

Institutional analysis of groundwater irrigation in Northeast Ghana

LYDIA KWOYIGA

Department of Hydrosociences, 01069, Technische Universität Dresden, Dresden, Germany.

Email: lydia.kwoyiga@tu-dresden.de

Abstract

Groundwater irrigation is a major livelihood activity particularly in the dry season in Ghana. Considering their significance including shaping economic incentives and defining property rights, institutions have been crafted to regulate the use of groundwater for this purpose. Ghana's water sector institutions, in general, have undergone several reforms. However, analysis of them tends to focus on formal institutions which relate to surface water irrigation rather than groundwater irrigation. Such analysis focuses more on the working of laws, policies and administration; the three pillars of the water economy which the New Institutional Economics (NIE) regarded as the Institutional Environment. Discussions of this sort are widespread and are seen recently in the works of Maria Saleth, Ariel Dinar and D.J. Bandaragoda, perhaps influenced by Elinor Ostrom's contributions culminating in her award of the Nobel Prize in Economics. This paper differed in that it looked at both formal and traditional/informal institutions in regulating groundwater for irrigational purposes and the implications of these for groundwater sustainability. Ethnographic studies in Atankwidi showed major limitations of the position of NIE as far as institutions regulating groundwater for irrigation are concerned. The findings implied that informal institutions were more effective than formal institutions. Additionally, informal institutions were widely adopted while formal institutions were poorly enforced due to lack of interest by formal administrative agencies. Considering the future of groundwater resources for irrigation, the informal institutions managed demand effectively but needed improvement to boost recharge. There is, therefore, the need for traditional leaders to reconstitute the existing informal institutions taking into consideration measures of tree planting, water conservation practices and conjunctive use of surface and groundwater resources.

Keywords: Institutions; Analysis; Groundwater Irrigation; Ghana; Qualitative.

1. Introduction

There seems to be a general consensus among theorists and researchers regarding the importance of institutions in influencing human behaviour (De Koning, 2011). Institutional theories have been widely applied in discussing natural resources management, especially Common Property Resources. With the publication of *The Tragedy of the Common* by Garret Hardin (1968) followed by counter arguments by Elinor Ostrom and others, the institutional debate gained momentum (see Hardin, 1968; Ostrom, 1990, 1999, 2010; Ostrom *et al.*, 1994; Wade, 1987). The central role of institutions in defining property rights, generating and sharing information, resolving conflicts, building social trust among other things in view of natural resources was therefore brought to the fore (De Soysa and Jütting, 2006).

Noteworthy, both “formal and informal institutions play an important role in water resource management, in their potential to set rules and demarcate responsibilities between actors; coordinate mechanisms to minimize jurisdictional overlaps or deficiencies; bridge the gap between political and natural resources boundaries; match responsibilities and serve as authorities and facilitators of actions” (Hill, 2012:19). Specific to this paper, it is noted that institutions facilitate the successful governance of irrigation systems (Namara and Sally, 2014). They ensure that the implementation of water-related interventions are achieved and, also contribute to sustained changes in water management (Haileslassie *et al.*, 2009). Focusing on groundwater irrigation, institutions “provide the enabling environment for groundwater management... They have legitimacy in the eyes of stakeholders, are inclusive and are characterised by credible and verifiable commitments.” (Food and Agriculture Organisation, 2016:48). As an example, it is realised that institutions are at the forefront of optimizing wealth creation from groundwater in South Asia (Shah, 2014).

Nonetheless, there have been arguments for the application of only formal institutions in the water economy both globally and nationally and across developed and developing countries: arguments deeply rooted in the New Institutional Economics (NIE) as reflected in the works of Williamson, de Soto, Ostrom and others (De Soto, 2000; Ostrom, 1990; Ostrom *et al.*, 1994; Williamson, 2000). Trends of these discussions are reflected in recent research works (Agyenim, 2011; Bandaragoda, 2000; Bandaragoda and Firdousi, 1992; Saleth, 2006; Saleth and Dinar, 2004; Sharma, 2012). For instance, in a book titled

The institutional economics of water: a cross-country analysis of institutions and performance, a review of institutional changes in eleven countries focused largely on laws, policies and administration (see Saleth and Dinar, 2004).

Inspired by such NIE arguments together with colonialism and its legacies in Ghana, one sees the multiplicity of formal institutions widely embraced for regulating water resources use (especially surface water irrigation) since after independence. In that same manner, research works also tend to follow in the country (see Kyei-Baffour and Ofori, 2006). Issues about institutions and groundwater irrigation in general are seldom given attention, with informal institutions in particular in this regard completely relegated to the background. Even where the focus is on the development and use of groundwater resources, attention tends to be shifted towards domestic purposes. So, if the so-called formal institutional environment and practices are effective, why would Opoku-Ankomah *et al.* (2006) suggest for the integration of traditional institutions and customary water laws with modern management practices to achieving water resources management in the Volta Basin? Like it is noted of the water sector reforms (with focus on formal institutions) in India, why would Shah (2007:65) make an assertion that “this transition is proving difficult in India and elsewhere in the developing world. Here, making water laws is easy – enforcing them is not. Renaming regional water departments as basin organizations is easy – but managing water resources at basin level is not. Declaring water an economic good is simple – but using the price mechanism to direct water to high-value uses is proving complex”? He admitted that reforms in the form of laws, prices and rights enshrined in informal water economies are unlikely to work.

Similar views about the inadequacies and inappropriateness of formal institutions have been noted elsewhere (see Cleaver and Franks, 2005; Obeng-Odoom, 2016). The questions that are yet to be addressed in these institutional debates between NIE and others are: (i) are there studies that comprehensively looked at the nature of both formal and informal institutions in regulating groundwater irrigation? (ii) between formal and informal institutions, which one best represent the situation and workable in a place like Atankwidi catchment (iii) are those widely adopted by groundwater irrigation farmers effective enough to secure the future of groundwater for irrigational purposes? Such questions are central to the debates between New Institutionalism and the emergent Post Institutionalism (Critical Institutionalism) schools of thought about institutions in Africa.

With reference to the existing literature pertinent to these arguments about institutions, it is realised that mostly, formal institutions have been discussed independently of informal institutions, which conversely is the case of discussions relating to informal institutions. The situation results in a less significant exploration of the interactions or linkages between both types of institutions (Zenger *et al.*, 2000). This paper differs in the sense that it discusses both types of institutions together with significant attention being given to informal institutions (which appeared neglected) because of the foundational and effective roles they continue to play in the water economies of African countries like Ghana despite the invasion of water sector reforms (deepened by arguments of NIE). Within this broad geographical area, focusing on Atankwidi is thus important for three reasons.

Firstly, groundwater irrigation in general in the northern part of the country is well documented (see Barry *et al.*, 2010; Obuobie, 2008; van den Berg, 2008). Northern compared to southern Ghana, has a history of concentrated groundwater irrigation activities driven by the sole application of local knowledge. In this area, in particular, groundwater compared to surface water irrigation activities have increased in scale (see Dittoh *et al.*, 2013). This has contributed to community development and livelihood enhancement especially of the people and the communities within the Atankwidi catchment, in particular (Namara *et al.*, 2011). However, Kwoyiga and Stefan (2018) observed that studies have tended to focus on the biophysical aspects of groundwater irrigation (see Forkuor *et al.*, 2013; Martin and Giesen, 2005; Namara *et al.*, 2011; Pavelic *et al.*, 2013). The analysis of the role of regulatory institutions in groundwater development and use particularly for irrigation in northern Ghana and for that matter, Atankwidi is seldom.

The population in the Atankwidi catchment depends almost entirely on groundwater resources. With favourable conditions for dry season irrigation in the form of better infrastructure and the presence of a tomato factory (Laube *et al.*, 2012), there is an increasing demand for groundwater in general in the catchment. However, there is evidence of fallen water tables in the northern part of the country including the Atankwidi catchment (Johnston and McCartney, 2010; Martin, 2006). Also, in this era of global change including climate change and its impacts, it has been noted that groundwater recharge will reduce in the future (Kankam-Yeboah *et al.*, 2009). These prevailing conditions and other impacts anticipated have implications regarding the sustainability of groundwater for irrigation. As such, the role of institutions has been advocated in Africa as a way of addressing these impacts (Niang *et al.*, 2015).

Moreover, as a transboundary catchment with Ghana and Burkina Faso as the riparian countries, effective institutional regulations of the Atankwidi is necessary for addressing the many water-related issues such as conflicts; actual and potential. From the NIE, Ostrom (see Ostrom, 1990) and others emphasise the role of formal rules and clearly defined resources boundaries to achieving this. However, within the Post Institutionalism (Critical Institutionalism), it has been noted that organisation of people's lives and their resources are partly shaped by cultural and social networks (nature of institutions) in Africa rather than simply boundaries (Cleaver, 2000, 2002, 2017; Cleaver and Toner, 2006; Cleaver and Franks, 2005; Cleaver and De Koning, 2015). Kwoyiga and Stefan (2018) revealed that some farmers in the catchment are able to access groundwater and cultivate crops in Burkina Faso (outside their jurisdictions) without restrictions or fee charged. The study intends to further understand and clarify the kind of institutional arrangements around groundwater in the catchment as far as these two schools of institutionalism are concerned.

Hence this paper examines the regulatory institutions for their roles in groundwater irrigation within the Atankwidi catchment. It looks specifically at how their operations affect the future of groundwater resources in the catchment. In order to achieve the objectives of the paper, the study is situated in institutional political economy considering issues of history, ethnography, social theory, and political ecology where social relationships, reciprocity and networks, and kinship are part of defining the economy (Cleaver, 2002, 2017; De Koning, 2011) to explore the fields of NIE and Post Institutionalism (Critical Institutionalism) who offer explanations regarding what institutions are, their nature and purposes (see De Koning, 2011). The key argument in this paper is that informal institutions regulating irrigation remain effective and should not be formalized as the existing formal ones are less understood and enforced.

Follow from this introduction, the paper further reviews the literature about water and irrigation institutions in Ghana. It offers an insight into the arguments from the NIE and Critical Institutionalism about what best constitute the term institutions. A presentation on both formal government and catchment level traditional/informal institutions constitutes the next part of the discussion. The paper concludes by arguing that the application of informal institutions in regulating groundwater use for irrigation is appropriate because they are effective and easily enforced by the local people.

2. Existing literature and theories

2.1. *Institutions and theories*

A common definition of institutions appears elusive (Vatn, 2005). Regarding the point of focus of theorists/researchers, Vatn (2005:8) noted that “while sociologists and anthropologists tend to focus on informal institutions and institutions as giving meaning to life, economists, when focusing on institutions, tend to look at these more as formalised rules, that is property rights”. With a similar view, De Koning (2011) wrote that there are several schools of thought relating to the definition and functions of institutions, as a result, the term has different interpretations and still under continuous discussion. Nevertheless, this paper is not limited to any sphere or school of thought.

In defining institutions, North (1990:3) explained that institutions are the “rules of the game”. He followed up by seeing them as humanly devised constraints; informal (sanctions, taboos, customs, traditions and codes of conduct that structure) and formal constitutions, laws, property rights that structure interaction. Ostrom (2010) discussed institutions as shared concepts adopted by humans who are engaged in repetitive situations on the basis of rules, norms, and strategies. Similarly, Knight (1992:2), defined institutions as “a set of rules that structure social interactions in particular ways.” Institutions with respect to water resources have been defined as the normative and cognitive frames, formal or informal characterising actors involved in a collective activity (Hassenforder and Barone, 2018). They are further seen as the “rules that define action situations, delineate action sets, provide incentives and determine outcomes... in the context of water development, allocation, use and management” (Saleth, 2006:4). Focusing on formal institutions within the water sector, Saleth and Dinar (2004) decomposed them into laws, policies and administration.

It is, however, common to see most of these definitions pointing in the direction of formal rules, even though informal institutions are equally important (Cleaver, 2002; Cleaver and Franks, 2005; De Koning, 2011). As North (1991) noted, both formal and informal institutions complement each other, with informal institutions enabling people to go about their everyday process of making exchange without thinking exactly at each point and in each instance, the term of exchange. According to Constanze (2011), informal institutions form the basis of formal institutions in that they determine a society’s basic attitudes and beliefs. Rauf (2009) mentioned that “informal institutions are responsible for generating social capital; which has been considered as an additional factor of

production in recent literature. Social and cultural norms impact the utilization of resources in many ways. People who share a common background, language, culture and customs can mobilize their resources effectively towards creating positive synergies” (Rauf, 2006:26). These discussions trace their roots to the Old Institutionalism, NIE, among others.

Nonetheless, while the discussion on institutions and their nature is still going on with dominance from the NIE, one sees an emergent Post Institutionalism theorists agreeing to some extent with NIE (Ostrom and others) but taking a divergent view on some issues (De Koning, 2011). The next discussion explores the NIE and Post Institutionalism (Critical Institutionalism) in order to understand the situation in Atankwidi better as this offers a lens through which the institutional situation in this catchment could be viewed better.

Drawing from the myriad of definitions of institutions, the paper sees institutions as both formal and informal structures. The formal institutions are in the form of policies, laws/legislative instruments and administrative structures while the informal institutions entail norms, taboos, traditions, practices among others which have historical connotations, hold important the social environment, and operate outside officially sanctioned channels. These institutions shape social interactions among people and groups on daily basis, evolved to serve several purposes and are dynamic in nature.

2.2. The institutional debate

The arguments underpinning institutions in the water economy are diverse and numerous. These arguments reached a crescendo in the 1980s with those from New Institutionalism Economics (NIE) being dominant especially in developed countries, with a push to spread them to other places. The NIE which is traced to the fields of transaction cost economics, property rights economics and economic contract (Richter, 2005) saw notable contributions from Douglas North, Ronald Coase and Oliver Williamson (who is believed to have coined the term NIE in 1975). The core argument of the NIE is that, “institutions matter and are susceptible to analysis“ (Williamson, 1996:3).

Central to the NIE discussions is the role of formal institutions. The group of writers within the NIE, while acknowledging the presence of informal institutions (considered the level 1) tended to focus largely on formal institutions likened to the levels 2 and 3 of social analysis of institutions (see Williamson, 2000). From their point of view, the role of the market and formal institutions in regulating the water economy are paramount (North, 1990; Ostrom *et al.*, 1994).

For instance, it is argued that moving away from informal institutions to clearly formalized property regimes are necessary for economic efficiency (De Soto, 2000). Hart (2001) who associated informal institutions with norms argued that although norms are important, it is difficult to integrate them into theory and this may continue in the future. Williamson (2000) who came out with what is called the Institutional Environment though not neglecting the presence of informal institutions contended that these are underdeveloped and change very slowly hence NIE prefers neglecting them in its discussions, as they are considered unclear, unrecorded and unreported (see De Soto, 2000).

Consolidating the position of the NIE was also the contributions of Nobel Laureate Elinor Ostrom who through her research works defended the management of common pool resources through formal design principles. In the same vein, the study of the Peruvian economy by Hernandez de Soto (1989) as captured in his book, *The Other Path*, popularized the need for the formalization of the economy as the informal economy is the root of underdevelopment especially in less developed countries. De Soto (2000) again in his book, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*, defended his position against the informal economy and called for strong and clear property rights, formalized rather than informal. In fact, while de Soto over simplifies the informal economy, he argued for converting community informal property rights to private property, with formalized clear property rights replacing informal rights as the antidotes for economic efficiency. He was praised by people like the late Kofi Annan (the then Secretary General of the United Nations), while Bill Clinton called him “the world’s greatest living economist” (see Cao, 2012). This has culminated into his award of “2017 Global Award for Entrepreneurship Research”.

Common in recent discussions about institutions but inspired by Williamson and others within the NIE are the terms Institutional Environment (IE) and Institutional Arrangement (IAs) (see Saleth and Dinar, 2004; Shah, 2007). The former represents constraints in the form of laws, policies (explicit) and norms, customs (implicit) while the latter is made of structures humanly imposed such as water users associations. Looking at the IE and IAs holistically in terms of practice, it is realised that attention is shifted towards laws, policies and water agencies/associations as noted already (Bandaragoda, 2000; Saleth, 2006; Saleth and Dinar, 2004).

Informal institutions which constitute a major characteristic of developing or African countries continue to be neglected by the NIE. However, several

studies relating to the informal sector have been undertaken which substantially discussed the rationale and significance of informal institutions and the economy (Chen, 2005, 2012; Meagher, 2013). While analysing water resources management in Australia where the NIE approach has been largely adopted, it was recommended to focus also on social institutions such as cultural norms and behavioural attitudes towards water management (Sharma, 2012).

Using land to illustrate the significance of informal institutions in South Africa, it is realised that informality means flexibility which stands to benefit the most vulnerable in terms of social needs (Cao, 2012). Informal institutions, it is noted in Cameroun, have proved resilient and remain the choice of the local people despite the presence of formal financial institutions. This is due to the social benefits of networking and solidarity which are reinforced by culture and kinship ties. Such benefits cannot be provided by formal institutions (Ojong and Obeng-Odoom, 2017). Additionally, it is proved that attempts at formalizing the Melanesian land economy only destroyed sustained informal economic activities with fewer benefits associated with the formal economic activities (Anderson, 2011).

Critical of the NIE is the emergent Critical Institutionalism which is considered part of Post Institutionalism even though it shares some views with NIE, but only tries to fill in the gaps between theories and current realities created by New Institutional Economics (De Koning, 2011). Describing the nature of institutions as defined by the NIE, Cleaver noted that, institutions here are designed, negotiated, altered and administered with attention being given to formal and public institutions rather than norms (Cleaver, 2017:200). Guided by rational choice assumptions about human behaviour, individuals act purposefully in their own interest. As such (Cleaver, 2002; Cleaver and De Koning, 2015), rules are self-consciously crafted by individuals to change the structure of repetitive situations they face in improving their outcomes. Coming out with what is called Institutional Bricolage (“a process through which people consciously and non-consciously assemble or reshape institutional arrangements, drawing on whatever materials that are available to regardless of their original purposes”, Cleaver and De Koning, 2015:4), Cleaver and others critiqued the NIE that institutions are crafted to be efficient and created for a particular purpose. Further criticism focuses on the rational choice assumptions about human behaviour as being purposeful and interest based (Cleaver and De Koning, 2015). This category of theorists again criticised the NIE for its limited attention given to local institutions and its interpretations of social-environmental interactions (Cleaver, 2017).

Thus, drawing from social theory, legal pluralism, ethnography and political ecology with examples from Africa, these theorists argued that institutions are “both formal and informal; they are often multi-purpose, intermittent and semi-opaque in operation. Access to natural resources may be mediated by a range of institutions. These include designed arrangements of varying degrees of publicness and formality, institutionalised interactions as embodied in kinship and social networks, relations to reciprocity and patronage and in sets of norms and practices deeply embedded in the habits and routines of everyday life” (Cleaver, 2017: 13-14). As noted by Cleaver *et al.* (2013), the history of institutions and the complex interplay between modern and traditional, formal and informal arrangements are paramount. With reference to Ostrom (Ostrom, 1990; Ostrom *et al.*, 1994) design principles of long enduring resources, Cleaver and others noted in Tanzania that social relations, network and kinship ties penetrate the so-called formalized structures of regulating watershed management (see Cleaver and Toner, 2006).

Looking at the debate, it can be said that the water economy is one which is viewed through the lens of formal and informal institutions, formalized and not-formalized, developed and developing economies depending on what works better. Ghana has experienced several water sector reforms and this offers an opportunity to look at the situation drawing from these debates about how water resources in the light of irrigation in the country are being managed.

2.3. Water and irrigation institutions in Ghana

Considering institutional evolution with regards to water resources in Africa, it is intuitive to avoid linear thinking of institutional processes from precolonial to post-colonial activities. From the commonly existing literature on Ghana, three periods; pre-colonial, colonial and post colonials are often identified and discussed (see Obeng-Odoom, 2016; Opoku-Ankomah *et al.*, 2006). They tend to argue that during the pre-colonial era, traditional water management practices in the form of customs and rules (reflecting the beliefs and practices of various ethnic groups) were crafted, perhaps developed over centuries and were closely linked to land but vary temporally. Chiefs and priests are said to have acted as guardians and regulators of water and land resources for and on behalf of the gods and ancestors. During the colonial era, two systems of water management operated; traditional and modern, formal and informal, state-regulated and community-regulated even though the colonial dominated that of the traditional laws and practices. The post-colonial era witnessed a legion

of formal regulatory practices and institutions with less formal recognition of traditional water practices, even though “the traditional approaches to water and land management were effective during the pre-colonial and colonial era and contributed to the sustainable use of the resource” (Opoku-Ankomah *et al.*, 2006:20). One finds that beyond the precolonial era, there have been overlapping systems although more pronounced during the colonial ear, as can be expected of an evolving system.

While it is difficult to offer an inventory of institutions characterising both the water and irrigation sectors, some attempts have been made. In their study *Mapping the Water Sector of Ghana; An Inventory of Institutions and Actors*, it is noted that the water sector is characterised by public water laws and legal instruments; policy frameworks and related development programmes; bye-laws; project laws; local laws or self-regulation; informal rules governing national actors; national agencies, organisations and bodies, district level or general authorities; local actors, donor organisation and international actors; private companies; research institutes among others (Fuest *et al.*, 2005). An extensive study of water institutions in the Volta Basin titled *Hydro-political Assessment of Water Governance from the Top-down and Review of Literature on Local Level Institutions and Practices in the Volta Basin* offered insights into the nature of these institutions in both Ghana and Burkina Faso. This presented a plethora of both formal and informal institutions suggesting that the situation in Ghana requires an integration of both traditional institutions and customary water laws with modern management practices for the successful management of water resources (see Opoku-Ankomah *et al.*, 2006).

Irrigation in Ghana is categorised into three forms: informal or smallholder irrigation, formal irrigation, and large scale commercial irrigation. The informal type of irrigation entails irrigation practised by individual who cultivates an area of up to about 0.5ha or more by using simple structures and equipment for water storage, conveyance and distribution. This informal irrigation is dominant and contributes significantly to livelihood enhancement (Ministry of Food and Agriculture, 2011). Groundwater irrigation forms part of informal irrigation in the country. Nonetheless, since after independence, the interest has been to develop surface water irrigation. Associated with this, are several water and irrigation reforms in the country. Therefore, most of the existing formal institutions as defined already (Fuest *et al.*, 2005) are applicable to surface water irrigation.

One, therefore, sees the existence of agencies like the Ministry of Food and Agriculture which operates through the Ghana Irrigation Development Authority (GIDA), an autonomous body. The GIDA through the Irrigation Development Authority Act, 1977 was transformed from the erstwhile Irrigation Department of the then Ministry of Agriculture into an autonomous authority, giving the administration of the country's irrigational activities a legal outlook. This authority provides services such as Agriculture Water Management (AWM), Crop selection and seed production, Farmer Training, Provision of Technical Information on Irrigation, Study, Design, Construction, and supervision of dams, Capacity building for Water Users Association, Design of Irrigation Infrastructure and many others. Others institutions exist in the form of national development plans and agricultural policies over the years with irrigation being considered a tool which can be used to tackle poverty and promote community development.

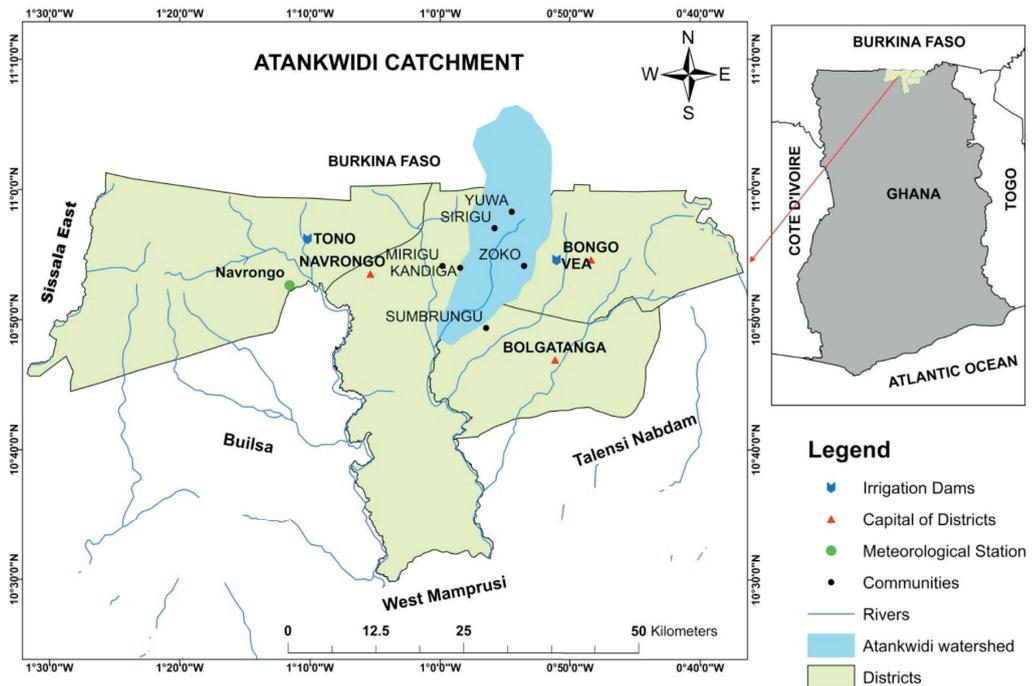
Despite its neglect, it is interesting to note that groundwater irrigation which forms part of informal irrigation in the country has evolved to become a major agricultural activity for mostly rural people, particularly, in the dry season. This age-long practice of groundwater irrigation in Ghana of over 200 years has spread all over the country starting from the area between Keta lagoon and the sandbars in southern Ghana to the Atankwidi catchment of the White Volta basin in the northeast of the country, yielding enormous benefits. What then makes informal groundwater irrigation work better even though it enjoys limited support from the government? Why are more farmers still willing to engage in informal irrigation economy (groundwater) in the country? These are some of the inherent questions that may be addressed in this discussion.

3. Materials and methods

3.1. Study area

The Atankwidi catchment (Figure 1) is part of the White Volta Basin which by nature is transboundary. Its area in Ghana is about 159km² (Salifu and Agyare, 2012). The total population of the catchment was 45,841 in 2010 (Ghana Statistical Service, 2012). The catchment in Ghana covers the entire Upper East Region of which four districts namely Kasena/Nankana Municipality, Kasena/Nankana East District, Bolgatanga Municipality and Bongo District are its local governments. Within these districts, the following communities make up the catchment: Kandiga, Sirigu, Yuwa, Zorko, parts of Sumbrugu and Mirigu.

FIGURE 1: MAP OF GHANA SHOWING THE LOCATION OF ATANKWIDI



Source: Author.

The Atankwidi catchment covers a largely rural area inhabited by people of Gurunsi ethnic group. Although of the same ancestral heritage, currently the Guruni people find themselves within two countries, Ghana and Burkina Faso due to British and French colonialism. They are now considered transboundary people trapped in artificial boundaries created through colonial activities. Thus, it is common to find that the people at the border like Yua have their relatives in Burkina Faso and vice versa. These families though administratively separated, blood/family/kinship ties still bind them. The local language, culture, and social life of the people in these two countries remain similar. Due to irrigational activities, the people of Atankwidi have built social networks with other people in neighbouring Burkina Faso with whom they share their resources with. Social interactions are frequent due to the close-knit nature of the communities. Social relations are warm with a sense of ‘oneness’ (togetherness). A communal way of living is evident. Social capital, therefore, plays a crucial role in promoting local development among the people.

Hydro-geologically, the catchment has three aquifers, namely; shallow perched aquifer, principal regolith and fractured aquifer (Martin, 2006). Irrigators

rely on groundwater from the shallow aquifer for dry season farming (van den Berg, 2008). According to Martin (2006), groundwater recharge in the catchment is between 1 and 13% of the mean annual rainfall (Martin, 2006). The quality of water for irrigation is considered suitable. (Barnie *et al.*, 2014). Barry *et al.* (2010) noted that the total area put to groundwater irrigation is about 387 ha.

3.2. Data for the study

In order to have an in-depth knowledge of the institutional situation in its natural form, the study was approached in a qualitative manner. The writer, therefore, undertook community-wide interactions involving irrigation farmers and traditional leaders. Interviews, conversations, group discussions, informal discussions and observation were the tools used to obtain empirical data. Interactions during visits to the farms of irrigators provided first-hand information on groundwater development and use, agronomic practices and general farm organisation and management. They further provided information on institutions both formal and informal regulating groundwater. Outside of the farms, traditional leaders like chiefs, elders and clans/family heads were engaged to explore further the traditions, practices, and customs governing land/groundwater resources for dry season farming. A total of 91 respondents were interviewed.

Formal discussions with two officials at the Water Resources Commission (WRC) in the Upper East Region took place in order to obtain information on the institutions regulating groundwater resources. Thus, a four-month field trip was undertaken in Ghana in 2017 and later a two-month field trip in 2018.

Existing literature on institutions and water resources in Ghana and elsewhere was reviewed (Barry *et al.*, 2010; 2008; Kyei-Baffour and Ofori, 2006; Ministry of Food and Agriculture, 2011; Namara *et al.*, 2011; Obeng-Odoom, 2016; Opoku-Ankomah *et al.*, 2006). The internet provided this chunk of materials for the review. The focus was on policy documents, legal and administrative organisations and their provisions on groundwater irrigation. Other documents were obtained from the office of the WRC in Bolgatanga A research assistant who also served as an interpreter assisted with the data collection. Data were first recorded, transcribed and then analyzed manually.

4. Results and discussion

4.1. Groundwater irrigation in the Atankwidi Catchment

Land is an important factor as far as groundwater irrigation is concerned in the catchment. Land and groundwater go hand in hand. Following the pressure that

was mounted by elites, the people and chiefs from northern Ghana against the then form of land ownership in the northern part of the country, a decision was taken in 1979. Based on this decision, land in this part of the country was vested in any such person or appropriate skin (symbol of royal authority in northern Ghana); that is the customary authority. The 1992 constitution, (Article 36(8)) of the country reinforced this decision by vesting all customary lands in the appropriate stool, skin, or landowning family on behalf of and in trust for their people, to be managed according as pertained in the duties of the traditional authorities based on customary law (see Kasanga and Kotey, 2001; Yaro, 2012).

This is the case in Atankwidi where land for groundwater irrigation is considered skin land. Land ownership is communal. Individual, families and clans own land; a subset of the community/communal ownership. It is entrusted in the various earth priests called *tindanma* who act as the appropriator and also a mediator between the gods and the people. As custodians, the *tindanma* are entrusted with spiritual matters concerning the land. Hence the *tindanma* have traditional regulatory oversight on customary land matters. The traditional chiefs serve only as political heads who might arbitrate in terms of disputes and no more.

Groundwater irrigation is like any other livelihood activity in the catchment; any person from the catchment and its neighbouring communities can engage in it. Noticeable is that groundwater irrigation is practised by mostly men and in the dry season. Land put to such use is based on its proximity to streams, rivers, or low lying areas where the water table is high. Access to land for such a purpose is usually obtained through negotiations with people who own pieces of land near suitable groundwater locations. Individual farmers who are fortunate to own land at such locations easily put them to use.

The calendar for dry season farming usually runs from October to the end of February. The nursing of seedling by farmers starts as early as July/August when the rainy season is at its peak. This serves to reduce the pressure on groundwater resources. The farmers also noted that when the seeds are nursed and subjected to rainfall, their resistance to diseases increases.

The farmers said wells are constructed around October with their depth deepened as the level of water in them reduces in response to seasonal weather vagaries. Each cropping field relies on water harvested from two to three wells depending on size. Water is drawn from the wells either manually using buckets and ropes and treadle pumping machines or mechanically, using motorised pumping machines. The riverine wells which tended to be very shallow and

temporary were refilled after the dry season period to make way for rainy season farming. This was found to also help prevent accidents by animals and humans.

The crops put under groundwater irrigation in the catchment were found to be largely vegetables such as tomatoes, onions, pepper, carrots, lettuces, and cabbage. Cereals such as maize and nut/legumes such as groundnut and beans were also cultivated. The main source of labour was farmers themselves who may be assisted by family and friends. Farmers provided security on their farms both day and night and where one is absent, a family member or friend is contacted for assistance. Almost all the farms are fenced using materials such as bricks, mud, straws, sticks, nets, millet stocks, vegetable fibres, nylon robes, thorns, or any materials. This is to hedge out animals from the crops and any other thing that may pose threats. Product marketing was said to be done on the farms, local and nearby markets and in major towns like Navrongo, Paga, and Bolgatanga.

4.2. Formal institutions and groundwater irrigation in Atankwidi

4.2.1. Laws

As desired of the NIE, Ghana has crafted formal institutions to regulate irrigation in the country reflecting the IE in the form of written down, laws, legislative instruments, rules and regulations, as found in official documents. While the NIE emphasis the role of the formal institutions especially in defining property rights (De Soto, 2000), one sees the same institution recognising the significance of informal institutions in defining land ownership. In Atankwidi, formal institutions (laws) are defining and reinforcing the position of the informal institutions (customary laws/traditions). As noted already, presently, the 1992 Constitution, (Article 36(8)) vests all customary lands in the appropriate stool, skin, or landowning family on behalf of and in trust for their people, to be managed as pertained in the duties of the traditional authorities based on customary law as noted already.

The Water Resources Commission (WRC) 1996 Act 522 is the second law that appeared relevant to water and groundwater irrigation. With the coming into being of the Water Resources Commission (WRC) 1996 Act 522, an amendment was made to the 1992 Constitution. This Act declared that ownership of all water resources is vested in the President on behalf of, and entrust for the people of the Republic. The Act, however, recognised the 1992 Constitution definition of ownership of land in the northern part of Ghana in skins, families, and clans of which water resources form part of.

However, during the interactions, it was found out that, farmers in the catchment still held on to the old provisions, claiming that ownership of land means automatic ownership of groundwater. The consequence of this update is that though it is well documented, groundwater farmers have less knowledge about it as they continue to interpret groundwater ownership in line with the 1992 Constitution. At this point, one begins to see the emergence of multiple formal institutions (laws) but poorly enforced. So as Shah (2007) observed of India, it is not about adopting formal institutions but how to enforce them as is the case of Atankwidi.

The third legal provision is the Drilling License and Groundwater Development Legislative Instrument (L.I) 1827 which made provisions covering Water Drilling Licence and Wells Construction in the country. The first part of it stipulates that a person shall not construct a well for the abstraction, or monitoring of groundwater or for research if that person does not have a drilling licence granted in accordance with these Regulations. In the second part, it is stated that a drilling contractor shall not construct or begin to construct a well without notice to the Commission of the intention to do so. These provisions are however not applicable within the context of groundwater use for informal irrigation as seen in the Water Use Regulations. The Water Use Regulations (L.I 1692) 2001 states that any water use resulting from the abstraction of water by manual means is exempted from these Regulations. Thus, looking at the nature of livelihood activities/organisation and the level of their development in Ghana at the moment, formalising the water economy as argued by the NIE may be unrealistic.

The Irrigation Development Authority Act 1977 also made some provisions for groundwater irrigation even though they are limited. The contribution of this Act is that it categorises groundwater irrigation an informal activity (Ministry of Food and Agriculture, 2011).

In summary, the relevant laws (as part of formal institutions) within the context of groundwater irrigation in Atankwidi reveal a multiplicity of them at play. Access to groundwater for irrigation is mediated through a range of them and they serve multiple purposes which agree with Cleaver and others definition of institutions (Cleaver, 2000; Cleaver *et al.*, 2013; De Koning, 2011). Some of the provisions of these laws are about property rights, access, regulation and issuance of permits (which in the case of farmers in Atankwidi is not applicable). Considering the level of knowledge about these laws among farmers in Atankwidi, one wonders how formal institutions can shape behaviour with

regards to groundwater resources use in this context if they are not understood or rather misunderstood by users.

4.2.2. Policies

According to the IE of the NIE, policies are one aspect of formal institutions as far as the water sector is concerned. However, it is difficult to identify any policy that captures significantly the activities of groundwater irrigation in Ghana. For instance, policies like the Food and Agricultural Sector Development Policy (FASDEP I & II) of 2003 and 2007 respectively, Ghana Water Policy 2007, the National Climate Change Adaptation Strategy 2012 and National Climate Change Adaptation Policy 2014 contain virtually no measures, strategies or activities for groundwater irrigation. The Water Policy 2007 appeared vague on groundwater irrigation. This is because section 2.2.3 (Water for Food Security) only touches on supporting micro-irrigation schemes among rural areas without specifying the source of water for these schemes. The Irrigation Policy, 2011 also briefly stated that efforts shall be made to promote access to safer groundwater or safer irrigation practices where only marginal quality water is availability. It is not surprising that the Irrigation Policy itself laments the status of groundwater irrigation in the country that even though informal irrigation dominates the bulk of irrigated output in Ghana; it was seldom given attention in the past. Also, the policy stated that institutional mandate for informal irrigation is usually unclear.

Moreover, some Africa countries like Kenya have implemented groundwater management plans. Ghana is yet to do so despite the fact that most communities in Ghana according to Ofosu-Addo *et al.* (2008) rely on groundwater for water supply. In fact, the WRC in 2011 came out with the country's Groundwater Management Strategy. This is yet to be implemented; implying that at the moment there is no specific guideline about groundwater management in the entire country.

So, it is realised that there are instances where these formal institutions exist but their designs/contents are not comprehensive enough hence automatically create room for farmers to defer them. The situation thus painted a complex picture of policies in the water sector which is difficult to adopt.

4.2.3. Administration

Just as it is difficult to associate groundwater irrigation with policies in the country so it is with administration. Groundwater irrigation is not seen to be the responsibility of the Ghana Irrigation Development Authority. The District/

Municipal Assemblies only support the management of groundwater facilities for domestic purposes. In fact, during the fieldwork in Ghana in 2017, visits to the regional officials of the GIDA in the area to discuss engagements between the authority and groundwater farmers in the region were revealing. Planned interviews were not granted because the regional director claimed that the authority's activities do not cover groundwater resources and that of its farmers.

It was found out that the activities of the local Agricultural Offices at the District/Municipal levels did not include irrigation, so they did not benefit from new methods of farming and agricultural inputs like fertilizer and seedlings. This has been confirmed by van den Berg (2008) in his study, *Exploring shallow groundwater irrigation: current status and future application*. Hence the farmers depended solely on local knowledge to develop and use groundwater, got assistance from friends and families to finance irrigation and liaised with one another organise markets for their products. The farmers also organised themselves to provide security on their farms and resolve conflicts among themselves (if possible).

4.3. Informal institutions and groundwater irrigation in Atankwidi

Though the NIE holds it that informal institutions are difficult to understand and work with as they are unreported and undocumented coupled with their slow pace of development (De Soto, 2000; Hart, 2001; Williamson, 2000), the Critical Institutionalism (Cleaver and Franks, 2005; De Koning, 2011) has made giant strides in the sense that it gives equal weight to both formal and informal institutions. Guided by the approach of Critical Institutionalism, it was realised from the interviews that the Atankwidi catchment had informal institutions which are operational. A myriad of informal institutions, traditional, cultural, religious, and local in nature was found to be in operation in the catchment. The culture and social environment of the people were influencing the application of these institutions in the people's livelihood activities. The institutions are historically old and time tested. They have been widely applied in regulating groundwater use for livelihood activities including irrigation. This relates to Opoku-Ankomah *et al.* (2006) observation on the nature of indigenous water practices in the entire Volta Basin.

Like the formal institutions, there were no specific informal institutions devoted to regulating groundwater irrigation. The existing ones thus apply to most of the livelihood activities around the natural environment including the use of land/groundwater. This confirms the argument by the Critical Institutionalism

(Cleaver, 2000, 2002; Cleaver *et al.*, 2013) that the regulating institutions in Africa were multi-purposed and not deliberately/consciously crafted for a particular purpose.

As noted elsewhere (Ojong and Obeng-Odoom, 2017), in Atankwidi, kinship ties or social relations play a decisive role in defining access to groundwater. Based on the conditions of reciprocity, people are willing to freely share their land and groundwater with others irrespective of geographic/administrative differences (similar observation was made in Tanzania by (Cleaver and Franks, 2005). Therefore, one sees the wide application of informal institutions in regulating groundwater irrigation in the catchment. This explains the cross-border groundwater irrigation situation which is commonly practised around communities such as Yua. The following constitute some of these informal institutions in relation to groundwater irrigation in Atankwidi.

4.3.1. Informal/unwritten down rules

- Any person who is from Atankwidi is guaranteed automatic access to land and groundwater. Social ties/network also enables people from neighbouring communities' access groundwater in the catchment.
- The use of groundwater and tilling of the land are done in the same geographic location. Groundwater cannot be exploited and transported to a different jurisdiction/location for farming.
- Access to and appropriation of groundwater is based on the construction and maintenance of individual wells.
- Where a farmer faces water scarcity, he/she has to negotiate with other farmers. No one is supposed to trespass on another irrigator's land/groundwater. Influenced by social bonds or sense of togetherness, irrigators, however, sometimes help one another by granting access to water in their wells.
- For domestic purposes, free access to wells/groundwater is granted to everyone irrespective of your background. It is morally and spiritually obligatory.
- There are no general rules that determine when to develop and extract groundwater. However, some instances require seeking permission or guidance from traditional leaders, earth priest, or diviners.
- Information about the spiritual component of irrigation must be kept secret.

4.3.2. Taboos, norms, convention

Taboos play a central role in influencing behaviour regarding the use of the environment including groundwater. Even though there were no taboos that

forbade the use of groundwater, there were some that specifically defined where wells could be dug. For instance, it was said that wells could not be dug in places declared as sacred/groves. In the Yua community, no farmer was allowed to fetch water from the wells at midnight to water crops. The people believe that the gods of the area come out at midnight hence should not be disturbed by human activities. It was also said that deep wells could not be covered in the night as the people believe that the gods and other spirits use them at night.

4.3.3. Traditions / customs / practices

Each community has a Traditional Political System which plays an important role regarding the social and political organization of the people. Chiefs and elders are key leaders who are chosen by the gods to govern the people on anything pertinent to their community including the environment and its resources. The chief and his elders maintain law and order in the community.

Of equal importance is the earth priest called *tindaanma*. The *tindaanma* is the spiritual leader of the people regarding any issues relating to the land. He/she plays a key role as far as access to land for groundwater dry season farming is concerned. They also resolve groundwater related conflicts among farmers and help enforce taboos to regulate groundwater use.

Consulting diviners before the start of irrigation is important for irrigators. Rituals/sacrifices may be performed by individual irrigators before and after irrigation. This is to ask for bumper harvest from the gods and also for protection and good health. In the same vein, sacrifices may be done to thank the gods after the end of the irrigation season. Irrigators who negotiated for the land were expected to show appreciation to the original owners by presenting them with some produce after the season.

4.4. Implication of the existing institutional arrangement regarding the future of groundwater resources

The previous discussion which looked at the existing institutions in relation to groundwater irrigation provided an opportunity to further examine the provisions of these regarding the future of groundwater for irrigation in the catchment. This is important because as noted already, the population of the catchment depends largely on groundwater not just for irrigation but also for domestic and industrial purposes. The ensuing discussion, therefore, looks at how these institutions define demand management and recharge of groundwater for irrigation taking the future into consideration.

4.4.1. Managing groundwater demand

In a formalised institutional arrangement as prescribed by the NIE, the market, water allocation guidelines such as pricing, quota, charges or tariffs help manage groundwater demand. There were no such formal groundwater instruments deliberately designed to manage groundwater demand in Atankwidi as far as groundwater irrigation is concerned. Farmers were, however, obliged by society and culture to judiciously use water. As noted already, groundwater came from the gods; it is thus considered sacred and must be treated with reverence. Also, farmers used manual means to dig wells and draw water. They, therefore, tended to be efficient in the application of water to crops. This was because of the drudgery of drawing and transporting water to the base of crops (using buckets, watering cans and pumping machines). Furthermore, some farmers were beginning to switch from the cultivation of vegetables to legumes.

The farmers were also conscious of conserving groundwater for later use. This manifested in the conjunctive use of both ground and surface water as a way of reducing pressure on the available groundwater. This was the case at the early stages of the irrigation period where water in ephemeral bodies was still available. Hence farmers delayed the use of groundwater by relying on water from ponds and rivers at the stages of planting. It has also been captured already that most farmers endeavoured to nurse their seedlings in the rainy season. These were deliberate or conscious conservation strategies.

It can be said that even though informal methods were largely applied in managing demand, they appeared effective. These methods are thus capable of securing groundwater for future use to a large extent considering the level of the irrigation at the moment. The definition of institutions partly linked to a set of norms and practices immersed in habits and routines of everyday life and resources use as offered by Cleaver and others (Cleaver, 2002; Cleaver and De Koning, 2015; De Koning, 2011) is seen in the water management practices of these farmers. One sees farmers influenced by their social environment, culture and religion judiciously using water for irrigation. It can be said that even though formal institutions are not adopted, informal institutions appear good.

4.4.2. Boosting groundwater recharge

Artificial methods of groundwater recharge have long been adopted in some parts of the world as a way of boosting recharge by intentionally harvesting surface water which is subsequently used to recharge groundwater. However, in Atankwidi catchment, farmers did not adopt any traditional or modern methods

that enhance recharge; recharge is largely natural through rainfall infiltration and streams/rivers discharge.

Moreover, the protection of natural areas through land surface zoning to safeguard the natural recharge capacity of groundwater was another way of boosting recharge which was not a collective regulated practice. However, what came close was the use of taboos to forbid the construction of wells in places declared as sacred groves; it was one way of controlling the siting of wells. Additionally, looking at the nature of the activity done in the dry season, it was realised that the rainy season served as a fallow period where there was no use of but only recharge. This allowed sufficient groundwater to be stored in aquifers for use in the dry season.

Catchment conservation through the practices of afforestation and reforestation is another way of enhancing recharge. Even though farmers were not obliged by institutions, some farmers who depended on infield wells planted trees such as Mangoes, Guava, Cashew nuts, and others on their farms.

5. Conclusion

As a common characteristic of studies in the Atankwidi catchment where focus is on the bio-physical aspect of it, this paper offered an insight into local resource management in promoting seasonal livelihoods from the perspective of institutions. It provided insights into how formal and informal institutions regulate groundwater resources. It is realised that there existed both formal and informal institutions, as far as groundwater irrigation is concerned. However, these institutions were not directly pointing at or consciously designed specifically for groundwater irrigation. This eluded the NIE argument that institutions have specific purposes and supported the argument of the Critical Institutionalism that institutions are multi-purposed. It is realised that at the level of practice, irrigators were guided by the informal institutions hence widely applied. Also, it was found out that formal agencies were disinterested in the enforcement of formal institutions where they were applicable. Noteworthy is the fact that the informal institutions to a large extent were effective.

Though trapped in artificial colonial boundaries, kinship ties, social networks and relationships, and sense of communalism and reciprocity defy these boundaries and penetrate them when it comes to access to groundwater for irrigation. This explains the cross-border practice of groundwater irrigation between the farmers in Ghana and those in Burkina Faso. Considering the future

of groundwater resources for irrigation, the use of groundwater instruments notable of NIE were absent but informal institutions which were widely applied managed demand effectively. Nonetheless, informal institutions were not significantly contributing to groundwater recharge.

It is, therefore, suggested that informal institutions need to be reconstituted especially to support groundwater recharge in order to meet future groundwater needs. This may, however, be challenging since from the results, groundwater institutions at the catchment level are applied to other livelihood activities and, also not purposely and consciously crafted. Therefore, educating traditional leaders who craft these institutions will contribute to realising some form of institutional change. The new set of informal institutions should be more pragmatic about tree planting activities, water conservation practices and conjunctive use of surface and groundwater resources.

Biographical Notes

Lydia Kwoyiga holds a PhD in Environmental science from Technische Universität Dresden. As a lecturer in the Department of Development Education Studies, University for Development Studies, Ghana. She teaches courses relating to the natural environment. Her published works cover the areas of Institutions and the Environment, Groundwater Resources, Climate Change Adaptation, Local Knowledge and Sustainable Development. Her most recent works are *Institutional Feasibility of Managed Aquifer Recharge in Northeast Ghana* (2019), *Groundwater Development for Dry Season Irrigation in North East Ghana: The Place of Local Knowledge* (2018) and *Community Based Ecotourism for Sustainable Development: the place of Indigenous Knowledge Systems* (2017).

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