. Final Report, p. 288.

Della Porta, D. and Vannucci, A., (2005). "The governance mechanisms of corrupt transactions". In Lambsdorff J., and Taube, M. (Eds.), pp. 152-180, London, UK: Corrupt Transactions.

Galtung F. (2005). Measuring the Immeasurable: Boundaries and Functions of (Macro) Corruption Indices. In *Measuring Corruption*, Fredrik Galtung and Charles Sampford (Editors), Ashgate (UK).

Ghana Integrity Initiative GII (2011). Ghana's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Ghana. Accessed 30.07.2012. Source:http://www.tighana.org/giipages/publication/TISDA%20LAUNCH%20REPORT%202011.pdf

Huppert, W. (2005). Water Management in the 'Moral Hazard Trap', The Example of Irrigation. Paper presented at World Water Week 2005 in Stockholm, seminar on 'Corruption in the Water Sector: How to fight it?, p. 18. SIWI Stockholm. Accessed 23.01.2010. Source: http://www.swedishwaterhouse.se/opencms/en/cluster_groups/Completed_Cluster_Groups/Water_and_Anti-corruption_Netwrok.html

Huppert, W., Svendsen, M. and Vermillion, D. (2001). Governing Maintenance Provision in Irrigation. A Guide to Institutionally Viable Maintenance Strategies. Schriftenreihe der GTZ, No. 273, p. 193. GTZ Eschborn, Germany.

Huppert, W. and Wolff, B. (2002). Principal-agent problems in irrigation – inviting rent seeking and corruption. Quarterly Journal of International Agriculture, 41 (2002), No. 1/2, pp. 99-118.

Kaufmann, D. (2005). "Myths and Realities of Governance and Corruption". In Global Competitiveness Report 2005-06 (2005). MPRA Paper No. 8089, pp. 81-98, accessed 24.01.2010 http://mpra.ub.uni-muenchen.de/8089/

Krause, M. (2009). The political economy of water and sanitation, p. 252. New York: Routledge.

Klitgaard, R. (1998). "Controlling Corruption". Berkeley, CA: University of California Press.

Mugo, F. (2010). Managing Water and Sewerage Utilities amid Global Challenges: Experience of Nairobi City Water & Sewerage Company (NCWSC). Presentation at the CEOs' Forum at the 15th African Water Congress, Kampala, Uganda.

Plummer, J. and Cross, P. (2007). "Tackling Corruption in the Water and Sanitation Sector in Africa. Starting the Dialogue. In The Many Faces of Corruption Campos, J.E. Pradhan, S. (Eds.), Washington: World Bank.

Repetto, R. (1986). Skimming the water: rent-seeking and the performance of public irrigation systems. Research Report No. 4, p. 47. Washington, USA: World Resources Institute.

Rieu-Clarke, A., Allan A. and Magsig B.O. (2008). Assessing governance in the context of IWRM Strategy and methodology for improved IWRM - An integrated interdisciplinary assessment in four twinning river basins (STRIVER), Issue No. 8, p. 6. STRIVER policy brief.

Rose-Ackerman, S. (1997). "The political economy of corruption". In: Corruption and the Global Economy. Elliott, K.A. (Ed). Institute for international economics. Washington DC, EEUU, pp. 31-60. Accessed 23.01.201 www.iie.com/publications/chapters_preview/12/2iie2334.pdf

Stålgren, P. (2006). Corruption in the Water Sector: Causes, Consequences and Potential Reform. Swedish Water House Policy Brief Nr. 4, p. 24. SIWI.

Schwartz, K. (2008). The New Public Management: The future for reforms in the African water supply and sanitation sector? Utilities Policy 16, pp. 49-58.

Theesfeld, I. (2001). "Constraints for Collective Action in Bulgaria's Irrigation Sector". Central and Eastern European Sustainable Agriculture (CEESA) Discussion Paper No.5 2001, p. 28. Accessed 25.01.2010 http://ageconsearch.umn.edu/handle/18891

Transparency International (2009). The Anti-Corruption Plain Language Guide, p. 60. Transparency International.

Transparency International (2010). Analysis of corruption in the forestry sector p. 101. Forestry Governance Integrity Programme. Transparency International.

Transparency International (2011). Analisis y tratamiento de los riesgos de integridad en programas de transferencia condicionada guía de implementación. Transparency International and Zigla Consultores, p. 44.

TI Kenya (2011). Kenya's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Kenya. Transparency International Kenya. Accessed 07.12.2011. Source: http://www.tikenya.org/~tikenyao/index.php?option=com_docman&task=cat_view&gid=115&limitstart=5

Uwejamomere T. (2007). Ghana, civil society organization involvement in urban water sector reform, p. 11. WaterAid case study.

Wade, R. (1982). "The System of Administrative and Political Corruption: Canal Irrigation in South India", Journal of Development Studies, 18, 2 (1982), pp. 287-327.

Warner, J., Butterworth, J., Wegerich, K., Mora Vallejo, A., Martinez, G., Gouet, C. and Visscher, J.T. (2009). Corruption. Risks in Water Licensing with Case Studies from Chile and Kazakhstan. Swedish Water House Report 27, p. 30. SIWI.

Water Integrity Network (2013). User's Guide on Assessing Water Governance, p. 100. UNPD. Accessed on 28.09.2014. Source: http://www.watergovernance.org/documents/WGF/Reports/20058-UNDP-Assessing-water_web.pdf

Water and Sanitation Program (2007). Water Utilities in Africa: Case Studies of Transformation and Market Access (July 2007, revised 2009). Water and Sanitation Program (WSP) and Public-Private Infrastructure Advisory Facility (PPIAF), p. 100.

Wegerich, K. (2006). "Illicit' water: un-accounted, but paid for: Observations on rent-seeking as causes of drainage floods in the lower Amu Darya". Research School for Resource Studies for Development Research. Seminar "News from the Water Front: Alternative views on Water Reform". 8.10.2006. Wageningen University, The Netherlands, p. 14. Accessed 23.01.2010. www.ceres.wur.nl/seminars/2006_Wegerich_illicit_water.pdf

World Bank (2005). Management Contract for Urban Water. Accessed 29.04.2011. Source: http://siteresources.worldbank.org/INFOSHOP1/Resources/managementcontract.pdf

5. ‘Management practices and corruption risks in Water Service Delivery in Kenya and Ghana’

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Chapter 5 contains a submitted paper, co-written by the author, which revisits the concept of water control and management in the context of water sector reform in Kenya and Ghana. Reform has brought considerable changes and a shift in power among actors at policy and regulation, provision and consumption WSD levels. In its turn, change in institutions and organizations has resulted in a specific WSD governance model for each country. Considering the principal-agent analysis of the previous chapter, the paper shows how the balance of power between principals and agents for each of the identified corruption risks characterize different water control situations that may relate to management practices as described in the literature.

The paper concludes that corruption risks in policy and regulation in Kenya and Ghana are characterized by opportunistic management with a clear power imbalance between water ministries and regulators. At the provision level, the situation differs between the two countries. The situation in Kenya is characterised by an opportunistic management where municipalities hold the power in relation to the water providers (water corporations). In Ghana, where a balanced distribution of power between the water operator and the water agency exists, management is pragmatic. Corruption risks at the consumption level in both countries, where is a power balance between providers and users, are characterized by pragmatic management. Furthermore, opportunistic management seems related to ‘reform capture’: actors who have lost power in the reform will try to capture the reform in their own interest (Boehm, 2007).

Management practices and corruption risks in Water Service Delivery in Kenya and Ghana

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Abstract

This paper looks at water control in the context of corruption risks in Kenyan and Ghanaian Water Service Delivery (WSD). Water sector reform has brought considerable changes in organizations and institutions in these two countries that have resulted in different governance models in each of them. The changes have also brought a shift in the balance of power between the different actors involved in WSD. The paper analyses each governance model in terms of the power distribution between principals and agents in relation to identified corruption risks at policy and regulation, provision and consumption WSD levels. The results identify different water control situations that are compared to management practices described in literature. Furthermore, the opportunistic management identified seems to be related to reform: when changes take place, the actors involved in WSD will compete for water control-capturing reform.

Keywords: water reform, water control, corruption risks, management practices, governance models

1. Introduction

Corruption has been pointed out as one of the main challenges in the governance of the water sector as jeopardizing access to the service for large parts of the population in sub-Saharan countries (Trop and Stålgren, 2005). According to rent-seeking theory, rents are captured, affecting the efficiency of water utilities; reform in the public water sector has been seen as a solution, in order to introduce competitive pressure to increase performance whilst reducing corruption (Repetto, 1986; Rinaudo, 2002).

However, the examples of Kenya and Ghana show that low performance has remained low in certain locations of the service area of the water utilities and corruption is pervasive in spite of the reforms carried out in the 1990s. TI Kenya (2011) and GII (2011) showed that important deficiencies exist in urban water systems. Non-Revenue Water (NRW) is considerable and in several cases above 50% and severe rationing is the norm in many systems. Illegal connections are also a problem in many systems. In its turn the implementation of new rules and regulations resulting from the water sector reform in Kenya and Ghana has brought a number of challenges in terms of integrity. TI Kenya (2011) and GII (2011) identified a number of corruption risks at different levels of Water Service Delivery (WSD) in these two countries. For instance, at the policy and regulation level, the appointing of high-ranking staff to regulatory bodies by ministries in Kenya and Ghana was identified as a regulatory capture risk. At the provision level, the municipal councils in Kenya participated directly in the daily management of the water utilities by appointing members of the Board of Directors, raising conflicts of interest and highlighting the risk of political opportunism. In turn, state capture risk was identified in Ghana because the service management contract between the national water agency and the contracted operator lacked monitoring, which could give the operator an opportunity to act in its own interest. In terms of consumption, the user's role was very limited in both countries with little access to information and not being involved at the decision level (e.g. discussing or setting up tariffs or subsidies). The service offered by the water utilities was not properly monitored with the subsequent risk of moral hazard. Meanwhile the users could free-ride the service looking for better access.

The World Bank (2008) acknowledges that stakeholders' interests and the power relations between social actors obviously influence their support or opposition to reform (WB, 2008). If the actors that are gaining from the 'status quo' are powerful, change is unlikely to occur if it brings less power to this group of actors. The 'status quo' and with it the privileges of certain groups therefore tend to perpetuate over time or result and further benefit those with power (the 'Iron Law of Oligarchy', see also the argument in Acemoglu and Robinson, 2012). In this sense, some scholars (Batley, 2004; Laffont, 2005; Shirley, 2000) argue that changes of reform will be only 'successful' if the elites are 'compensated' for the former benefits. Rampa (2011) showed how profit-led private decisions by the political elite during the reform process in Kenya aimed to defend their status quo. The interesting point is that the exercise of power manifested through control (Narain, 2003), relates to management defined as 'the process of dealing with or controlling things or people' (Oxford English Dictionary).

Indeed management practices seem to have an important role in the understanding of why performance of water service providers (WSP) remains low in spite of the sector reform. Auriol and Blanc (2009) analyse the problem of corruption and capture of public water utilities in sub-Saharan Africa. In this seminal paper, Auriol points out that water utilities run by private-public partnerships are not optimally managed either because private managers and government are incompetent or not benevolent. The fact is that the wealthiest areas of the cities have been taking over by public-private partnerships improving the quality of WSD. On the other hand, the poorest sections of the population are served by private providers (water tankers, vendors) at higher prices per value of water than the better-off areas. The contradiction remains in the fact that meanwhile the high-class areas should be served at higher prices to extract rents subsiding the poor class, and that prices and new investment are subsidized in the wealthy neighbourhoods.

Another example of how management affects low WSD performance is provided by the NRW indicator (NRW can be considered as one of the main elements expressing the performance of water service provision and constitutes one key aspect in water demand management[11]). Meanwhile in developing countries municipal water utilities report high losses from false meter readings and unauthorized connections related to a major managerial problem, and this does not take into consideration that NRW (especially the physical losses) is unaccounted for but paid for by users and credited loans and grants through service management contracts, leases and other delegated management forms including the private sector. In that way, the 'apparent' lack of operational management (Operations & Maintenance) can relate to an intentional mismanagement (e.g. for an eventual weighty and growing 'water black market' through informal providers). Therefore, water loss management (Kayaga and Smout, 2007) and by extension low management efficiency can tend to be an open door for opportunistic behaviour.

The concept of mismanagement understood as poor or bad management is a broad concept that needs to be further developed. Mismanagement can be due to lack of technical knowledge and capacities or in order to decrease work overload[12], rather than a more effective management. Nevertheless, mismanagement can be intentionally led by 'opportunistic behaviour' for self-benefit, occurring in

[11] NRW losses in the systems can be physical or real losses as a result of leakages, or commercial such as illegal connections and falsified meter readings, unbilled authorized consumption such as free public standpipes, and water used for fire-fighting or other utility operational uses.

[12] Managerial efficiency is well documented by Molle and Berkoff (2008) and Bellaubi (2004) in irrigation systems but the concept can also be applied to water supply systems. Managerial efficiency is based on two broad types of management response: pragmatic management (based on the concept of comfort margin and minimum overload) and volumetric management (based on the concept of physical efficiency and economic optimum). This classification is based on the following field experience. In water systems with an abundant relative water supply (RWS) relation between water delivered and targeted demand after discarded losses of the system, the water available in the system is sufficient to meet demand in most circumstances and the risk of water shortage is very low. In such environments, real supply is not established based on water needs but, rather, on discharges that incorporate a 'comfort margin' or a 'local optimum' that minimizes both management and the user's complaints. Nevertheless, the equity in the water allocation remains low amongst users (the famous top-tail enders problem in irrigation systems). Further literature can be found in Wegerich (2006).

corruption. Indeed, managers and technicians can follow 'pragmatic' management (Molle and Berkoff, 2008) because it is less costly and involves less workload, so they do not have any interest in a more efficient management. However, this mismanagement can also be intentionally driven in order to seek rents from new maintenance programs and new investments. This situation benefits both the formal and informal water sectors, politicians and bureaucrats involved in water sector reform and private-public partnerships (PSP).

The described situation is documented by Huppert and Urban (2000, p. 74): *'a suboptimal service may be provided due to external influences, even though the provider makes all efforts needed to fulfill the client's expectations. However, failures in service provision may also be due to opportunistic behaviour of the provider who may reduce his efforts of service provision and use the relationship to further other 'private', often remunerative, interests'.* Huppert and Wolff (2002, p. 1) also wrote: *'efficiency deficits may be well in the interest of most of the influential stakeholders involved.'* In the case of Kenya this situation was well reported by TI Kenya (2009) in their 'Water Governance Study Report, 2009': '*the technicians create artificial water shortages and get payments to release water to particular areas…*'.

Because mismanagement may lead to corruption it is not possible to establish a simple relation between corruption and performance according to the rent-seeking theory and this relation needs to be revisited. In this paper, we are interested in learning more about the relation between corruption and management practices based on the analysis of three case studies in Kenya and two in Ghana conducted by Bellaubi and Visscher (2014), and the following research question is posed: What are the management practices and their relation with existing corruption risks at the WSD levels in the scope of the governance model resulting from reform in Kenya and Ghana?

Since the field research was conducted, further change has taken place that implies that our analysis here may not reflect the up-to-date situation of water service delivery in Kenya and Ghana. The analysis nevertheless does illustrate how water control and management concepts can be applied when analysing the governance of the water sector, which is our main objective here. The paper is organized as follows. Section 2 presents the research methodology. Section 3 presents the regulatory, organizational and governance outcomes of reform in Kenya and Ghana, identifying the governance model in each country. Section 4 analyses the power distribution in the relationships between the actors involved at the different levels of WSD for each governance model. The results are presented in relation to corruption risks, proposing (or suggesting) different management practices based on existing definitions. Section 5 concludes by providing an explanation for WSD management practices in Kenya and Ghana as the result of reform.

2. Methodology

This section reviews the concept of water control as exertion of power. Water control defines management practices according to Bolding, Mollinga and Van Straaten (1995); however the methodology suggests that aspects such as the transparency, accountability and participation of the governance mechanisms that rules an actor's relationships need to be considered. The present research takes into consideration the concepts of corruption risk and water control to complete management practice definitions used in literature but according to the criteria of the authors considered insufficient to reflect on the empirical observations found in the three case studies in Kenya and two in Ghana carried out by Bellaubi and Visscher (2014).

2.1 Revisiting the water control concept

The reform in Kenya and Ghana set up a new governance model as a result of changes in institutions, organisations and processes (Bakker, 2007). The concept of governance that involves the exercise of authority to administer power for the benefit of a group through a decision-making process aiming to reach an objective (Bakker, 2007) implicitly acknowledges that these changes defining new governance models involved a shift of power distribution among the actors in the reform process.

However it is important to distinguish governance from management. Whilst governance models may define management practices, governance refers to the decision-making process, whereas management is the operationalization of it (Nowlan and Bakker, 2010). Governance is constituted by a number of of rules, norms… that 'regulate' or define the actor relationships in who does what, and how they do it[13]. Bellaubi and Visscher (2010) characterize governance mechanisms in terms of transparency, accountability and participation (TAP) defining corruption risks. Management refers to the political process of control as exercise of power (Narain, 2003). The exercise of power through autonomy and dependence relationships by the authority entitled to it may pursue the benefit of a specific group ('performing power')[14]. However in some cases the administration of power may be dysfunctional, and power (ab)used by those 'entrusted' with it for self-benefitting purposes, matching the definition of corruption (TI, 2009) and where power asymmetries determine the actors who can exploit their advantage to their own benefit (Cascão and Zeitoun, 2010).

Literature offers some examples of management practices and different scholars refer to water control and power to define different management practices. Batley (2004) and Huppert and Wolff (2002) present the concept of opportunistic management. Under opportunistic management the provider of a service will tend to use their 'power' to divert benefits in their own direction. In turn, Molle and Berkoff (2007) introduced the concept of pragmatic management and volumetric management in relation to different degrees of water control in water allocation. Although these categories of management refer mainly to organisational aspects where the concept of management is used in the narrow sense, water management is often used in a broader sense of referring to the whole process of 'water control' (Bolding et al., 1995) in its different dimensions: (1) technical, (2) organizational and (3) socio-economic and political. Technical control is exercised through the operation of physical artefacts. Organizational control refers to organizing and co-coordinating a set of activities among people. Socio-economic and political control relate to the regulation of processes and labour.

In order to answer the research question posed in this research the authors used three case studies in Kenya and two in Ghana presented in detail in Bellaubi and Visscher (2014). These case studies represent specific water situations in terms of quality of the WSD at different country locations within the service area of a water utility[15]. Bellaubi and Visscher (2014) showed that the quality of the WSD in the case study locations was low. Furthermore, the authors looked at existing corruption risks between the actors involved in WSD in the case study locations using a principal-agent framework (Bellaubi and Visscher, 2010). The principal-agent framework is defined as a principal who demands a service and the agent who provides it. The relationship between principals and agents can be defined as a transaction ruled by governance mechanisms that are characterized by levels of Transparency, Accountability and Participation (TAP). Corruption risks are defined within this framework as principal-agent relations with low TAP levels.

In order to investigate the relation between management practices and corruption risks, the paper looks at the corruption risks identified at the three levels of WSD and analyses the balance of power

[13] 'who gets water, when, how, where and why' (http://watergovernance.org/governance/what-is-water-governance/).

[14] The concept of power is used in an absolute sense and in a relative sense. In an absolute sense, it refers to a transformative capacity to achieve certain goals and purposes. In a relative sense, power is seen as exercised through regularized relations of autonomy and dependence (Giddens 1984, from Narain, 2003). In the scope of this paper, power is regarded as compensatory power (Galbraith, 1983).

[15] The case studies were conducted as a part of Transparency International's *Transparency and Integrity in Service Delivery in Africa program*.

asymmetry of power between the principals and agents to characterize water control, in a similar way to Batley (2004). The paper identifies the three levels of WSD, where corruption may take place with the three dimensions of water control (Bolding et al., 1995). The socio-economic and political control dimension relates to the regulation of water services, involving policy makers and regulators respectively (policy and regulation level). The organizational control refers to the organization of the water providers in terms of who operates and owns the infrastructure (provision level). The technical control implies the daily operating and maintaining of physical processes involving water providers and the users as receptors of the services (consumption level). As a result, the power analysis between agents and principals will also follow these three levels.

The analysis aims to show if different levels of TAP expressing corruption risks and balance of power between principals and agents may characterize certain forms of water control or management practices in the three levels of WSD. The analysis is carried out in the scope of the reform in Kenya and Ghana, because the reform has brought about changes in institutions, organizations and governance in the three WSD levels. These changes define governance models (Bakker, 2007) under which a shift in the balance of power balance among the actors has taken place.

3. WSD governance models in Kenya and Ghana

This section looks at the main objectives and outcomes of the reform in terms of institutions and organizations in Kenya and Ghana that define a specific governance model in WSD for each country (Bakker, 2007). The section is organized presenting the reform changes at the three levels: policy and regulation, provision and consumption.

3.1 Reform outcomes at policy and regulatory level

Before the reform, the Kenyan water sector was ruled by the Water Act Chapter 372, 1962. Ombogo (2009) points out the overlapping roles and responsibilities of key public actors in the sector, which were, in his view, the main causes of conflicts and poor services. The reform in Kenya was shaped by the National Water Policy 1999 and the Water Act 2002, encompassing both urban and rural water supply. The development of the National Water Policy was largely funded and supported by international donors such as GTZ, SIDA and the World Bank (Mumma, 2007).

The Water Act 2002 separated water resource management from water and sewage services and provided regulation through the creation of the Water Services Regulatory Board (WASREB). WASREB is a non-commercial State Corporation established in March 2003 (WASREB, 2014). WASREB's main role is to approve the licenses of the Water Service Providers (WSPs) that operate and maintain the water systems and to develop guidelines for fixing tariffs for the provision of water services. WASREB also carries out performance benchmarking amongst the WSPs and follows up customer complaints (WASREB, 2014)

The reform in Ghana was initiated in the early 1990s with the Water Sector Restructuring Project (WSRP) to increase the water sector performance. The WSRP was supported and funded mainly by the World Bank amongst other international donors and agencies (the Austrian and Italian governments, Nordic Development Fund, African Development Bank, CIDA, DFID, KfW, GTZ, OECF, ECGD and CFD/ADF (GWCL, 2014). Ghana approved its National Water Policy in 2007, which incorporates the Water Resources Policy of 2002 (GII, 2011).

The main outcomes were the creation of the Water Resources Commission (WRC) to be in charge of overall regulation and management of water resources utilization, the Public Utilities Regulatory Commission (PURC) established with the purpose of setting tariffs and quality standards for the operation of public utilities, and the Community Water and Sanitation Agency (CWSA) being responsible for management of rural water supply systems (GWCL, 2014).

3.2 Reform outcomes at provision level

Previous to reform, water supply and sanitation services in Kenya were provided by the municipal department. The National Water Conservation and Pipeline Corporation (NWCPC), a State Corporation established in 1988, was in charge of developing water schemes in large municipalities serving urban centres (NWCPC, 2014), being the infrastructure owned by the local governments (municipalities).

The Water Act 2002 made a distinction between the asset holding and development responsibility of a Water Service Board (WSBs), and the operations and management responsibility of a Water Service Provider (WSP) (Ombogo, 2009). Under the new model WSBs contract WSPs which are to provide the services subject to approval by WASREB, which is granted or rejected on the basis of the request for a 5-year renewable water licence submitted by WSBs to WASREB for a specific WSP. In most cases these WSPs are companies owned by municipalities that were established by transforming their technical department into a private company. Therefore, WSPs are corporate public utilities with a licence, given by WASREB and obtained through the WSBs, to provide water and sewerage services within their areas of operation and collect tariffs as specified in their respective Service Provision Agreement (SPA).

The Ghana Water and Sewerage Corporation (GWSC) was established in 1965 to be responsible for water supply and sanitation in rural as well as urban areas. As a result of the reform, the Ghana Water Company Limited (GWCL) was established in 1999 to replace the GWSC. GWCL is a state-owned limited liability company with the responsibility for urban water supply and is regulated by PURC (GWLC, 2014). In 2006, GWCL changed its operations and signed a five-year contract with Aqua Vitens Rand Limited (AVRL) to operate 81 water supply systems on their behalf. This has led to changes in the organizational structure and roles of GWCL.

AVRL was a Dutch-South African private joint venture company combining Vitens Evides International (Netherlands) and Rand Water Services (South Africa), which won an international tender that was issued by the GWCL. Specific responsibilities of AVRL included production, distribution, customer billing, collection of revenue and maintenance of the systems (Barendrecht and Nisse, 2011). In turn, GWCL was in charge of monitoring the performance of AVRL, which operated the systems and undertook routine maintenance. GWCL was directly responsible for the planning, development construction, rehabilitation and extension of new systems and remained the legal owner of all the assets of the company (GII, 2011). The management contract was discontinued in 2011 as the expected results were not achieved by AVRL (Shang-Quartey, 2013).

3.3 Reform outcomes at consumption level

Kenyan and Ghanaian water sector reform involved commercialization measures. Commercialization defines water as an economic good rather than a public good, and redefines users as individual customers rather than a collective of citizens. Commercialization involves the introduction of commercial principles such as water pricing in order to meet full cost recovery in water supply (Bakker, 2007).

The Kenyan Water Act 2002 recognizes water as an economic and social good, meaning the adoption of sustainable tariff strategies and the overall policy states that users pay tariffs which, in the case of urban supplies, meet operation and maintenance costs as well as repayment of investment. The immediate objective of a tariff is to cover Operation and Maintenance costs while at the same time guaranteeing performance improvements. Tariff adjustments consider the ability to pay, especially of the poor population. As a second step, the objective was to move towards full cost recovery in order to ensure long-term sustainability (TI Kenya, 2011).

In turn, in Ghana the National Water Policy 2007 is anchored in the Growth and Poverty Reduction Strategy of the Government that stipulates the right of everyone to basic social services such as healthcare, safe drinking water, sanitation and the protection of the rights of vulnerable members of society. In Ghana, the overall policy states that users pay tariffs, which in the case of urban supplies are used to meet operation and maintenance costs as well as the repayment of investment costs. Prompt payment of tariffs is encouraged through provision of incentives and disincentives (charging interest on delayed payments by large consumers, pre-paid metering etc.). The tariff structure is based on progressive pricing, allowing cross-subsidies from large users and helping to discourage excessive water consumption (GII, 2011).

Another important output resulting from reform was the role played by consumers either as user-citizens or user-customers where each role implies different rights, responsibilities and enforcing accountability mechanisms. In Kenya with corporate providers owned by the municipalities, the consumer becomes a user-citizen with the possibility to use the political process via elections as an accountability mechanism for better services[16]. In Ghana, the involvement of a private operator limits the role of the consumer to user-customer, litigation being the main accountability mechanism.

Participation of consumers was also an element of reform both in Kenya and Ghana. Providers have put in place a number of measures to improve the feedback and information given to the consumers. Consumer care services have been set up in order to manage complaints, speed up connections etc., but users know very little about their rights and even less about their obligations. Besides, most of the decisions related to the service provided remain unknown to the users and responsible public participation in decision-making is non-existent (GII, 2011; TI Kenya, 2011).

3.4 Governance models in Kenya and Ghana

In both countries the objective of reform was to increase the performance of water service delivery. To achieve this objective both countries have carried out a number of changes at different levels. From an institutional perspective Ghana and Kenya have developed regulatory frameworks. Also both countries have adopted commercialisation measures, looking for full cost recovery. However, at organisational level the reform in Kenya has shifted from local government water departments to publicly owned corporations under company laws, introducing corporate structures similar to market-oriented enterprises, known as New Public Management (NPM) (Schwartz, 2008). Ghana has developed Private Sector Participation (PSP) through outsourcing contracts. This difference has had further implications in terms of participation. In Kenya, because the water companies remained public, the users' role as citizens was supposed to devolve and give them a higher degree of participation. In Ghana, users remained as simple consumers. Following Bakker's governance model framework (2007), Kenya followed a public governance model with clear characteristics of NPM, while Ghana evolved to a private governance model. Table 1 summarizes the reforms carried out in Kenya and Ghana (Table 1).

[16] The TISDA Project (TI Kenya, 2011) showed that in the context of poor water service delivery, user-consumers rely on political electoral promises in order to improve the basic services such as water, education and health and political leaders are held accountable in the polls. However results may not reflect that the citizens can be manipulated or that broad sectors of the electorate can be 'bribed' by developing certain projects in their areas.

Table 1. Main aspects of reform in Kenya and Ghana

WSD levels	Country	Target of reform	Type of reform
Policy-making and regulation	Kenya	Regulatory framework	Decentralization. Creation of a regulatory body (WASREB)
	Ghana		Decentralization. Creation of a regulatory body (PURC)
Provision	Kenya	Asset management	Corporatization. Conversion of municipal water service departments into a public owned corporation (WSPs)
	Ghana	Organization structure	Private sector participation through a service management contract (AVRL)
Consumption	Kenya	Performance incentives	Commercialization. Introduction of commercial principles (full cost recovery)
	Ghana		
	Kenya	User's participation	User as a citizen (voting via elections)
	Ghana		User as a consumer (consumer opinion)

4. Power analysis in Kenya and Ghana WSD

In this section we analyse the power balance between agents and principals at the three levels of water service delivery for each of the corruption risks identified by Bellaubi and Visscher (forthcoming). Indicators to evaluate the main reform outcomes have been chosen to assess the resulting power balance between principals and agents.

4.1 Analysis of power distribution

At policy and regulatory level the identified agent and principal were the regulator and the policy makers respectively. Regulators were in charge of supervising and monitoring to ensure that water services were provided in an efficient, fair, and sustainable manner, while bearing in mind the social priorities set out by the policy makers (both at national and local government levels) (Trémolet and Hunt, 2006). Policy makers provided the regulator with financial support.

Reforms tackling policy and regulation looked at the delegation and separation of policy from regulation. Therefore the capacity of water control by policy makers is characterized by the degree of delegation manifested in the creation of new organisational structures and separation of powers in resource allocation and management. In other words, it is expected that the capacity of policy makers' control will be less after the delegation and separation of policy making and regulation has taken place.

In Kenya, delegation has meant the creation of WSBs to be in charge of providing water to their areas of jurisdiction. Meanwhile, in Ghana GWSC was converted into a 100% state-owned limited liability GWCL with the responsibility for only urban water supply (GWCL, 2014).

At first glance, the water ministries in Kenya (MWI) and Ghana (MHWW) have lost power to the newly created regulatory bodies. However, the ministries have kept control by appointing the members of these regulatory bodies. This situation with low accountability between water ministries and regulators, where the politicians may obtain private gains by abusing regulatory powers, has been identified as regulatory opportunism (Boehm, 2007) in terms of corruption risk.

At provision level in Kenya, the municipalities were identified as the agents providing the assets to the WSPs to operate the water system and receive a payment in return. In Ghana AVRL was the agent providing water on behalf of GWCL (the principal).

The main reforms introduced in Kenya and Ghana looked at achieving a higher level of autonomy and increasing the market orientation of the utility. Autonomy of water companies has been identified as a key component in reform increasing the performance of WSD (Braadbaart, Van Eybergen and Hoffer, 2007; Schwartz, 2008). In turn, market orientation of water utilities allows the utilities to focus on their core activities by outsourcing a number of services. The control capacity of water companies is greater with greater autonomy and market-profit orientation.

The adoption of private sector management practices (New Public Management, NPM) in Kenya implied the corporatization of water utilities that gained in autonomy. In terms of market orientation, water utilities were still in charge of water production, distribution and treatment, maintenance, billing and customer care and only large repairs were in the hands of WSBs.

In spite of the apparent shift of power toward water providers, municipal councils, being members of the Board of Directors (BoD) and shareholders at the same time, exerted a great control over WSPs by interfering with the management and the daily operations. Low transparency and accountability were identified as a problem in the relationships between providers and municipalities. This means that the latter had the possibility to abuse their power in influencing decisions of the water companies for their own benefit, known as political opportunism (Boehm, 2007).

In Ghana, reform involved Private Sector Participation (PSP) through a service management contract between GWCL and AVRL. AVRL was a fully independent private company. In terms of market orientation, AVRL managed water production, distribution and treatment, billing and customer care. Rehabilitation works were the responsibility of GWCL and were carried out by private contractors (tenders).

In this situation at first glance AVRL had control over GWCL, however although AVRL remained an independent operator responsible for production, distribution, billing and revenue collection, a number of decisions such as users' disconnections remained under GWCL. Also AVRL's staff was seconded by GWCL (Shang-Quartey, 2013), meaning that in some aspects AVRL had very little power to influence GWCL. In its turn, GWCL had difficulties in monitoring the performance targets under the AVRL contract (Adu-Ampog, n.d.; Ainuison, 2010), which was incomplete (Dagdeviren and Robertson, 2013). In terms of corruption risks, existing weak transparency and accountability between AVRL and GWCL pointed out a risk of state capture (Boehm, 2007), where AVRL could have taken advantage of the situation by shaping the design of the service contract in its favour before it came into effect.

At consumption level water utilities (agents) provide water services to the users (principals) in return for payment for the water consumed.

The reform in Kenya and Ghana targeted commercialisation and users' participation. The introduction of full cost recovery in tariffs in water service delivery implied not only an increase in the tariff itself but also a shift in the main source for utility funds (from the government agency to the consumers). Under this approach the utility becomes dependent on the consumers for their income and needs a higher degree of consumer-orientation (Schwartz, 2008). In its turn, users' participation involves devolving water services and monitoring to lower levels of government or individual water users (Bakker, 2007). The capacity of control of users would increase with a higher customer orientation and participation.

In Kenya and Ghana, water utilities have started to be concerned about customer satisfaction as the result of commercialization measures. This has materialized in a number of measures such as a customer-friendly billing and collection system, orientation toward seeking customers' opinions and

views, availability of options for service delivery, timely information for customers on developments in relation to water services, and response to customers' complaints (Baietti, Kingdom and Van Ginneken, 2006). In spite of this, water utilities suffered from a lack of credibility to the users (GII, 2011; TI Kenya, 2011).

In terms of participation, water utilities made efforts to make the information provided to the users more transparent and accountable but users were still not involved in utility decision making (e.g. discussing priorities in service extension areas or tariff approval). In Kenya the fact that municipal councils were the owners of water utilities made a difference to how the users as citizens have potential influence on water utilities according to their degree of satisfaction with the service received through the election polls (e.g. users vote for political leaders according to promises to improve services). In contrast, in Ghana the role of the users was merely as consumers with no power to influence AVRL.

Both countries presented low transparency, accountability and participation between water providers and users, identifying moral hazard and free-riding as the main corruption risks. In the case of moral hazard (Huppert and Wolff, 2002), providers may offer a suboptimal service to some parts or the whole service area, being not accountable for it. Free-riding (Huppert, Svendsen and Vermillion, 2001) involves users taking advantage of the service provided through illegal connections, meter falsifications and tapping.

4.2 Water control and management practices in water service delivery

Table 2 shows the power balance between principals and agents resulting from the reform changes and the subsequent corruption risks associated with the low TAP at the three levels of WSD in Kenya and Ghana.

Table 2. Power balance between principals and agents and related corruption risks at WSD levels in Kenya and Ghana

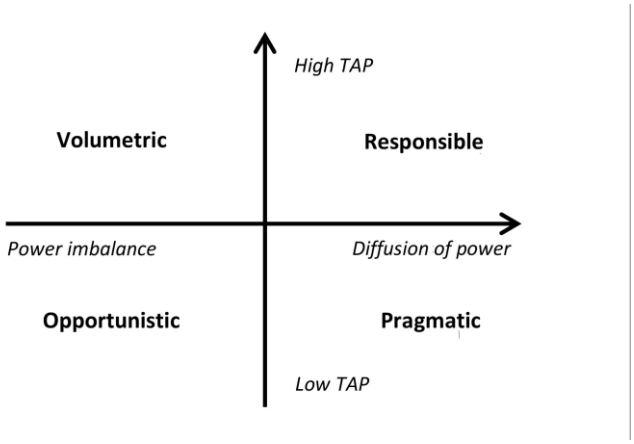
WSD level	**Consumption level**	**Provision level**	**Policy level**
Indicators	• Customer orientation • User participation	• Autonomy of utilities • Market orientation	• Separation policy-regulation • Delegation of power
Kenya			
Principals - agents	**Users - WSPs**	**WSPs - Municipalities**	**MWI - WASREB**
Distribution of power	Devolving power to users as citizens is not exercised because of low credibility of WSPs	WSPs are corporate entities and outsource new investments but are under the power of municipalities	Creation of a regulatory body but MWI keeps power, appointing the members of WASREB
Corruption risks	Moral hazard / free-riding	Political opportunism	Regulatory opportunism
Ghana			
Principals - agents	**Users - AVRL**	**GWCL - AVRL**	**MHWW - PURC**
Distribution of power	Users as consumers have little power to influence AVRL	AVRL is a fully independent company but GWCL retains power	Creation of a regulatory body but MHWW keeps power, appointing the members of PURC
Corruption risks	Moral hazard / free-riding	State capture	Regulatory opportunism

Looking at the results of the power balance analysis and their relation to corruption risks (Table 2), we can distinguish three different situations at the different levels of WSD:

- Situations where power is unequally distributed (power imbalance) between principals and agents and presenting corruption risks. This is the case at the policy and regulation level in Kenya and Ghana and provision level in Kenya. In these cases an actor who holds power over a peer may misuse it to behave opportunistically due to the low TAP levels. This situation is similar to the one referred to in literature by Batley (2004) and Huppert and Wolff (2002) as opportunistic management.
- Situations where the power balance between principals and agents is diffuse but presents corruption risks. Such cases exist at the provision level in Ghana and at the consumption level in Kenya and Ghana. In these cases, water control is weak and principals and agents behave reactively, motivated by their own interest as there is low TAP. The concept of pragmatic management introduced by Molle and Berkoff (2007) as reactive to a situation in contrast to a more water-controlled volumetric management could be associated with the situation described.
- A third situation, which is however not observed in our case studies, would be a situation without any corruption risks. Here, none of the actors could abuse their power because of the high level of TAP. Under this situation, actors would behave ethically within a norm and rule framework in a so-called responsible management.

The above power balance situations in relation with different TAPs levels may help to characterize different water control or management practices as represented in Figure 1.

Figure 1 Water control characterization under TAP and power balance



5. Conclusions

This paper provides a methodological approach to analyse the power balance between actors at the different levels of WSD. The main conclusion of this paper is that different levels of Transparency, Accountability and Participation (TAP) and power distribution between actors may characterize how water is controlled/managed and whether an actor can misuse his power (mismanagement) or perform ethically according to certain rules and regulations (governance mechanisms that rule services and returns).

From the results of the paper, it is possible to differentiate two situations of water control as management practices. The first situation under low TAP involves corruption risks and unequal power balance between principals and agents, which may induce the actors who have power over their peers to misuse it and behave opportunistically. A second situation may occur when there is corruption risk (low TAP), and power is diffused between principals and agents, and consequently the principal and

agents may behave pragmatically to achieve services and returns in their own interest without regarding their peers.

Opportunistic management seems to be related to the reform carried out in the Kenya and Ghana water sectors. According to Bates (1995), sector reform will occur in a 'social dilemma of second order' where actors will compete to keep power. Changes in organizational structures and institutions as the result of water sector reform means that water control ('power') will be removed from some actors ('losers') and transferred to others ('winners') in a new governance model. When the reform was favourable to the hydrocratic elites or 'winners', the status quo remained as it was previous to the reform. On the other hand, the elites that are now the 'losers' tried to capture the reform (Boehm, 2007) in their own interest, through management practices in the resulting governance model and following a 'path dependence' behaviour (Della Porta and Vannucci, 2005; Theesfeld, 2001). This situation would allow the 'winners' to influence the new rules in their favour ('reform opportunism').

The causes of opportunistic management in Kenya are highlighted by Mumma (2007) and Rampa (2011), because of the patrimonial governance and personalization of roles involving conflicts of interest that are derived in regulatory and political opportunism risks. In Ghana this explanation could apply at regulatory level; the situation differs at provision level because of the involvement of PSP. In this sense, further research would be desirable to get a better understanding of the reasons behind the relation between different management practices and corruption risks (e.g. considering the social links and learning capacity of principals and agents).

An interesting possibility to explore these complex links is the use of Agent Based Modelling (ABM) as a learning model to understand how the different actors involved in WSD interact amongst themselves (management practices) in an institutional environment characterized by different levels of TAP and according to internal behavioural and social norms (e.g. social cost and gains) as well as cognitive abilities (e.g. learning capacities). Through ABM, we can test what the factors are that determine an individual's choice to engage in different management practices with their peers. Furthermore, ABM should make it possible to measure how their choice affects the performance.

6. References

Acemoglu, D. and Robinson, J. (2012). *Why Nations Fail. The origins of power, prosperity, and poverty*. London: Profile Books.

Adu-Ampong, E. (n.d.).Water Privatization Policy in Ghana: Stalled for Good or a Strategic Pause. Development Economics: Poverty, Inequality and Growth, Institut Barcelona D'Estudis Internacionals, p. 13.

Ainuison, K. G. (2010). Urban water politics and water security in disadvantaged urban communities in Ghana. African Studies Quarterly, 11, 24. Retrieved from http://www.africa.ufl.edu/asq/v11/v11i4a4.pdf

Auriol E. and Blanc A. (2009). Capture and corruption in public utilities: the cases of water and electricity in sub-Saharan Africa. Utilities Policy, 17, 203–216.

Baietti, A., Kingdom, W. and Van Ginneken, M. (2006). Characteristics of well performing public water utilities. Water Supply & Sanitation Working Notes. Note No. 9, May 2006. Washington World Bank.

Bakker, K. (2007). The 'Commons' versus the 'Commodity: Alter-globalization, Anti-privatization and the Human Right to Water in the Global South Journal compilation'. Antipode 39(3), 393-570. Retrieved from www.watergovernance.ca/Workshop3/PDF/Bakker%20publication.pdf

Barendrecht, A. and Nisse, M. (2011). Management Contract 2006-2011 for urban water supply in Ghana. A Partnership – *in and for* – development. Netherlands Vitens Evides International, p. 48.

Bates, R. H. (1995). Social Dilemmas and Rational Individuals. An assessment of the new institutionalism. In J. Harris J. Hunter and C. M. Lewis (Eds.), *The New Institutional Economics and Third World Development* (pp. 27-48). London, UK: Routledge.

Batley, R. (2004). The Politics of Service Delivery Reform. Development and Change 35, 31-56.

Bellaubi, F. (2004). Water efficiency and equity in an irrigation system: the case study of Walawe River Basin, Sri Lanka (MSc thesis). Institut Agronomique Méditerranéen. Montpellier

Bellaubi, F. and Visscher, J. T. (2010). Enhancing integrity to improve service delivery in water service supply provision. Pumps, Pipes and Promises: Costs, Finances and Accountability for Sustainable WASH Services, IRC Symposium. J. Butterwood (Ed.). The Hague: IRC p.19. Retrieved from http://www.irc.nl/page/55907

Bellaubi, F. and Visscher, J. T. (2014). Water service delivery in Kenya and Ghana: an area-based assessment of water utility performance. Netherlands Water International. Retrieved from http://www.tandfonline.com/doi/full/10.1080/02508060.2015.985976

Bellaubi, F. and Visscher, J. T. (forthcoming). Integrity in Water Service Delivery in Kenya and Ghana.
Boehm, F. (2007). *Regulatory Capture Revisited – Lessons from Economics of Corruption* (Working Paper No. 22). University of Passau. Retrieved from http://www.icgg.org/corruption.research.html
Bolding, A., Mollinga, P. and Van Straaten, K. (1995). Modules for modernisation: Colonial irrigation in India and the technological dimension of agrarian change. Journal of Development Studies, 31, 805-844.
Braadbaart, O., Van Eybergen, N. and Hoffer, J. (2007). Managerial Autonomy: Does it matters for the performance of water utilities? Public Administration Development. 27, 111–121.
Cascão, A. E. and Zeitoun, M. (2010). Power, hegemony and critical hydropolitics. In A. Earle A. Jägerskog and J. Öjendal (Eds), *Transboundary Water Management: Principles and Practice* (pp. 27-42). London: Earthscan.
Dagdeviren, H. and Robertson, S. (2013). A critical assessment of the incomplete contracts theory for private participation in public services: the case of water sector Ghana. Cambridge Journal of Economics, 32.
Della Porta, D. and Vannucci, A. (2005). The governance mechanisms of corrupt transactions. In J. Lambsdorff and M/ Taube (Eds.). *Corrupt Transactions* (pp. 152-180), London, UK.
Galbraith, J. K. (1983). *The Anatomy of Power*.Boston Houghton Mifflin Company, p. 206.
Ghana Integrity Initiative (GII). (2011). Ghana's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Ghana. Retrieved from http://www.tighana.org/giipages/publication/TISDA%20LAUNCH%20REPORT%202011.pdf
Ghana Water Company Limited (GWCL). (2014). Retrieved from http://www.gwcl.com.gh/pgs/history.php
Huppert, W. and Urban, K. (2000). Institutional Analysis of Water Delivery and Maintenance Service Provision in Irrigation: The Example of the Jordan Valle (MAINTAIN – Case Study No. 3). Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).
Huppert, W. and Wolff, B. (2002). Principal-agent problems in irrigation – inviting rent seeking and corruption. Quarterly Journal of International Agriculture, 41, 99-118.
Huppert, W., Svendsen, M. and Vermillion D. L. (2001). *Governing Maintenance Provision in Irrigation, A Guide to Institutionally Viable Maintenance Strategies* (Schriftenreihe der GTZ, Nr. 273). Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), p. 192.
Kayaga, S. and Smout, I. K. (2007). Water Loss Management for Utilities in Low Income Countries: Case studies from Four African Water Utilities, IWA International Specialised Conference: Water Loss 2007, Bucharest, Romania, 23 September 2007, p. 11. Retrieved from www.waterloss2007.com/pdf_vortraege/Dienstag/A7-1.pdf
Laffont, J.-J. (2005). *Regulation and Development. Federico Caffè Lectures*. Cambridge: Cambridge University Press.
Molle, F. and Berkoff, J. (2007). Water Pricing in Irrigation: Mapping the Debate in the Light of Experience. In F. Molle and J. Berkoff (Eds.), *Irrigation Water Pricing* (p. 73). France. CAB International.
Mumma, A. (2007). Kenya's New Water Law: an Analysis of the Implications of Kenya's Water Act, 2002, for the Rural Poor. In B. van Koppen, M. Giordano and J. Butterworth (Eds.), *Community-based Water Law and Water Resource Management Reform in Developing Countries* (Cap 10, pp. 158-172). Kenya
Narain, V. (2003). Institutions, technology and water control: water user associations and irrigation management reform in two large-scale systems in India. PhD Thesis Wageningen University, 28 April 2003, p. 275.
National Water Conservation and Pipeline Corporation (NWCPC). (2014). Retrieved from http://www.nwcpc.go.ke/content/background-0
Nowlan, L. and Bakker, K. (2010). Practising shared water governance: a primer. University of British Columbia. Program on Water Governance. Vancouver, p. 56.
Ombogo, P. (2009). Presentation Water Sector Reforms. Status of Water Sector Reforms in Kenya. Challenges and Lessons. World Water Week, Stockholm, 2009. Retrieved from http://www.worldwaterweek.org/documents/WWW_PDF/2009/wednesday/T3/Patrick_ombaga_Situation_analysis_and_lessons_learnt_Water_Sector_reforms_in_Kenya.pdf
Rampa, F. (2011). *Analysing governance in the water sector in Kenya* (Discussion Paper No. 124, p. 40). Belgium. European Centre for Development Policy Management.
Repetto, R. (1986). Skimming the water: rent-seeking and the performance of public irrigation systems (Research Report No. 4. P 47). Washington: World Resources Institute.
Rinaudo, J. D. (2002). Corruption and allocation of water: the case of public irrigation in Pakistan. *Water Policy*, 4, 405–422.
Schwartz, K. (2008). The New Public Management: The future for reforms in the African water supply and sanitation sector? *Utilities Policy*, 16, 49-58.
Shang-Quartey, L. (2013). From Private Sector Participation to Full Public Ownership: Why the Urban Water Management Contract in Ghana was Discontinued (MSc Thesis). Institute of Social Studies, Netherlands, p. 78.
Shirley, M. (2000). The Politics and Economics of Reforming Urban Water Systems. Draft.
Theesfeld, I. (2001). Constraints for Collective Action in Bulgaria's Irrigation Sector. Central and Eastern European Sustainable Agriculture (CEESA) (Discussion Paper No. 5, p. 28). Retrieved from http://ageconsearch.umn.edu/handle/18891
TI Kenya. (2011). Kenya's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Kenya. Kenya: Transparency International Kenya. Retrieved from http://www.tikenya.org/~tikenyao/index.php?option=com_docman&task=cat_view&gid=115&limitstart=5
Transparency International. (2009). *The Anti-Corruption Plain Language Guide*. Germany. Transparency International, p.60.
Trémolet, S. and Hunt, C. (2006). Taking account of the poor in water sector regulation (Water Supply & Sanitation Working Notes. Note No. 11) Washington. World Bank.
Trop, H. and Stålgren, P. (2005). The Dynamics of Corruption: Putting limitations to water development. A paper originally prepared for Stockholm World Water Week Seminar, 2005: Can International Water Targets Be Met without Fighting Corruption? p. 13.

Water Services Regulatory Board (WASREB). (2014). Retrieved from http://www.wasreb.go.ke/about-us
Wegerich, K. (2006). 'Illicit' water: un-accounted, but paid for: Observations on rent-seeking as causes of drainage floods in the lower Amu Darya. Research School for Resource Studies for Development Research. Seminar 'News from the Water Front: Alternative views on Water Reform'. 8 October 2006. The Netherlands: Wageningen University, 14 p. Retrieved from www.ceres.wur.nl/seminars/2006_Wegerich_illicit_water.pdf
World Bank. (2008). *The Political Economy of Policy Reform: Issues and Implications for Policy Dialogue and Development Operations* (Report No. – 44288-GLB. Social Development Department, p. 116). Washington

6. ‘Corruption risks, management practices and performance in Kenya’s and Ghana’s Water Service Delivery: an agent-based model’

Paper 1 submitted to Ecology and Society 15 April 2016

‘An agent-based model to identify management practices, integrity and performance in Kenya’s and Ghana’s Water Service Delivery’

Paper 2 published in CoMSES Net Computational Model Library 09 Dec 2014

Chapter 6 contains two papers (one submitted and one published), co-written by the author. Paper 1 builds an ABM explanatory deterministic model based on the findings of the three previous chapters in order to understand how corruption risks and management practices affects performance in the Kenya and Ghana case studies. The ABM takes into consideration the fundamentals of game theory. The main actors involved in WSD levels are modelled in terms of principals and agents playing different games that reflect different social dilemmas. Payoffs of the various games are defined based on transparency, accountability, participation and the social cost of the relationships between the principals and the agents. The decisions by the bounded-rational actors take into consideration the expected payoff of the peer through learning capacity but also social comparison. The resulting cooperation defection strategies of the actor’s choices are explained in relation to the different management practices and corruption risks at different WSD levels.

The ABM provides a framework for understanding how management practices and corruption risks may relate to WSD performance. When principals and agents play a Prisoner’s dilemma game, the resulting defection-defection strategies may explain corruption risks under opportunistic management characterized by low performance of WSD. The Snow-Drift game played by principals and agents with resulting defection-cooperation or cooperation-defection strategies matches corruption risks under pragmatic management, resulting better performing WSD.

Paper 2 complements Paper 1 by explaining how the model was developed.

Paper 1

Corruption Risks, Management Practices and Performance in Water Service Delivery in Kenya And Ghana: An Agent-Based Model

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ABSTRACT

Water Service Delivery (WSD) in Kenya and Ghana is of low quality and there are weak integrity mechanisms in place that are prone to corruption. WSD is also characterized by pragmatic and opportunistic management practices. This paper explores the extent to which corruption and management practices affect the performance of WSD by developing an exploratory agent-based model (ABM) that builds on the principal-agent theory. Based on empirical research on case studies in Kenya and Ghana, the different actors involved in WSD are modelled in terms of principals and agents that play various games reflecting different social dilemmas. Payoffs from the games are defined based on transparency, accountability, participation and the social costs of the relationship between the principals and the agents. Decisions made by bounded-rational actors take into consideration the expected payoff but also social comparison. The results show that corruption risks and opportunistic practices reduce the performance of WSD.

Key words: Corruption; management; performance; Water Service Delivery

INTRODUCTION: CORRUPTION AND MANAGEMENT IN WSD IN KENYA AND GHANA

Kenya and Ghana are sub-Saharan African countries that began to reform the water sector in the 1990s in an attempt to improve the performance of water supply. The changes in institutions and organizations of policy and regulation, provision and consumption levels define a specific governance model in each country. The reform affected the different Water Service Delivery (WSD) levels. At policy and regulation level, both countries developed regulatory frameworks. In terms of provision, Kenyan municipal water services were transformed into public corporations, while Ghana embraced Private Sector Participation (PSP). Both countries developed commercialization measures to increase cost recovery. At consumption level, participation by users was introduced by adopting customer-care strategies from providers (TI Kenya 2011, GII 2011).

Bellaubi and Visscher (2014) assessed the quality of WSD in five case studies in Kenya and Ghana and identified low levels of coverage, high levels of rationing and low water quality in these locations. They also analyzed the actors involved in WSD and their multiple relationships in a complex network. A number of corruption risks were identified by analyzing these relationships using a principal-agent framework where the agents provide a service and the principals pay a return (TI Kenya 2011, GII 2011). Corruption risks were identified by looking at the transparency, accountability and participation (TAP) of the

relationships between the principals and agents involved in the different WSD levels (Bellaubi and Visscher 2010) from policy and regulation to provision and consumption.

Different levels of TAP and the balance of power between the principals and the agents can be related to various types of management practices (Bellaubi personal observation) that have been distinguished in the literature (Batley 2004, Huppert 2005, Molle and Berkoff 2007), namely 'opportunistic' and 'pragmatic'.

From these case studies, it appears that the relationship of corruption risks and management practices regarding the performance of WSD is unknown. This uncertainty may impede the setting up of clear remedial actions and policies to increase the quality of WSD. For this reason, this paper poses the following research question: How do corruption risks and management practices affect the performance of WSD governance in Kenya and Ghana? To investigate the complex relationships between management practices, corruption and performance of WSD, an agent-based model (ABM) built up on the principal-agent theory was developed and applied to Kenya and Ghana.

The paper is structured according to the following sections: Research Methodology justifies the use of an ABM to answer the research question. The description of the principal-agent representation in Kenya and Ghana presents the principal-agent relationships, informed by the case studies carried out in Kenya and Ghana, and serve as a basis for each of the ABMs. Description of the ABM depicts the ABM and presents the results of the calibration. The section entitled Results of the ABM in Kenya and Ghana then applies the ABM to the case of WSD in Kenya and Ghana, showing how identified corruption risks and management practices may affect WSD performance. The final section draws conclusions.

RESEARCH METHODOLOGY

ABM is a modelling approach used in various disciplines and allows individual entities and their interactions to be directly represented (Gilbert 2008). This makes it an attractive approach for modelling social dilemmas (Kehagias 1994, Szilagyi 2003, Sheng et al. 2008, Szilagyi and Somogyi 2008, Power 2009), considering the role of different types of social networks (Nowak and May 1992, Hauert and Doebeli 2004, Santos and Pacheco 2005, Santos et al. 2007) and, more directly, addressing the problem of corruption (Guerrero 2009, Situngkir 2003*a*, Situngkir 2003*b*).

Although the study of corruption has been approached through laboratory (Lambsdorf and Bjorn 2007) and field experiments (Olken 2007), the results obtained have a high degree of abstraction and may not entirely capture the heterogeneity of an actor behavior and their interactions with the environment (Balacco 2011).

The ABM used in this research is an exploratory learning model (Pahl-Wostl et al. 2007) that makes it possible to simulate how actors in the water system interact amongst themselves. The aim of the ABM is to understand the relationship of corruption risks and management practices with the performance of WSD, considering social links and also cognitive abilities of the actors. This combines adaptive (learning) and interactive (relations with others) expectations. The ABM builds on a principal-agent representation for Kenya and Ghana WSD that results from analyzing three case studies in Kenya and two in Ghana, carried out as a part of Transparency International's Transparency and Integrity in Service Delivery in Africa Program (Bellaubi and Visscher 2014). This empirical information, both qualitative and

quantitative, is used as input data for the ABM to test the model and to extract more general conclusions (Janssen and Ostrom 2006).

DESCRIPTION OF THE PRINCIPAL-AGENT REPRESENTATION IN KENYA AND GHANA

This section briefly describes the principal-agent representation as a result of the aggregation of the case studies conducted in Kenya and Ghana, naming corruption risks and management practices, and gives the WSD performance of the water systems according to TI Kenya (2011), GII (2011), Bellaubi and Visscher (2014).

Each case study represents a specific water situation within the service area of a water provider or water utility (hence the water system). Furthermore, it looks at governance mechanisms among the actors identifying corruption risks and management practices according to TAP scores and power asymmetries. In addition, the case studies characterize the performance of WSD. The different case studies in a country serve as a principal-agent representation where only the main actors (principals and agents) are taken into consideration for the ABM.

The principal-agent framework (Huppert 2005) makes it possible to represent actors (organizations or individuals) that are related to each other under specific governance mechanisms (rules such as contracts and regulations) and transactions (services and returns). The relationship is that an actor acting as an agent offers a service to an actor acting as a principal and, in return, the principal pays the agent. The agent can hide information from the principal, failing ex-ante to provide the service. In turn, the principal can refuse ex-post any return for the service provided. Finally, an external observer (an independent actor not directly involved in the principal-agent transaction) can verify and influence the transaction if sufficient information is accessible for him. Bellaubi and Visscher (2010) define different levels of integrity for each of these transactions in terms of transparency, accountability and participation (TAP) (Table 1) where a low level TAP identifies high corruption risks. Management practices are defined based on TAP levels and power balance between principals and agents (Table 2) (Bellaubi personal observation).

Table 1. Integrity definitions and levels (as applied in the case studies)

Integrity definition	Scoring levels (participatory scoring)
Transparency: Existence of clear written rules and regulations defining relationships between actors	1 = Comprehensive written rules.
	0.5 = Rules are one-sided.
	0 = Rules are verbal or incomprehensible.
Accountability: Application of control mechanisms for holding actors responsible for their actions based on the rules and regulations	1 = Applied control mechanisms on services and returns.
	0.5 = Control mechanisms not enforced.
	0 = Control mechanisms do not exist.
Participation: Accessibility of information to third parties with a possibility to influence the outcome of the relationship	1= Third party can influence the outcome.
	0.5 = Third party limited access to information.
	0 = No access to information.

Table 2. Management practices and TAP-Power characteristics (Bellaubi personal observation)

Management definition	TAP-Power levels
Pragmatic management: Actors follow their own interests	Low TAP and power balance between actors.
Opportunistic management: Actors use their power over their peer.	Low TAP and unequal power distribution.
Ethical management: Actors comply with a set of rules.	High TAP and unequal power distribution.

To measure the performance of WSD in each of the case studies, a Water Service Delivery Approach (WSDA) was used (Bellaubi and Visscher 2014). The WSDA analyzes the quality of the service in a specific location of the service area of a water utility and, thus, refers to its performance within that location in terms of the quality of the service obtained by the users/consumers. The performance of the WSD of a water system is considered as the result of all interactions between the principals and agents measured at the user's end (Table 3).

Table 3. WSDA Performance indicators and their levels (as measured in the case studies)

Indicator definition	Scoring levels (participatory scoring)
Technical efficiency	
Continuity (percentage of population in the areas which uses the piped supply as its main water)	0 = < 4 h/d; 1 = 4 – 10 h/d; 2 = > 10 h/d
Quality (taste, colours, smell as perceived by the users)	0 = < 90%; 1 = 90 – 95%; 2 = > 95% of tests in compliance with the residual chlorine standards
Access	
Coverage (uninterrupted hours of supply)	0 = <50%; 1 = 50-90%; 2 = > 90%
Affordability (users' restriction in consumption because of cost)	0 = >10% people restrict water; 1= 5-10%; 2 = < 5%
Quantity (litres of water consumed per household)	0 = <20 l/c/d; 1 = 20 – 100 l/c/d; 2 = > 100 l/c/d

The principal-agent model in Kenya

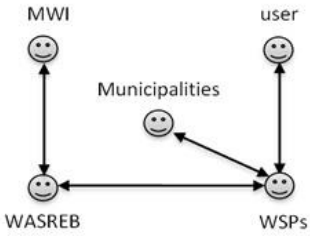
The case studies in Kenya were carried out in Old Town (Mombasa), Migosi (Kissumu) and Kangemi (Nairobi). The main actors involved at policy making and regulation, provision and consumption levels are listed in Table 4.

Table 4. Main actors involved in WSD in Kenya and their roles

Levels	Actors and their roles in Kenya
Policy and regulation	Ministry of Water and Irrigation (MWI) Overall coordination of the water sector, setting policies and legislations and sourcing funds.
	Water Services Regulatory Board (WASREB) Approving the operators (WSP) that are selected and regulating tariffs.
Provision	Water Services Providers (WSPs) Operating and maintaining the systems and providing water and sanitation services.
	Municipality owner of the WSPs. WSPs are corporate public utilities.
Consumption	Users active paying recipients of water

The principal-agent representation in Kenya shows the different between actors (principals and agents) defining the governance mechanisms and their respective services and returns as well as the TAP and social cost scores (Figure 1).

Fig. 1. Main actors involved in WSD in Kenya and their governance mechanism, services and returns, TAP and social costs



	WSP (agent) – User (principal) game 1	WASREB (agent) – MWI (principal) game 3
Governance	Provision agreement	Water Act
Service	Water provision	Regulation in water service provision
Return	Monthly payment of the water bills	Financial resources to implement MWI policies
Transparency	0.5 = not clear what happens if WSP does not provide water	1 = Water Act is clear in its understanding
Accountability	0.5 = WSP does not compensate users if no service	0.5 = WASREB funding depends on MWI
Participation	1 = complaints followed up by WASREB	0.5 = information is accessible to third parties
Social cost†	0 = autonomy between both	0.5 = WASREB members appointed by MWI
Corruption risk	Moral hazard/ free-riding	Regulatory opportunism
Management	Pragmatic	Opportunistic

	WASREB (agent) – WSP (principal) game 2	Municipality (agent) – WSP (principal) game 4
Governance	Service Provision agreement (SPA)	Companies Act
Service	Supervision of performance standards	Lease of assets through Water Service Boards
Return	Levy (percentage of billing)	Dividends plus lease of the assets
Transparency	1 = SPA is clear in its understanding	0.5 = original contract not available
Accountability	0.5 = is not clear how WASREB reinforces its role	0.5 = corporate guidelines not applied
Participation	0.5 = information is accessible to third parties	1 = MWI can influence decisions
Social cost†	0 = autonomy between both	0.5 = influence on the Board of Directors
Corruption risk		Political opportunism
Management		Opportunistic

†For the purpose of the ABM the variable social cost was introduced, 0 being the minimum value and 0.5 the maximum value.

The total WSD performance of the water system was calculated as the average of the differently scored indicators (Table 5) in the case studies. In the various case study locations, the total performance ranged from 20% to 26.6% (assuming the highest performance would be attained when the total score per case study is 15).

Table 5. Performance score in Kenya case study locations following a WSDA

Performance criteria	Indicator (max. value 3)	Old Town (Kenya) MOWASCO	Migosi (Kenya) KIWASCO	Kangemi (Kenya) NCWSC
Technical efficiency	Continuity	0	1	0
	Quality	0	2	1
Access	Coverage	0	0	0
	Affordability	2	0	2
	Quantity	1	1	0
Total score		3	4	3
% of the total performance of the system		20.0%	26.6%	20.0%

The principal-agent model in Ghana

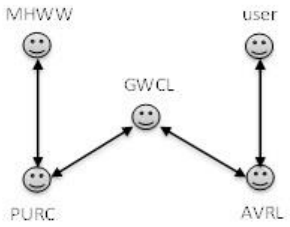
In Ghana the case studies were carried out in Nima and Madina (Accra). The main actors involved at policy making and regulation, provision and consumption levels are listed in Table 6.

Table 6. Main actors involved in WSD in Ghana and their roles

Levels	Actors and their roles in Ghana
Policy and regulation	Ministry of Housing, Works and Water (MHWW) Overall coordination of the water sector, setting policies and legislations and sourcing funds.
	Public Utility Regulatory Commission (PURC) Examining and approving tariffs, monitoring and enforcing standards of performance, receiving and investigating complaints and settling disputes between consumers and providers.
Provision	Ghana Water Limited Company (GWLC) Legal owner of the system and responsible for the provision, distribution and management of urban water supply as well as for its rehabilitation and expansion.
	Aqua Vitens Rand Limited (AVRL) Private operator responsible for production, distribution, billing, revenue collection, setting the tariff.
Consumption	Users Passive paying recipients of water

The principal-agent representation in Ghana shows the different relationships between actors (principals and agents) defining the governance mechanisms and their respective services and returns as well as the TAP and social costs scores (Figure 2).

Fig. 2. Main actors involved in WSD in Ghana and their governance mechanism, services and returns, TAP and social cost scores



	AVRL (agent) – User (principal) game 1	PURC (agent) – MHWW (principal) game 3
Governance	Registration	PURC Act
Service	Water provision	Regulation in water service provision
Return	Monthly payment of the water bills	Financial resources to implement MWI policies
Transparency	0 = no contract but a registration form	1 = PURC Act is clear in its understanding
Accountability	0.5 = AVRL does not compensate users if no service	0.5 = PURC funding depends on MHWW
Participation	0.5 = PURC does not follow up complaints	0 = information is not accessible to third parties
Social cost†	0 = autonomy between both	0.5 = PURC members appointed by MHWW
Corruption risk	Moral hazard/ free-riding	Regulatory opportunism
Management	Pragmatic	Opportunistic
	PURC (agent) – GWLC (principal) game 2	AVRL (agent) – GWLC (principal) game 4
Governance	Performance contract	Management contract
Service	Supervision of performance and tariff setting	Operations, maintenance and reporting
Return	No return	No return by GWCL
Transparency	0.5 = is not clear how tariffs are approved	0.5 = original contract not available
Accountability	0.5 = is not clear how PURC reinforces its role	0.5 = sanctions are not applied
Participation	0 = information is not accessible to third parties	0.5 = PURC follows up performance of AVRL
Social cost†	0.5 = influence on PURC	0 = autonomy between both
Corruption risk		State capture
Management		Pragmatic

†For the purpose of the ABM the variable social cost was introduced, 0 being the minimum value and 0.5 the maximum value.

The total WSD performance of the water system was calculated as the average of the differently scored indicators (Table 7) in the case studies. In the various case study locations, the total performance ranged from 13.3% to 20% (assuming the highest performance would be attained when the total score per case study is 15).

Table 7. Performance score in Ghana case study locations following a WSDA

Performance criteria	Indicator (max. value 3)	Madina (Ghana) AVRL	Nima (Ghana) AVRL
Technical efficiency	Continuity	0	0
	Quality	2	2
Access	Coverage	0	1
	Affordability	0	0
	Quantity	0	0
Total score per case study		2	3
% of the total performance of the system		13.3%	20.0%

DESCRIPTION OF THE ABM

The ABM is described according to the ODD protocol in Bellaubi et al. (2014), and was implemented in Netlogo version 4.1.3 (Wilensky 1999). It can be found at www.openabm.org/model/4144/version/4/view.

The ABM builds on a principal-agent representation in Kenya and Ghana (Figures 1 and 2), where actors playing as agents or principals that relate to each other in terms of services and returns respectively. The transaction sets up a game in which cooperation means following the rule of law, while defecting is equivalent to breaking the rule of law. Actors can play in multiple games simultaneously and can be a principal in one game and an agent in another game at the same time. The empirical observation of the actors in the case studies suggests that decisions to cooperate or defect do not consider only the utility maximization derived from a specific interaction but also positive or negative social impacts (social gains/costs) that follow their decisions (Fábrega 2008). According to Janssen (2008), experimental research has shown that people value not only material payoff but also non-material consequences, such as an improvement or deterioration in social relationships. Thus, the ABM considers bounded rational actors (Simon 1955, as cited in Kirkebøen 2009:2), where actors do not optimize but opt for satisficing choices, a behavior that results from their adaptiveness and from learning from previous decisions.

The performance of WSD refers to the payoff obtained by an actor as the result of a service or a return for this service. TAP and social cost/gain values of the relationships determine the payoff table from which the actors get their payoff according to their decisions to cooperate or defect. The total performance of WSD is measured as the sum of the different payoffs obtained by all the actors involved as the result of the transactions among each other.

The model time step is one month and it runs for 12 months, simulating the cycle of water service provision through one whole year. The games are played in each time step sequentially with the agent acting first and the principal second. The sequence gives to the agent a 'first-to-choose' power over the principal. This situation is counterbalanced by the principal of being aware of the agent's decision. This sequence reproduces the principal-agent model where the agent offers services and the principal gives a return. The agent re-iterates

his previous decision if this has been 'good enough' when comparing his payoff with the other actors linked to him. If this is not the case, he tries to improve by taking into account expectations of the principal's behavior to maximize his utility. The principal is affected by, and knows about, the previous decision of the agent and the principal is thus easily able to maximize based on the previous decision of the agent. Afterwards the agent adapts his expectations of the principal's behavior. The various agents' and principals' choices per round constitute the strategy of the game. These strategies may vary over time being cooperation-cooperation (Cc), defection-defection (Dd), cooperation-defection (Cd) or defection-cooperation (Dc).

The ABM is calibrated against performance of the WSD of the water system found in the cases studies. Finally, the ABM's resulting strategies for each game and the associated payoffs (representing WSD performance) are compared with different management practices defined by the principal agent representation of the case studies.

Payoff table

Each game is defined by a payoff table with R being the reward for mutual cooperation, P being the payoff for mutual defection, T being the temptation to defect, and S being the 'sucker's payoff'. The values in the payoff table are derived from the transparency, accountability, participation (TAP) and social cost/gain scores of the transactions between a principal and an agent (Table 8).

Table 8. Calculation of payoffs

Payoff value	Formula
T	1.5 - accountability
R	1
S	(participation / 2) - social cost
P	social gain

R is the service offered by the agent or the return that the principal pays to the agent to obtain the service when both cooperate. The optimal service/return can be arbitrarily valued as 1, i.e. R = 1. It is assumed that if both act according to the law, this has no effect on social relationships.

T is the temptation of the agent to provide only a suboptimal service while receiving an optimal return or the temptation of the principal to receive an optimal service but to provide only a suboptimal return. T can hence arguably be higher than R. This depends, however, on the accountability of the transaction, which reflects punishment through the control mechanisms in place. To reflect on these considerations, the following settings were made: T = 1.5 - accountability, where accountability ϵ [1, 0] and therefore T ϵ [1.5, 0.5].

S is the 'sucker's payoff' that results in being cheated when offering an optimal service or an optimal return but receiving only a suboptimal service or suboptimal return. S increases with the level of participation of the transaction and decreases with the social cost involved of not reciprocating. Participation thus includes the observation of the transaction through third parties (e.g. NGOs, the general public, regulators) and the resulting incentive to act according to the law, even if cheated by one's peer. This incentive is modeled here as the benefit received by the cheated, if he/she decides to cooperate. In turn, the social costs reflect the

social consequences for an individual of his/her personal decision and becomes relevant in cases where the agent or the principal has strong social ties with the peer, e.g. a bribe that is offered whose rejection causes a disturbance in the receiver's social relationships in terms of social costs. The rationale is that actors may suffer from the so-called 'Bureaucrat's Dilemma': '*sometimes [bureaucrats] need to bend rules to remain a participant on [sic] network of reciprocity (even at his own risk and without immediate retribution)*' (Fábrega 2008:28). Actors are thus members of networks and their decision is influenced by their role as a member of the network. The social cost quantifies the power of the agent over the principal or the opposite in terms of the level of ties between the agent and principal: when the ties between peer actors are high then the social costs are also high, assuming that the imbalance of power between peer actors increases the social costs (the actors are bounded to positively reciprocate because of the social ties). It is assumed that direct social ties weigh more than participation. The following was set: S = (participation / C) – social cost, where participation ϵ [0,1], social costs ϵ [0, 0.5] and consequently S ϵ [-0.5, 0.5]. 'C' is a variable allowing the calibration of the model. Social costs are equivalent to social gain (Table 8): when social costs are low, then (participation / C) - social costs > social gains, therefore S > P.

P is the suboptimal service or return of the principal and the agent respectively when both 'defect' and can be considered almost nil. It is considered that when both the agent and principal break the rule of law, there is a corrupt deal (Lambsdorff 2007) involving social gain as a result of the social ties of reciprocity between the agent and the principal. Social gains are considered to be equivalent to the social costs introduced above, such that P ϵ [0, 0.5].

Accordingly to the principals' and actors' choices to cooperate or defect, the payoff values obtained are R, T, S or P for the agent and r, t, p or s for the principal (Table 9).

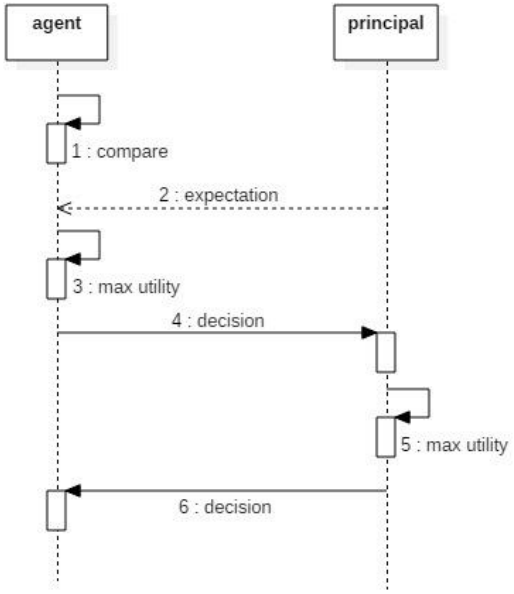
Table 9. Payoff table

		Principal's choice	
		Cooperation	Defection
Agent's choice	Cooperation	R, r	S, t
	Defection	T, s	P, p

The decision-making process

The processes executed for each round of the games between agents and principals are: 1) the agent's decision, 2) the principal's decision, 3) getting a payoff and 4) updating expectation. A sequence diagram is given in Figure 3.

Fig. 3. UML sequence diagram



In the agent's decision, the agent reiterates his previous decision if, on average, he/she has been better off than his/her peers. The assumption is that the agent does not have the full information about the consequences of acting differently and therefore evaluates his previous decision as 'good enough' as long as he is at least as well off as his peers in the network. If this is not the case, he tries to improve his position through taking a deliberate decision based on the maximization of the expected utility considering the expectation about the principal's behavior (EPC) as follows.

```
if (payoff  < avgNeighborsPayoff) [
      set expectedUtilityCoop = EPC * R + (1 - EPC) * S
      set expectedUtilityDefect = EPC * T + (1 - EPC) * P
      if (expectedUtilityCoop > expectedUtilityDefect) [
         decision_Agent = cooperate
      ]
      else [
        decision_Agent = defect
      ]
]
```

In the principal's decision, the principal maximizes his payoff (EU) based on the knowledge of the agent's prior decision to cooperate or defect.

```
  if [decision_Agent] = cooperate [
     set expectedUtilityCoop R
     set expectedUtilityDefect T]
     ifelse expectedUtilityCoop > expectedUtilityDefect [
     set decision_Principal = cooperate] [set decision_Principal = defect]
     if [decision_Agent] = defect [
     set expectedUtilityCoop S
     set expectedUtilityDefect P]
     ifelse expectedUtilityCoop > expectedUtilityDefect [
     set decision_Principal = cooperate] [set decision_Principal = defect]
   ]
  ]
```

While obtaining a payoff, payoff values are assigned to the agent and the principal according to the values of the payoff table, taking into consideration both decisions.

Finally in updating expectation, the agent's expectation of the principal's behavior is updated based on the principal's decision. The agent's expectation that the principal will cooperate (EPC) or defect (1 - EPC) is influenced by the learning capacity of the agents that weights off the current experience with the expectations that have been built up in previous games.

If the principal decides to cooperate, then the expectation that the principal will act in a similar way in future games is increased. If the principal decides to defect, then the expectation that the principal will cooperate in future time steps decreases. The initial value of EPC is equal to the transparency of the principal-agent transaction.

```
ifelse ( [decision_Principal] =  cooperate)[
  ask Agent [set EPC EPC + (1 - EPC) * learning_agent]
  ]
  [ask Agent [set EPC (1 - learning_agent) * EPC]
]
```

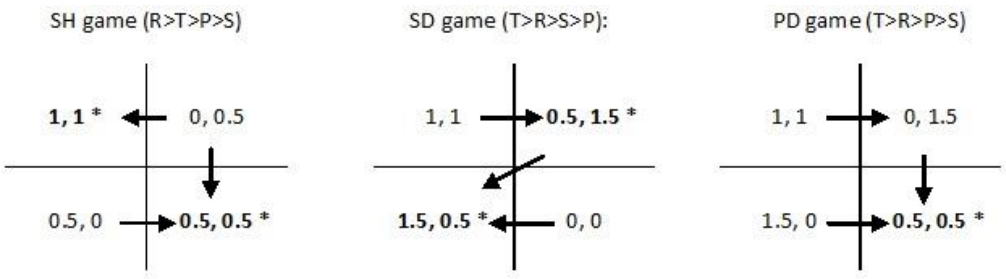
Understanding a single principal-agent model

In order to calibrate the model, it is necessary to determine the variables affecting the outcomes (strategies and payoffs) in the ABM. This is done through the simulation of an agent and a principal playing a single game (single principal-agent model).

The analysis focuses on understanding the importance of the various variables in the ABM for the actors to reach the equilibrium, ('stable' strategy on time), considering a strategy as set up by the agent's and principal's decisions. The resulting strategy depends on the values of accountability, participation and social cost that define R, T, S and P, the agents' and principals' initial decisions and the agent's expectations of the principal's behavior. The latest is a function of the learning capacity of the agent and the transparency of the relationship between the principal and the agent. The multiplicity of all the possible games played by the principals and agents can be abstracted into three social dilemmas known from game theory: the Snow Drift game (R>T>S>P), the Prisoner's Dilemma (T>R>P>S) and the Stag Hunt game (R>T>P>S) which are analyzed here (Santos et al. 2007).

Figure 4 displays the payoff matrixes for each social dilemma with the equilibriums according to game theory (*), the path strategies (arrows) and the resulting strategies (in bold) for a single principal-agent model.

Fig. 4. Evolution of strategies for different social dilemmas with specific R, T, S and P



When the agent's initial decision is such that he is at least as well off as the principal and the principal maximizes his payoff, equilibrium is attained in the first round. In some cases, the principal does not maximize his payoff with his initial decision and then equilibrium is attained in the second round. There are also situations where the payoff for the agent is smaller than the payoff for the principal. In these cases and when transparency is higher than 0, the agent's learning that reflects the agent's expectations of the principal's decision (EPC) plays a role in defining the subsequent decisions and the strategy of the game.

A game can develop several strategies through the year depending on the initial decisions of the agent and the principal. Subsequently, the dynamics of strategies over time only become important if the initial setting is not the resulting equilibrium of the specific game. In fact, agents' and principals' initial decisions have a 'delaying' role in reaching equilibrium, as stated by game theory for the different social dilemmas. As a result, the overall performance over the year in question differs from the one predicted by game theory for the different social dilemmas.

Another interesting point is that when the social dilemma reflects the conditions of the Snow Drift game and an agent learns from a previous principal's decision, the resulting emerging Cd strategy in the ABM implies that the agent remains worse off than the principal.

ABM calibration

Calibration is done against the performance of the water system as observed in the case studies (Tables 5 and 7). The total performance of a water system results from all the actor's interactions involved at the different WSD's levels: policy and regulation, provision and consumption. The calibration of the model is done comparing the WSD's performance given by the ABM with the WSD performance measured from the case studies. The WSD's performance given by the ABM is the sum of the payoffs of all the actors' relationships. In the case studies, the WSD performance of the water system is measured at the user's end with technical efficiency and access indicators (Table 3). Because the performance of the case studies is not measured in absolute but relative terms to benchmarking, a percentage of the performance is given. This percentage is then applied to the resulting payoffs of the ABM, and thus both performance and payoffs can be compared.

The input variables for the calibration of the ABM in Kenya and Ghana are:

a) Transparency, accountability, participation and social costs of the transactions between a principal and an agent defined in the principal-agent representation (Figure 1 and 2). These values define the payoff table and thus the games (social dilemma) played by the agents and principals.
b) The structure of the social network, i.e. who plays which game with whom and in what role (what the games are, who the agent is and who the principal is).
c) The variable 'C' setting the relationship between participation and the social cost in the payoff table is the parameter for the calibration of the ABM.
d) Multiple combinations of the initial actors' decisions play a role in delaying the resulting strategy and therefore the total payoff, but do not change the game (social dilemma) played by the agents and principals. The actor's initial decisions are applied to two situations: the initial decisions of all the actors are set in cooperation and the initial decisions of all the actors are set in defection. This enables a comparison of how payoff (performance) changes under situations of initial cooperation between actors.

e) Empirical evidence from the case studies confirms that agents learn from the previous principal's decisions, so the agent's learning is set to 1.

The NetLogo BehaviourSpace Tool produces the total payoff outputs for all the c values. Tables 10 and 11 list the C variable and total payoff values with the more similar value in comparison to the relative WSD's performance as measured in the case studies in Kenya and Ghana. The WSD performance of the case studies in Kenya was calculated at 20% and 26.6%. For the purpose of the calibration, the average was taken at 23.3%, which is equal to a total payoff of 61 for the ABM when all the actors' initial decisions are defection and 67.0 when all the actors' decisions are cooperation. In Ghana, the average WSD performance of the case studies was 16.6%, which equals a payoff of 56.9 and 61.9 when all the actors' initial decisions are defection or cooperation respectively.

The calibration of the model demonstrates that in both cases in Kenya and Ghana social ties weigh more than participation, as stated in the section, Description of the ABM. In addition, the results show that when an actor's initial decision is cooperation, the payoff is higher than when they choose defection.

Table 10. C and payoff values in ABM in Kenya

Initial decision defection		Initial decision cooperation	
C	Total payoff	C	Total payoff
1	68.0	1	74.5
1.1	66.4	1.1	72.7
1.2	65.0	1.2	71.3
1.3	63.8	1.3	70.0
1.4	62.9	1.4	68.9
1.5	62.0	1.5	68.0
1.6	61.3	1.6	67.2
1.7	60.6	1.7	66.5
1.8	60.0	1.8	65.8
1.9	59.5	1.9	65.3
2	59.0	2	64.8

Table 11. C and payoff values in ABM in Ghana

Initial decision defection		Initial decision cooperation	
C	Total payoff	C	Total payoff
1	62.0	1	67.0
1.1	60.9	1.1	65.9
1.2	60.0	1.2	65.0
1.3	59.2	1.3	64.2
1.4	58.6	1.4	63.6
1.5	58.0	1.5	63.0
1.6	57.5	1.6	62.5
1.7	57.1	1.7	62.1
1.8	56.7	1.8	61.7
1.9	56.3	1.9	61.3
2	56.0	2	61.0

RESULTS OF THE ABM IN KENYA AND GHANA

This section examines the resulting strategies from the different games played between agents and principals in the Kenyan and Ghanaian ABM in relation to the observed corruption risks and management practices defined by the respective principal-agent representation. The section interprets the result of the simulation results in light of empirical observation and game theory (social dilemmas). Figures 5 and 6 both show the resulting strategies once the ABM in Kenya and Ghana have been calibrated, and the agents' initial decision is cooperation (same results are obtained when the agents' initial decision is defection).

Fig. 5. Strategies that result from the ABM in Kenya's games (y-axis 1 cooperation, 0 defection; x axis time step)

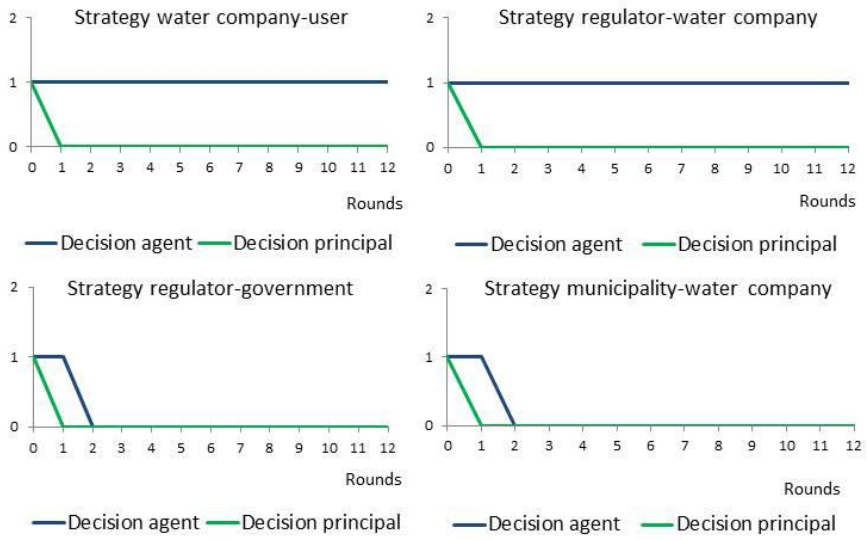
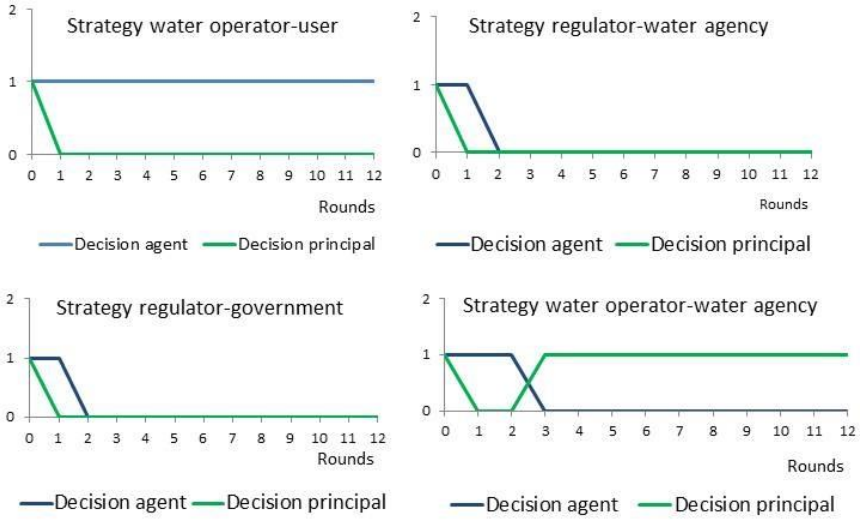


Fig. 6. Strategies that result from the ABM in Ghana's games (y-axis 1 cooperation, 0 defection; x axis timestep)



The strategies that result from the ABM in Kenya and Ghana are explained in the light of the TAP levels and the power balance between principals and agents that characterize corruption risk and management practices at the different WSD levels as well as the social costs in the principal-agent relationships based on the case studies (Table 12 and Table 13).

Table 12. Identified corruption risks, management practices and ABM resulting strategies in Kenya

WSD level	Agent-Principal	Management practices	Corruption risks	Strategy in ABM	Game
Policy and regulation	Regulator-government	Opportunistic	Regulatory opportunism	Dd	T≥R>P>S
	Regulator-water company			Cd	T≥R>S>P
Provision	Municipalities-water company	Opportunistic	Political opportunism	Dd	T≥R>P>S
Consumption	Water company users	Pragmatic	Moral hazard/ free-riding	Cd	T≥R>S>P

Table 13. Identified corruption risks, management practices and ABM resulting strategies in Ghana

WSD Level	Agent-Principal	Management in case studies	Corruption risks in case studies	Strategy in ABM	Game
Policy and regulation	Regulator-government	Opportunistic	Regulatory opportunism	Dd	T≥R>P>S
	Regulator-water agency			Dd	T≥R>P>S
Provision	Water operator- water agency	Pragmatic	State capture	Dc	T≥R>S>P
Consumption	Water operator-users	Pragmatic	Moral hazard/ free-riding	Cd	T≥R>S>P

At policy and regulatory level in Kenya, the regulator (WASREB) acts as an agent and the government (MWI) as principal. The relationship is characterized by low TAP and the unequal distribution of power between the principals and agents resulting in an opportunistic management. As a result of a power imbalance between the ministries and regulatory bodies and low TAP, politicians have the opportunity to abuse some regulatory powers for their own purposes, known as regulatory opportunism. The resulting Dd strategy from the ABM shows that the Ministry would break the rule of law to take advantage of its situation of power. At the same time the regulator (under the power of the Ministry) would reciprocate.

At provision level, municipalities act as agents and water companies (WSPs) as principals. Municipalities exert power over the water companies and there is low TAP, and as a result there is opportunistic management. The subsequent associated corruption risk is political opportunism. The ABM shows a Dd strategy where municipalities break the rule of law by interfering with management and influence the decisions of the company in order to increase their own gains. In their turn, the water companies, which are under the control of the municipalities, collude with them.

At consumption level, the relationship between water companies (agents) and users (principals) has low TAP and balance of power between the agent and the principal, resulting in a pragmatic management. Moral hazard and free riding were identified as corruption risks, meaning the possibility to encounter two different situations: the water companies respect the rule of law, while users break the rule of law free-riding the service, or WSPs take advantage of the service provided whilst the users respect the rule of law. The resulting strategy from the ABM explains the first situation.

At policy and regulatory level in Ghana, the regulator (PURC) acts as an agent and the government (MHWW). The principal-agent model shows low TAP and the unequal distribution of power between principals and agents resulting in an opportunistic management. As a result of a power imbalance between the ministry and the regulatory body and low TAP, politicians have the opportunity to abuse some regulatory powers for their own purposes. This is known as regulatory opportunism. As in the case of Kenya, the resulting Dd strategy from the ABM may explain how the Ministry would break the rule of law to take advantage of its situation of power. At the same the regulator (under the power of the Ministry) would reciprocate.

At provision level, the water operator (AVRL) is the agent and the water agency (GWLC) is the principal. The pragmatic management is characterized by a balance of power between agents and principals and low TAP (state capture risks) where AVRL can take advantage of GWLC. AVRL and GWLC are motivated by their own interests but AVRL can break the rule of law shaping the design rules of the service management contract in its favor, while GWLC can respect the rule of law as shown by the ABM Dc strategy.

At consumption level, the water operator (agent) and users (principal) have a relationship characterized by low TAP with a balance of power between the agent and the principal, resulting in a pragmatic management. Moral hazard and free riding were identified as corruption risks, meaning the possibility to encounter two different situations: AVRL respects the rule of law, while users break the rule of law free-riding the service, or AVRL could take advantage of the service provided whilst the users respect the rule of law. The resulting strategy from the ABM may explain the first situation.

In summary, Dd strategies resulting from the ABM may explain corruption risks, opportunistic management and low performance. Dd strategies emerge in two cases: First, when the temptation for the agent to defect is high ($T \geq R$), the principal will defect if the social gain is high ($P > S$), resulting in a Dd strategy as in the Prisoner's Dilemma: i.e. the principal cannot refuse a corrupt 'contract' offered by the agent because strong social ties of positive reciprocity exist. The higher the social gain, the higher the payoff of the agent and the principal are. Second, Dd strategies are also reproduced when the temptation of the agent to defect is low ($R > T$) and the social gain is high ($P > S$). In this case, Dd strategies occur as in the Stag Hunt dilemma. However this second situation is not found in the case studies and not shown by the model.

Corruption risks and pragmatic management are characterized by Cd/Dc strategies. Cd/Dc strategies appear when the agent and the principal play a Snow Drift dilemma. Empirical findings from the case studies at consumption level suggest a successive shift in Cd/Dc strategies in the ABM to reproduce moral hazard and free-riding situations. However, the sequential structure of the model with the agent 'moving' first does not allow this situation to be reflected. When the agent's temptation to defect is high ($T > R$), the principal will

cooperate if the social cost is low and participation is high (S > P), resulting in Dc strategies as in the SD game: i.e. the principal can afford to refuse the agent's decision. In other words, the principal will cooperate if the payoff through participation is high and the social cost is low. The symmetric situation (Cd strategies) arises if the agent initially chooses to cooperate, and consequently the principal defects. The equilibrium reflects negative reciprocity in both cases.

CONCLUSIONS

The ABM presented in this paper is a deterministic explanatory learning model that aims to show the relationship of corruption risks and management practices with performance as well as the role of learning and social networks in the field of WSD in Kenya and Ghana.

The ABM draws on principal-agent theory. In the model, coupled actors play different simultaneous games to reflect the various social dilemmas involved in WSD in Kenya and Ghana. This distinguishes the model from similar ones of competition for natural resources where several actors play the same game (e.g. Santos et al. 2007, Janssen 2008). Despite the maximization behavior of the agents, their bounded nature is taken into consideration by the ABM. There are two elements that go beyond a simple (repeated) utility maximizing game: i) the social costs of not reciprocating, which changes the payoff structure of the (simple) game; and ii) learning about the success of different strategies whereby strategies are considered good if the payoff is at least as high as the neighbors' average.

The model suggests a relation of management practices and corruption risks with the performance that emerges from social-dilemma strategies. The strategies in the ABM may explain the principal-agent behavior (cooperation or defection) under specific corruption risks and management practice situations and the resulting performance. The model allows these management practices and the associated corruption risks to be related to the characteristics of the transaction between the agent and the principal, namely transparency, accountability, participation and social costs, the agent's learning and initial decision values.

One of the limitations of the model is the 'simplification' of the actors involved in the different WSD levels. This does not allow the role of the social network and learning in actors' behavior to be fully evaluated. In other words, what happens in one game does not necessarily influence what happens in another game. The simulations show that this learning has little influence on the results. It was observed in several cases that equilibrium is reached after a number of interactions are played between principals and agents. The question remains as to whether a higher number of actors with an increasing number of neighbors' relations would impact on how equilibrium strategies are developed.

LITERATURE CITED

Balacco, H. R. 2011. *Sobre algunas posibles limitaciones del análisis econométrico*. Facultad de Ciencias Económicas, Universidad Nacional de Cuyo, p. 27.

Batley, R. 2004. The Politics of Service Delivery Reform. *Development and Change* 35(1):31-56.

Bell, W. P. 2012. *Progressing from Game Theory to Agent Based Modelling to Simulate Social Emergence*. The Society Pages. [online] URL: http://thesocietypages.org/sociologylens/2012/09/17/progressing-from-game-theory-to-agent-based-modelling-to-simulate-social-emergence/

Bellaubi, F., and J. T. Visscher. 2010. Enhancing integrity to improve service delivery in water service supply provision. Page 19 *in* J. Butterworth, editor. *Pumps, Pipes and Promises: Costs, Finances and*

Accountability for Sustainable WASH Services. IRC Symposium, IRC, The Hague. [online] URL: http://www.irc.nl/page/55907
Bellaubi, F., and J. T. Visscher. 2014. Water service delivery in Kenya and Ghana: an area-based assessment of water utility performance. *Water International*. [online] URL: http://www.tandfonline.com/doi/full/10.1080/02508060.2015.985976
Bellaubi, F., G. Holtz, and C. Pahl-Wostl. 2014. An agent-based model to identify management practices, integrity and performance in Kenya's and Ghana's Water Service Delivery. *CoMSES Computational Model Library*. [online] URL: http://www.openabm.org/model/4144/version/4
Fábrega, J. 2008. Petty corruption and social networks. Political Economy Workshop, Harris School of Public Policy, University of Chicago, 16 April 2008. University of Chicago, Chicago, p. 48. [online] URL: http://harrisschool.uchicago.edu/Programs/beyond/workshops/polecon_archive.asp
Ghana Integrity Initiative (GII). 2011. *Ghana's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Ghana*. [online] URL: http://www.tighana.org/giipages/publication/TISDA%20LAUNCH%20REPORT%202011.pdf
Gilbert, G. 2008. *Agent-based Models*. Series: Quantitative Applications in the Social Sciences, Number 07-153:98. Sage Publications, London.
Guerrero, O. 2009. *Bribery Dynamics: An agent-based approach with evolutionary learning*. Working paper, George Mason University. [online] URL: http://andromeda.rutgers.edu/~jmbarr/EEA2009/guerrero.pdf
Hauert, C., and M. Doebeli. 2004. Spatial structure often inhibits the evolution of cooperation in the snowdrift game. *Nature* 428:643-646.
Huppert, W. 2005. Water management in the Moral Hazard Trap, The example of irrigation. *Paper presented at World Water Week 2005 in Stockholm, seminar on Corruption in the Water Sector: How to fight it*? SIWI, Stockholm, p. 18. [online] URL: http://www.swedishwaterhouse.se/opencms/en/cluster_groups/Completed_Cluster_Groups/Water_and_Anti-corruption_Netwrok.html
Janssen, M. A. 2008. Evolution of cooperation in a one-shot Prisoner's Dilemma based on recognition of trustworthy and untrustworthy agents. *Journal of Economic Behavior & Organization* 65:458-471.
Janssen, M., and E. Ostrom. 2006. Empirically based, agent-based models. *Ecology and Society* 11(2):37.
Kehagias, A. 1994. *Probabilistic learning Automata and the Prisoner's Dilemma*. [online] URL: http://users.auth.gr/~kehagiat/KehPub/other/1994JLA1.pdf
Kirkebøen, G. 2009. Decision behavior – improving expert judgment. Pages 169-194 *in* I. T. W. Williams, K. Samset, and K. J. Sunnevåg, editors. *Making Essential Choices with Scant Information. Front-End Decision Making in Major Projects*. Palgrave-Macmillan, New York.
Lambsdorff, J. G. 2007. *The New Institutional Economics of Corruption and Reform: Theory, Policy and Evidence.* Cambridge University Press, Cambridge, p. 286.
Lambsdorff, J., and F. Björn. 2007. *Corrupt Reciprocity: An Experiment Diskussionsbeitrag.* Nr. V-51-07. Passauer Diskussionspapiere, Universität Passau, p. 20.
Molle, F., and J. Berkoff. 2007. Water pricing in irrigation; mapping the debate in the light of the experience. Pages 21-93 *in* F. Molle, and J. Berkoff, editors. *Irrigation Water Pricing: The Gap Between Theory and Practice*. CABI, Oxfordshire.
Nowak, M., and R. May. 1992. Evolutionary games and spatial chaos, *Nature* 359:826-829.
Pahl-Wostl, C., J. Sendzimir, P. Jeffrey, J. Aerts, G. Berkamp, and K. Cross. 2007. Managing change toward adaptive water management through social learning. *Ecology and Society* 12(2):30. [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art30/
Power, C. 2009. A spatial agent-based model of N-Person Prisoner's Dilemma. cooperation in a socio-geographic community. *Journal of Artificial Societies and Social Simulation* 12(1):8. [online] URL: http://jasss.soc.surrey.ac.uk/12/1/contents.html
Santos, F., and J. Pacheco. 2005. A new route to the evolution of cooperation. *European Society for Evolutionary Biology* 19:726-733.
Santos, F, J. Pacheco, and T. Lenaerts. 2007. Cooperation prevails when individuals adjust their social ties. *Presentation at NetSci 2007, NY.* [online] URL: http://www3.nd.edu/~netsci/TALKS/Santos_CT.pdf

Sheng, Z.-H., Y.-Z. Hou, X.-L. Wang, and J.-G. Du. 2008. The Evolution of Cooperation with Memory, Learning, and Dynamic Preferential Selection in Spatial Prisoner's Dilemma Game. 2007 International Symposium on Nonlinear Dynamics. *Journal of Physics*: *Conference Series* 96:1-6. [online] URL: http://iopscience.iop.org/1742-6596/96/1/012107

Situngkir, H. 2003a. *Moneyscape: A generic agent-based model of corruption*. Working Paper WPC2003. Bandung Fe Institute, Bandung.

Situngkir, H. 2003b. The dynamics of corruption. *Journal of Social Complexity* 1(3):3-17. Bandung Fe Institute, Bandung.

Szilagyi, M. 2003. Simulation of multi-agent Prisoner's Dilemma. *Systems Analysis and Modeling Simulation* 43(6):829-846.

Szilagyi, M., and I. Somogyi. 2008. Agent-based simulation of *N*-Person Games with crossing payoff functions. *Complex Systems* 17:427–439.

TI Kenya. 2011. *Kenya's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Kenya*. Transparency International Kenya, Kisumu, Kenya. [online] URL: http://www.tikenya.org/~tikenyao/index.php?option=com_docman&task=cat_view&gid=115&limitstart=5

Wilensky, U. 1999. *NetLogo*. Center for Connected Learning and Computed-Based Modelling, Northwestern University, Evaston, IL. [online] URL: http://ccl.northwestern.edu/netlogo

Paper 2

An agent-based model to identify management practices, integrity and performance in Kenya's and Ghana's Water Service Delivery

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Abstract

The agent-based model represents the main actors involved in Water Service Delivery (WSD) in Kenya and Ghana. These actors are modelled in terms of a principal and an agent playing different games that reflect different social dilemmas. The payoffs of the various games are defined based on the transparency, accountability, participation and social cost of the relationships between the principal and the agent. The decisions of the bounded-rational actors take into account the expected payoff as well as social comparisons. The decisions adopted by the actors constitute different management practices. The model can be used as a Decision Support Tool showing the best payoffs according to different management practices.

The model is based on empirical research carried out by Transparency Intentional Kenya and Ghana Integrity Initiative.

Key words: Water Service Delivery, management, transparency, accountability, participation, social cost, performance

1. Purpose

The agent-based model (ABM) addresses the following research question: how is the performance of Water Service Delivery (WSD) affected by the relation between management practices and integrity in terms of transparency, accountability and participation?

To address this question the ABM simulates games between the main actors involved in the WSD of Kenya and Ghana. These games define a specific social network for Kenya and Ghana. A game is defined by two actor's relationship. Actors can cooperate or defect (decision) with the peer in order to maximize his payoff. Payoffs are derived from the transparency, accountability, participation and social cost levels identified for the respective transactions between the actors. The decisions of two actors playing a game define a management practice. Management practices are related to the different equilibriums of the social dilemmas identified by the game theory.

The modelled relation between transparency, accountability, participation and social cost and previously defined management practices makes it possible to explain the differences in WSD between Kenya and Ghana. Furthermore, it allows more general conclusions on the factors influencing WSD to be drawn. It can be used as a Decision Support System to show how the performance of the actors and the system evolve when transparency, accountability, participation and social cost change.

The agent-based model is based on both National Water Integrity Studies (NWIS) carried out by Transparency International Kenya (2011) and Ghana Integrity Initiative (2011) in their respective countries. The NWISs compiled information from different case studies in these two countries. In Kenya three case studies were carried out namely Old Town (Mombasa), Migosi (Kissumu) and Kangemi (Nairobi). In Ghana, two case studies were carried out in Nima and Madina (Accra). Consequently two different models are initialized: one for Ghana and one for Kenya.

The ABM is presented according to the 'Overview, Design concepts and Details' (ODD) protocol developed by Grimm et al. (2006), Grimm et al. (2010) and Railsback and Grimm (2012). The main idea of the ODD protocol is to structure the information about the ABM in a logical way so that it is easy to understand the sequence of the modelling. This sequence consists of seven elements that can be grouped in three blocks: Overview, Design concepts, and Details. The Overview presents the overall purpose and structure of the model in three subsections: purpose, state variables and scale, process overview and scheduling. The Design concept section describes the general concepts underlying the design of the model. The Details includes three elements: initialization, input, and submodels, which contain the technical details of the model (Grimm et al. 2006).

2. Entities, state variables and scales

The actors relate to each other in games. A game represents a transaction between two actors: one actor playing as an agent that provides a service and the peer playing as a principal that receives the service. The agent receives a return from the principal for the service provided. Services and returns constitute the 'payoff' of the relationship.

The entities of the model are the main actors found in the case studies: the users, providers, regulator and government, coupled into pairs of principals and agents and each playing a game defined by the values of the payoff table. The actors can play in multiple games simultaneously. The state variables are the expected utility, payoff and decisions. The agents also have expectations of the principals' behaviour and a learning capacity.

3. Process overview and scheduling

The processes that are executed for each round of the games are: 1) *agent_decision,* 2) *principal_decision,* 3) *get_payoff* and 4) *update_expectation*.

In a*gent_decision*, the agent re-iterates his previous decision if he has been better off than his peers have been on average. The assumption here is that the agent does not have full information of the consequences of acting differently and therefore evaluates his previous decision as 'good enough' as long as he is at least as well off as his peers in the network. If this is not the case, he tries to improve through taking a deliberate decision based on the maximization of the expected utility and his expectations of the principal's behaviour.

In *principal_decision* the principal maximizes his payoff based on his knowledge of the agent's prior decision to cooperate or defect.

During *get_payoff*, payoff values are assigned to the agent and the principal taking into consideration both's decisions and according to the values of the payoff table.

Finally in *update_expectation*, the agent's expectation of the behaviour of the principal is updated based on the principal's decision. The agent's expectation is influenced by the learning capacity of the agents.

4. Design concepts

Basic Principles: The model builds on the principal-agent theory (Huppert, 2005) where a principal and an agent relate to each other. The relation involves a transaction where the agent offers a service to the principal and the principal pays the agent in return. Under the principal-agent framework, the agent can hide information to the principal, failing *ex-ante* to provide the service. In his turn, the principal can neglect *ex-post* the return for the service provided. Finally, an external observer[17] can verify and influence the transaction if sufficient information is accessible to him (Bellaubi & Visscher, 2010). Bellaubi & Visscher (2010) characterize transactions according to different levels of transparency, accountability and participation. A transaction sets up a game that is defined according to a payoff table whose values are derived from the transparency, accountability, participation and social cost levels. Different values of the payoff table determine different social dilemmas. In the game, to *cooperate* means to follow the rule of law, while to *defect* is equivalent to breaking the rule of law. According to the decision of the agent and principal to cooperate or defect, they each get a payoff representing the value of the service and the return respectively. This is shown in Table 1, where the first entry in each cell gives the payoff of the agent, with R being the reward of mutual cooperation, P being the payoff of mutual defection, T being the temptation to defect, and S being the 'sucker's' payoff. The second entry in each cell gives the payoff for the principal, which is the same as that of the agent. The performance of the transaction is defined as the sum of both payoffs. The decisions of the coupled pairs (i.e. Cc, Dd, Cd or Dc) define different management practices. Ethical management is defined by mutual cooperation between the principal and agent both following the rule of law. Under opportunistic management, the principal and agent both decide to defect, breaking the rule of law. This can represent a 'corrupted deal', which may generate social gains for both actors (see below). Situations in which one actor cooperates and one defects define a pragmatic management.

Table 1 Payoff table. C = agent cooperates, D = agent defects, c = principal cooperates, d = principal defects, where R = r, T = t, S = s, P = p

	Principal action	
Agent action	**C (following the rule of law)**	**D (breaking the rule of law)**
C (following the rule of law)	R, r	S, t
D (breaking the rule of law)	T, s	P, p

According to the different values of R, r, T, t, S, s and P, p, we can define three possible games or social dilemmas with different equilibriums (Table 2) that match different management practices.

[17] We define an external observer as an independent actor not directly involved in the principal-agent transaction but with possible transactions with the principal, the agent, or both.

Table 2 R, T, S and P values defining social dilemmas and equilibrium strategies and associated management practices according to the game theory

Game (social dilemma)	Payoff values	Equilibrium strategy	Management practice
Prisoner's Dilemma (PD)	T > R > P > S	Dd	Opportunistic management
Stag Hunt (SH) game	R > T > P > S	Cc Dd	Ethical management Opportunistic management
Snow Drift (SD) game	T > R > S > P	Cd, Dc	Pragmatic management

The agent behaves boundedly rationally. The assumption here is that the agent does not have full information about the consequences of his actions and therefore evaluates his previous decision as 'good enough' as long as he is at least as well off as his peers in the network. If this is not the case, he tries to improve through taking a deliberate decision based on his expectations of the principal's behaviour.

Emergence. In the model, the different management practices emerge of the actors' successive decisions to cooperate or defect with the peer. Management practices are imposed by the different values of transparency, accountability, participation and social cost. Social network does not seem to play a role in defining management practices. The performance of the system results from the different management practices.

Observation. The model output shows the decisions of all the players in all the games over time, accumulated payoff per management practice per game, and the payoff of each actor as well as the total performance of the system.

Adaptation. The payoff of the principal is affected by the previous decision of the agent, and therefore the principal decides based on the previous decision of the agent. Afterwards the agent adapts his expectations of the principal's behaviour as explained in the section 'Learning'.

Objective. The objective of each actor is to maximize his payoff. According to Janssen (2008), we know from experimental research that people not only value material payoff, but also non-material consequences such as the improvement or deterioration of social relationships. In order to include such social costs or gains of the transaction, the payoffs defined in the payoff table include material payoffs as well as the social cost or gain, as explained in detail in the section 'Submodels'.

Prediction. The agent predicts the behaviour of the principal when he is not better off than his peers are on average. This is explained in detail in the section 'Submodels'.

Learning: The agent learns from the principal's behaviour and builds up expectations of the principal's future behaviour. The agent's expectation of the principal's behaviour is influenced by the learning capacity of the agent based on his previous experience.

Interaction. The principal and agent will take decisions to maximize their payoff. The payoffs of both depend on both's decisions.

Scheduling. The games are played in a sequence (sequential game). This means that the agent moves first and takes a decision that is followed by the principal's decision (e.g. first the agent delivers water and then the principal decides to pay the bill or not).

Stochasticity. The model is deterministic and the initial decisions of the actors are imposed. There is no influence by random numbers.

Collectivities. Coupled pairs of principals and agents play simultaneously different games. Games can be changed when changing the values of R, T, S and P according to different accountability, participation and social cost values.

5. Initialization

The NWIS carried out in Kenya and Ghana provide the following inputs:

a) The transparency, accountability, participation and social cost/gain of the transactions between a principal and an agent. These values define the payoff matrix of services and returns.
b) The structure of the social network, i.e., who plays which game with whom and in what role (what are the games, who is the agent and who is the principal).
c) The actor's initial decisions as well as the learning capacity of the actors when playing as agents.

6. Input data

The values of, R, T, S and P are derived from the values of accountability, participation and social cost/gain in the case studies.

The initial decision of the principals and agents to cooperate (the actors follow the rule of law in the provision of the service) or defect (the actors break the rule of law in the expected return) as well as the learning capacity of the actors are also introduced manually according to the case studies.

7. Submodels

In *agent_decision*, the agent re-iterates his previous decision if he has been better off than his peers have been on average. The assumption here is that the agent does not have full information of the consequences of acting differently and therefore evaluates his previous decision as 'good enough' as long as he is at least as well off as his peers in the network. If this is not the case, he tries to improve through taking a deliberate decision based on the maximization of the expected utility (EU) and his expectations of the principal's behaviour (EPC) as follows.

$EU_{agent}(C) = EPC * R + (1 – EPC) * S$
and
$EU_{agent}(D) = EPC * T + (1 – EPC) * P$

For $EU_{agent}(C) > EU_{agent}(D)$, then agent C
For $EU_{agent}(C) \leq EU_{agent}(D)$, then agent D

In *principal_decision* the principal maximizes his payoff (EU) based on the knowledge of the agent's prior decision to cooperate or defect. Therefore,

if at t, agent_decision = C
then $EU_{principal}(c) = r$ and $EU_{principal}(d) = s$

if at t, agent_decision = D
then, $EU_{principal}(c) = t$ and $EU_{principal}(d) = p$

For $EU_{principal}(c) > EU_{principal}(d)$, then principal c
For $EU_{principal}(c) \leq EU_{principal}(d)$, then principal d

During *get_payoff*, payoff values are assigned to the agent and the principal taking into consideration both's decisions and according to the values of the payoff table.

The payoffs defined in the payoff table include the material payoff as well as the social cost or gain, as explained in detail in the following (see Table 3):

R is the service offered by the agent or the return the principal pays to the agent to get the service when both cooperate. The optimal service/return can be arbitrarily valued as 1, i.e., R = 1. It is assumed that if both act according to the law this has no effect on social relationships.

T is the temptation of the agent to provide only a suboptimal service while receiving an optimal return or the temptation of the principal to receive an optimal service while providing only a suboptimal return. T can hence arguably be higher than R. It depends however on the accountability of the transaction which reflects punishment through the control mechanisms in place. To reflect these considerations we set T = 1.5 - accountability, where accountability ϵ [1, 0] and therefore T ϵ [1.5, 0.5].

S is the 'sucker's' payoff as a result of being cheated when offering an optimal service or an optimal return but receiving only a suboptimal return or service. S increases with the level of participation of the transaction and decreases with the social cost involved of not reciprocating. Participation thereby includes the observation of the transaction through third parties (e.g. NGOs, the general public, and the regulator) and the resulting incentive to act according to the law, even if cheated by the peer. This incentive is modelled here as the benefit received by the cheated, if he decides to cooperate. In its turn, the social cost reflects the social consequences for an individual of his personal decision and this becomes relevant in cases where the agent or the principal have strong social ties with the peer, e.g. a bribe that is offered whose rejection causes disturbance in the receiver's social relationships in terms of

social costs[18]. It is assumed that direct social ties weigh heavier than participation. We therefore set S = (participation / 2) – social cost, where participation ϵ [0,1], social cost ϵ [0, 0.5] and consequently S ϵ [-0.5, 0.5].

P is the suboptimal service or return of the principal and the agent respectively when both defect and can be considered almost nil. We consider that when both the agent and principal break the rule of law there is a corrupt deal (Lambsdorf, 2007) involving a social gain as a result of the social ties of reciprocity between the agent and the principal. Social gains are considered to be equivalent to the social costs introduced above, such that P ϵ [0, 0.5].

Table 3 Calculation of the payoffs

Payoff value	Formula
T	1.5 - accountability
R	1
S	(participation / 2) - social cost
P	social gain

Finally in *update_expectation*, the agent's expectation of the principal's behaviour is updated based on the principal's decision. The agent's expectation that the principal will cooperate (EPC) or defect (1 – EPC) is influenced by the learning capacity of the agents that weights the current experience with the expectations which have been built up in previous games.

If the principal decides to cooperate, then the expectation that the principal acts in a similar way in future games is increased:

if at t, principal_decision = c
then, EPC (t + 1) = EPC (t) + (1 - EPC (t)) * Lc
with Lc being the learning rate assigned to each agent, where 0 < Lc < 1.

If the principal decides to defect, then the expectation that the principal cooperates in future time steps decreases:

if at t, principal_decision = d
then, EPC (t + 1) = (1 - Lc) * EPC (t)

The initial value of EPC is equal to the transparency of the principal-agent transaction.

[18] The rationale is that actors may suffer from the so-called 'Bureaucrat's Dilemma': '*sometimes [bureaucrats] they need to bend rules to remain a participant on network of reciprocity (even at his own risk and without immediate retribution [sic])'* (Fabrega, 2008). Thus, the actors are members of networks and their decisions are influenced by their role as a member of the network.

8. Bibliography

Bellaubi, F. and Visscher, J.T. (2010). "Enhancing integrity to improve service delivery in water service supply provision". Pumps, Pipes and Promises: Costs, Finances and Accountability for Sustainable WASH Services, IRC Symposium. Butherwood, J. (Ed.). IRC, The Hague, 19 p. http://www.irc.nl/page/55907

Fábrega J. (2008). 'Petty Corruption and Social Networks'. Harris School of Public Policy University of Chicago. Political Economy Workshop, University of Chicago, 16 April 2008, p. 48. Accessed 24.1.2010. Source: http://harrisschool.uchicago.edu/Programs/beyond/workshops/polecon_archive.asp

Ghana Integrity Initiative (2011). 'Ghana's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Ghana'. Accessed 30.07.2012.Source: http://www.tighana.org/giipages/publication/TISDA%20LAUNCH%20REPORT%202011.pdf

Grimm, V., Berger, U., Bastiansen, F., Eliassen, S., Ginot, V., Giske, J., Goss-Custard, J., Grand, T., Heinz, S., Huse, G., Huth, A., Jepsen, J. U., Jørgensen, C., Mooij, W. M., Müller, B., Pe'er, G., Piou, C., Railsback, S. F., Robbins, A. M., Robbins, M. M., Rossmanith, E., Rüger, N., Strand, E., Souissi, S., Stillman, R. A., Vabø, R., Visser, U., DeAngelis, D. L., (2006). 'A standard protocol for describing individual-based and agent-based models'. *Ecological Modelling* 198, pp. 115-126.

Grimm, V., Berger, U., DeAngelis, D. L., Polhill, J., Giske, J., and Railsback, S. (2010). 'The ODD protocol: A review and first update'. *Ecological Modelling* 211, 2760, p. 68.

Huppert, W. (2005). "Water Management in the 'Moral Hazard Trap' The Example of Irrigation". Paper presented at World Water Week 2005 in Stockholm, seminar on 'Corruption in the Water Sector: How to fight it?. SIWI Stockholm. 18 p. Accessed 23-1-2010 Source: http://www.swedishwaterhouse.se/opencms/en/cluster_groups/Completed_Cluster_Groups/Water_and_Anti-corruption_Netwrok.html

Janssen, M.A. (2008). 'Evolution of cooperation in a one-shot Prisoner's Dilemma based on recognition of trustworthy and untrustworthy agents'. *Journal of Economic Behavior & Organization,* Vol. 65, pp. 458–471.

Lambsdorff, J.G. (2007): '*The New Institutional Economics of Corruption and Reform: Theory, Policy, and Evidence*', Cambridge University Press, p. 286.

Railsback S. and Grimm V. (2012). '*Agent-Based and Individual-Based Modeling. A practical introduction*'. Princeton University Press, Princeton, p. 329.

Transparency International Kenya (2011). 'Kenya's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Kenya'. Transparency International Kenya. Accessed 07.12.2011. Source: http://www.tikenya.org/~tikenyao/index.php?option=com_docman&task=cat_view&gid=115&limitstart=5

7. General conclusions

This thesis proposed the following research question: 'How does the relation between corruption risks and management practices explain the low performance of WSD in Kenya and Ghana?' This question is answered through the development of an ABM. The ABM is a deterministic model that builds on the findings of performance, corruption and management in WSD in the five case studies in Kenya and Ghana. The characterization of corruption risks, management practices and performance that serve to develop the ABM model constitute the answers to the three sub-research questions in each of the different chapters of this thesis.

1. What is the performance of the urban WSD in Ghana and Kenya? (Chapter Three)

Using a Water Service Delivery Approach (WSDA), the answer to the first sub-research question shows that low-income urban areas in the case study areas are characterized by low performance.

2. What is the integrity of urban WSD in Ghana and Kenya in relation to governance mechanisms and what are the corruption risks? (Chapter Four)

The answer to the second sub-research question shows that corruption risks can be characterized according to transparency, accountably and participation (TAP integrity model) in the relationship between social actors (represented as principals and agents) at the policy and regulation, provision and consumption WSD levels. At policy and regulatory level, ministries in Kenya and Ghana influenced regulatory bodies, known as political opportunism. At provision level, Kenyan municipalities could interfere in the water corporation management (political optimism), whilst in Ghana the water operator's interests could influence the water agency (state capture). Free-riding and moral hazard were common corruption risks in both Kenya and Ghana between water companies and users (Kenya) and between the water operator and users (Ghana).

3. What are the management practices related to WSD corruption risks in Kenya and Ghana? (Chapter Five)

The answer to this sub-research question is the characterization of different management practices according to the power balance analysis between principals and agents in relation to

corruption risks. The result of the analysis showed that opportunistic management is characterized by low TAP and power imbalances between principals and agents, which is the case between ministries and regulatory bodies in Kenya and Ghana at regulatory level and between municipalities and water corporations in Kenya.

The relation between corruption and management can be explained through the empirical findings of the case studies; however, these do not offer enough insights to further understand the relation with performance in WSD. To answer the main research question

> ***'How does the relation between corruption risks and management practices explain the low performance of WSD in Kenya and Ghana?'*** (Chapter Six)

the research develops an ABM using the fundamentals of game theory and based on the empirical relation between corruption and management found in the case studies in Kenya and Ghana in order to explain the low performance of WSD.

In the ABM, the corruption risks are characterized by TAP levels that define a payoff matrix, where a specific payoff matrix represents a social dilemma in game theory. Management practices emerge from the different cooperation defection strategies resulting from the choices of the principals and agents involved in WSD. Strategies provide a payoff that represents the WSD performance at the policy and regulation, provision and consumption levels. Power relations between principals and agents are considered via social comparison.

The main conclusion to the present research is:

That the relation between performance and corruption is more complex than rent-seeking theory wants to acknowledge. The rent-seeking theory states that measures to improve performance in WSD will reduce corruption. This research shows that corruption risks (defined by TAP levels) relate to management practices in terms of balance of power between agents and principals and that different management practices affect the performance of WSD. The ABM shows that opportunistic management practices occur where there is a power imbalance between agents and principals and that low TAP results in low performance of WSD (represented by the Prisoner's Dilemma). Thus this research provides a better

understanding and explanation of the relation between corruption and performance in WSD than rent-seeking theory provides, by considering the relation with management practices.

In terms of the response given to answer the main research and sub-research questions, the use of social simulation through ABM together with case studies has proved useful in the analysis of the relation between corruption, management and performance in a specific water governance situation defined by the case studies in Kenya and Ghana. Meanwhile, the empirical findings of the case studies may explain how corruption and management practices relate in terms of power balance between the social actors involved in WSD, although they are not sufficient to explain how the corruption and management relation affects the performance of WSD. The understanding of the relation between corruption risks, management practices and WSD performance can be achieved with the help of ABM. The use of ABM as a tool able to capture bounded rationality enables an assessment of the impact of specific management practices on performance when changing the integrity (TAP levels) on rules in WSD within the context of multiple and inter-dependent relationships. ABM helps in unfolding these complex relationships using the empirical findings of the case studies to examine possible relations and comparing results against game theory. However, an interesting point still to be further explored is the role of social links (social networks) in relation to corruption and management practices.

The research offers an insight in order to reduce corruption, enhance management and improve the performance of WSD by using case studies and social modelling. Case studies are a good approach for identifying corruption risks and management practices, putting forward remedial actions led by actors involved in the WSD of a specific location. The use of ABM together with the case studies may improve and stimulate the discussions within multi-stakeholder settings, making complex effects of interventions comprehensible and visible.

8. Bibliography

(This bibliography refers to Chapters 1, 2 and 7)

- **Auriol, E. and Blanc, A.** (2008). 'Capture and corruption in public utilities: The cases of water and electricity in Sub-Saharan Africa'. Utilities Policy 30, pp. 1–14.
- **Asis de, M., O'Leary, D., Butterworth, J., and Ljung, P.,** (2009). 'Improving Transparency, Integrity and Accountability in the Water and Sanitation Sector', p. 177. World Bank Institute.
- **Baietti, A., Kingdom, W. and Van Ginneken, M.** (2006). 'Characteristics of well performing public water utilities. Water Supply & Sanitation Working Notes'. Note No. 9, May 2006. World Bank.
- **Barker A. and Manji F.** (2000). *'Writing for a Change. An Interactive Guide to Effective Writing, Writing for Science, and Writing for Advocacy'*. IDRC p. 28
- **Barreteau, O.** (2003). 'The joint use of role-playing games and models regarding negotiation processes: characterization of associations'. *Journal of Artificial Societies and Social Simulation*, 6 (2), p. 23. Accessed 02.02.2010. Source: http://jasss.soc.surrey.ac.uk/6/2/3.html
- **Bellaubi, F. and Visscher, J.T.** (2010). 'Enhancing integrity to improve service delivery in water service supply provision. Pumps, Pipes and Promises: Costs, Finances and Accountability for Sustainable WASH Services', IRC Symposium. Butterworth, J. (Ed.). IRC, The Hague, p. 19. Accessed 15.05.2014. Source: http://www.irc.nl/page/55907
- **Boehm, F.** (2007). 'Regulatory Capture Revisited – Lessons from Economics of Corruption'. Working Paper No. 22. University of Passau, p. 30. Accessed 23.01.2010. http://www.icgg.org/corruption.research.html
- **Bousquet, F., Lifran, R., Tidball, M., Thoyer, S. and Antona, M.** (2001). 'Agent-based modelling, game theory and natural resource management issues', *Journal of Artificial Societies and Social Simulation*, 4 (2). Accessed 15.09.2014. Source: http://jasss.soc.surrey.ac.uk/4/2/0.html
- **Braadbaart, O., Van Eybergen, N. and Hoffer, J.** (2007). 'Managerial Autonomy: Does it matters for the performance of water utilities?' Public Admin. Dev. 27, pp. 111–121.
- **Brown, E., Cloke, J. and Sohail, M.** (2004). **'**Key Myths about Corruption: A Briefing paper for a Workshop on Corruption and Development', Development Studies Association Annual Conference, Church House, Westminster, Saturday 6 November 2004, p. 12.
- **Butterworth, J.** (2009). 'Transparency and Accountability in the water sector'. For regional workshop organized by GII, IRC and TREND with support of the Water Integrity Network 26-27 September, Accra, Ghana.

- **Cavill, S. and Sohail, M.** (2007). 'Accountability arrangements to combat corruption: Literature review'. In Partnering to combat corruption series. Sohail, M. (Ed.). Water, Engineering and Development Centre WEDC. Loughborough University, UK, p. 76. Accessed 24.01.2010. Source: http://wedc.lboro.ac.uk/research/project_details.html?p=15
- **Davis, J.** (2004). 'Corruption in Public Service Delivery: Experience from South Asia's Water and Sanitation Sector.' *World Development* 32, No. 1: pp. 53–71.
- **Della Porta, D. and Vannucci, A.** (2005). 'Corruption as a Normative System'. Prepared for presentation at the International Conference on Corruption control in Political Life and the Quality of Democracy: A Comparative Perspective Europe – Latin America CIES - ISCTE, 19-20 May 2005. p. 22.
- **Domanski, A.** (2007). 'Regulation in a Liberalized Water Sector: How Institutional Weaknesses Can Lead to Dysfunctions?' Symposium on Privatisation and Regulation, 22/23.03.2007, TU Delft, p. 19. Accessed 23-01-2010. http://www.tbm.tudelft.nl/live/pagina.jsp?id=385313b2-4cc4-414f-adb4-515587b88522&lang=en
- **Fábrega, J.** (2008). 'Petty Corruption and Social Networks'. Harris School of Public Policy University of Chicago. Political Economy Workshop, University of Chicago, 16 April 2008, p. 48. Accessed 24-01-2010. http://harrisschool.uchicago.edu/Programs/beyond/workshops/polecon_archive.asp
- **Funtowicz, S.O., Martinez-Alier, J., Munda G. and Ravetz, J.R.** (1999). **'**Information tools for environmental policy under conditions of complexity'. Environmental issues series No 9. European Environment Agency. p. 34.
- **Guerrero, O.** (2009). 'Bribery Dynamics: An agent-based approach with evolutionary learning'. Working paper, George Mason University. Accessed 22.10.2012. Source: http://andromeda.rutgers.edu/~jmbarr/EEA2009/guerrero.pdf
- **Huppert, W. and Wolff, B.** (2002). 'Principal-agent problems in irrigation – inviting rentseeking and corruption'. *Quarterly Journal of International Agriculture*, 41 (2002), No. ½, pp. 99-118.
- **Huppert, W.** (2005). 'Water Management in the ‚Moral Hazard Trap' The Example of Irrigation'. Paper presented at World Water Week 2005 in Stockholm, seminar on 'Corruption in the Water Sector: How to fight it? SIWI Stockholm. 18 p. Accessed 23-1-2010 http://www.swedishwaterhouse.se/opencms/en/cluster_groups/Completed_Cluster_Groups/Water_and_Anti-corruption_Netwrok.html
- **Janssen, M.A.,** (2005). 'Agent-Based Modelling'. Internet Encyclopaedia of Ecological Economics 2005. Arizona State University. USA, p. 9. Accessed 02.02.2010. Source: http://www.ecoeco.org/education_encyclopedia.php

- **Kaufmann, D.** (2005). 'Myths and Realities of Governance and Corruption'. In Global Competitiveness Report 2005-06 (2005). MPRA Paper No. 8089, pp. 81-98. Accessed 24.01.2010. Source: http://mpra.ub.uni-muenchen.de/8089/
- **Kingdom B., Liemberger R. and Marin P.** (2006). 'The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries. How the Private Sector Can Help: A Look at Performance-Based Service Contracting'. Water Supply and Sanitation Board discussion papers Series 8 (2006). The World Bank, Washington, USA, p. 52. Accessed 02.02.2010. Source: http://www.ppiaf.org/content/view/356/485/
- **Krause, M.** (2009). 'The political economy of water and sanitation'. New York. Routledge, p. 252.
- **Lambsdorff, J.G.** (2007) '*The New Institutional Economics of Corruption and Reform: Theory, Policy, and Evidence'*, Cambridge University Press, p. 286.
- **Mollinga, P.** (2008). 'For a political sociology of water resources management'. In: Evers, H.-D., Gerke, S., Mollinga, P., Schetter, C. (Eds.) ZEF Working Paper Series 31. Center for Development Research, University of Bonn, p. 57. Accessed 02-02-2010 http://www.zef.de/workingpapers.html
- **North, D.C.** (1992). 'The new institutional economics and development'. Washington University, St. Louis. This essay is drawn from the John R. Commons lecture given at the American Economic Association meetings in January 1992 and subsequently published in the American Economist (Spring 1992, pp. 3-6) under the title "Institutions and Economic Theory".
- **Ostrom, E. (**1998). 'A behavioral approach to the rational choice theory of collective action.' American Political Science Review 92 (1), pp. 1-22.
- **Pahl-Wostl, C., Sendzimir, J., Jeffrey, P., Aerts, J., Berkamp, G. and Cross, K.** (2007). 'Managing change toward adaptive water management through social learning'. *Ecology and Society* 12(2). 30, p. 18. Accessed 02.02.2010. Source: http://www.ecologyandsociety.org/vol12/iss2/art30/
- **Plummer, J. and Cross, P.** (2007). 'Tackling Corruption in the Water and Sanitation Sector in Africa'. Starting the Dialogue. In The Many Faces of Corruption. Campos, J.E. and Pradhan, S. (Eds). World Bank. Washington. Accessed 23-1-2010 http://publications.worldbank.org/ecommerce/catalog/product?item_id=5824318
- **Repetto, R.** (1986). 'Skimming the water: rent-seeking and the performance of public irrigation systems'. Research Report No. 4. Washington. World Resources Institute. Washington, USA, p. 47.
- **Rinaudo, J.D.** (2002). 'Corruption and allocation of water: the case of public irrigation in Pakistan'. *Water Policy* 4, pp. 405–422.

- **Rose-Ackerman, S.** (1997). 'The political economy of corruption'. In: Corruption and the Global Economy. Elliott, K.A. (Ed). Institute for International Economics. Washington DC, EEUU, pp. 31-60. Accessed 23.01.2010. Source: www.iie.com/publications/chapters_preview/12/2iie2334.pdf
- **Situngkir, H**. (2003). 'Moneyscape: A Generic Agent-Based Model of Corruption'. Working Paper WPC2003. Bandung Fe Institute.
- **Theesfeld, I.** (2001). 'Constraints for Collective Action in Bulgaria's Irrigation Sector'. Central and Eastern European Sustainable Agriculture (CEESA) Discussion Paper No. 5 2001, p. 28. Accessed 25-01-2010 http://ageconsearch.umn.edu/handle/18891
- **TI Kenya** (2011). 'Kenya's National Water Supply Integrity Study. Mapping Transparency, Accountability & Participation in Service Delivery: An Analysis of the Water Supply Sector in Kenya'. Transparency International Kenya. Accessed 07.12.2011. Source: http://www.tikenya.org/~tikenyao/index.php?option=com_docman&task=cat_view&gid=115&limitstart=5
- **Transparency International** (2009). 'The Anti-Corruption Plain Language Guide', p. 60. Transparency International.
- **Transparency International TI** (2008). 'Global Corruption Report 2008'. Corruption in the water sector. TI. Cambridge University Press, p. 398.
- **Trop, H. and Stålgren, P**. (2005). 'The Dynamics of Corruption: Putting limitations to water development'. A paper originally prepared for Stockholm World Water Week Seminar, 2005: Can International Water Targets Be Met without Fighting Corruption? p. 13.
- **UNDP (2004)**. 'Anti-corruption Practice Note'. p. 35. Accessed 28.03.2011 Source http://www.undp.org/governance/docs/AC_PN_English.pdf#sthash.FRUV5Ab0.dpuf
- **Wade, R.** (1982). 'The System of Administrative and Political Corruption: Canal Irrigation in South India,' Journal of Development Studies, 18, 2 (1982), pp. 287-327.
- **Wutich, A.** (2007). 'Vulnerability, Resilience, and Robustness to Urban Water Scarcity: A Case from Cochabamba, Bolivia'. In: Perspectives on Social Vulnerability. Warner, K, (Ed). SOURCE Studies of the University: Research, Counsel, Education Publication Series of UNU-EHS No. 6/2007, pp. 62-71. Accessed 25.01.2010. Source: http://www.ehs.unu.edu/category:17?menu=36
- **Yin, R. K.** (1989). 'Case study research: design and methods'. Newbury Park, CA: Sage.