Ecosystem Management in Large-scale Irrigation Landscapes in Northern Ghana

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ABSTRACT
The concept of ecosystem and ecosystem management services has given rise to different definitions and classifications. Ecosystem may be defined as a natural unit of living things and their physical environment. Ecosystem concept shows the relationship of biodiversity and ecosystems and the benefits are the services enjoyed by humans. In the past, ecosystem resources were used by multiple groups and individuals across sub-Saharan for variety of purposes, sustaining agrarian livelihood through the use of customary laws and traditional social structures. After the Ghana’s 1992 amended constitution, lands in large-scale irrigation in the northern Ghana were returned to the traditional custodians. The study seeks to establish the current role of traditional custodians’ management of ecosystem in irrigation landscapes. The study was conducted in the Tono and Bontanga irrigation landscapes in Northern Ghana using participatory impact assessment methods. Despite the return of lands in irrigated landscapes, formal links and relationships are broken and little is done to amend the situation. Also, there is no clear understanding of the natural resources ownership and management and therefore transition from traditional subsistence agriculture into modern one, supported by irrigation and other technically advanced methods, with a full participation of the small-holder farmers are still lacking.

INTRODUCTION
The concept of ecosystem and ecosystem management services has given rise to different definitions and classifications (de Groot et. al., 2002; Abel et. al., 2003; MA, 2005; Boyd and Banzhaf, 2007). DEFRA (2007) defines ecosystem as a natural unit of living things (animals, plants and micro-organisms) and their physical environment. The living and non-living elements function together as an interdependent system where the damage of part the system have an impact on the whole system. Ecosystems can be terrestrial or marine, inland or coastal, rural or urban and can vary in scale from the global to the local. The definitions of ecosystem indicate the fact that the concepts of biodiversity and ecosystems are closely related and that all the parts of ecosystem in a landscape interact to produce a balanced system. Ecosystem functions are the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of an ecosystem.

Ecosystem may be referred to ‘nature benefits to people’ (Diaz et al., 2015). These benefits from nature are the services that ecosystem provide to people. Ecosystems services are thus categorised in provisioning, regulatory and cultural services generated by supporting services. The categorisations reflect the tangibility, intangibility, interdependence, interconnectedness, and centrality of this range of the services to the well-being of humans (MA, 2003) and the sustainability of one depends directly on the maintenance of the other.

Rural communities have managed the natural...
ecosystems through norms and cultural values that provide community members with necessary ecosystem services such as good quality water, fertile farm soils, genetic material for medicines and crop breeding, wild foods including fish, and buffering against extreme weather events for decades. Valuable cultural and spiritual ecosystem services derive from nature were also well managed by community members (Fisher et al., 2008).

In sub-Saharan Africa, traditional land tenure systems are still used widely and take different forms in the management of ecosystems. Customary land tenure may be regarded as land belonging to a social group (Fisher, 1993) and/or family, where family members enjoy unrestricted rights of usage. The head of the community or family is regarded as a symbol of the residuary, reversionary, and ultimate ownership of all land held by the collective (Mabogunje, 1992). Communal land is a social resource and has religious significance; it is only through a persons’ relationship with the land that she/he perceives a sense of place and personality (Payne, 2002).

Customary land rights are still prevailing in many Ghanaian communities and are closely related to economic, political, social and religious setup of the particular area/region. Within customary rights framework in northern Ghana, an egalitarian system is in use, with underlying principle of equity, fairness and security for members of the community rather than economic efficiency in the use of land and water.

The paper examines the role of traditional tenure on irrigated lands versus constitution-based formal systems of appropriation of lands in Ghana, based on some specific examples. The first part examines the traditional management of the land by local institutions. The second part looks at the constitutional framework of land appropriation of land resources in Northern Ghana, while the third section deals with the role of the local institutions after 1992 amended Constitution, when the lands were reverted back to the traditional owners. These arrangements are important, as they have profoundly contributed to the low performance of the irrigation schemes across the country, as observed by several authors (Namara et al., 2010, Owusu et al., 2013, Kotey et al., 2015). The paper further argues that lack of understanding of traditional management and use of natural resource has, furthermore, contributed to the collapse of many irrigation schemes, confirmed by other recent studies (Adongo et al., 2015).

Understanding this situation and addressing the problem is very important, especially at present time, when the climate change effects, coupled with rapidly increasing population are necessitating better performance of the local food-producing sector. While Government of Ghana is acknowledging the need for agricultural industrialisation and commercialisation of agriculture in number of its policy documents (FAO, 1991), some very obvious actions, such as improvement of the management of the natural resources of the government-established irrigation schemes seem to have been left out of the relevant ministries’ plans.

Almost all the government-established irrigation schemes in Ghana produce rice as a major crop. Their performance is poor and yields are low (Owusu et al., 2013), thus forcing the government to spend considerable amount of money on rice imports to complement low internal production levels.

If the management of the irrigation projects could be improved, resulting in higher crop yields, especially for rice, this will have obvious benefits, both directly for farmers, as well as for the overall economy. Thus, paying attention to the past and present ecosystem management and understanding fully intricate relationships governing irrigation projects resource management is of relevance for the entire economy, while at the same time serving long-term goals and ambitions of Ghana to be one of the leading rice producers in the region.

The paper examines the role of traditional tenure on irrigated landscapes versus constitution-based formal systems of appropriation of lands in Ghana, based on some specific examples. The paper examines the following:
- The role of the local institutions before independence
- The role of local institutions between 1957 to 1992 amended constitution
- The roles of local institutions after the amended constitution.

These arrangements are important, as they have contributed to the low performance of the irrigation schemes across the country.
The paper argues that lack of understanding of traditional ecosystem management has contributed to the collapse of many irrigation schemes in Ghana. Thus, understanding the situation and addressing the issues are very important, especially when the effects of climate change effects and increasing population requires better performance of the local food-producing sector. The Government of Ghana (GoG) acknowledges the need for agricultural industrialisation and commercialisation but actions, such as improvement of the management of the natural resources of irrigation landscapes seem to be ignored in relevant ministries’ plans.

**Traditional Arrangements for Use and Management of Natural Resources**

Almost 80% of lands in Ghana are customarily owned, with varying tenure systems (Sarpong, 2006). The landholders are mostly family and communal heads, holding the land in trust for the family and chief/tindana (custodian of communal lands), respectively (Kasanga and Kotey, 2001). These traditional arrangements were in place during the colonial period, before Ghana’s independence (1957) and same practices continued afterwards.

In a traditional setting, different groups (elders, women, men and youth) solve challenges after engaging in face-to-face communication (Ostrom, 2007). Small groups that use CPR for irrigation systems or pastures usually develop diversity of norms and rules to enable them solve problems of their use. Policies on land tenure therefore need to consider the complex nature of social relations that characterize the rural society (Le Meur, 2006).

**State Land Acquisitions in Northern Ghana**

Public/state and customary involvement in land tenure and management systems is enshrined in the Constitution of Ghana. In Northern Ghana, the administration of Lands Act, 1962 (Act 123) vested all lands in in the President and in practice, the government was the absolute landlord and has control over the collection and distribution of revenue to the exclusion of all others. These vesting powers were also extended to cover the rest of the country by the Stool Lands (Validation of Legislation) Act No 30 of 1959, Stool Lands Act, 1960 (Act 27) and the Administration of Lands Act 1962, (Act 123). After the 1969 constitution, Lands Commission held and managed all lands, under the Lands Commission Act 1971 (Act 362). Article 163 (5) which states: “The Lands Commission shall hold and manage to the exclusion of any other person or authority any land or minerals vested in the President by this Constitution or any other law or vested in the Commission by any law or acquired by the Government and shall have such other functions in relation thereto, as may be prescribed by or under an Act of Parliament”.

Lands for irrigation schemes in Northern Ghana were therefore acquired under the Stool Lands Acts of 1959, 1960 and Administration of Lands Act of 1962. Under these acts, the land and its resource were no longer controlled and managed by the traditional custodians, but under the full control of the irrigation scheme management, such as Ghana Irrigation Development Authority (GIDA) and Irrigation Company of Upper Region (ICOUR).

Ofori (1973) discussed this situation and observed that large tracts of land were acquired for state farms and factories without compensation paid to farmers cultivating these lands. In some instances, they were employed to work on the state farms as compensation.

**Amendments of the 1992 Constitution and Changes in Natural Resources Management**

Article 36 (8) of the amended 1992 Constitution recognised the concept of trusteeship in landholding and emphasised that those with responsibility for managing land must act in the wider interests and it states that: “the state shall recognise that ownership and possession of land carry a social obligation to serve the larger community and, in particular, the state shall recognise that the managers of public, stool, skin and family lands are fiduciaries charged with the obligation to discharge their functions for the benefit respectively of the people of Ghana, of the stool, skin or family concerned, and are accountable as fiduciaries in this regard” and

‘For the avoidance of doubt, it is hereby declared that all lands in the Northern, Upper East and Upper West Regions of Ghana which immediately before the coming into force of this Constitution were vested in the Government of Ghana are not public lands within the meaning of clauses (1) and (2) of this article’. 
The lands were thus reverted to the traditional custodians (family heads, chiefs and tindana/temdamba).

MATERIALS AND METHODS

Study Area

This study was conducted in the Guinea Savannah Ecological Zone of Northern Ghana, with unreliable rainfall pattern and prolonged drought spells (Kranjac-Berisavljevic et al., 2014). The climatic conditions necessitated the establishment of over 350 irrigation schemes in the area including Tono Irrigation Project (TIP) and Bontanga Irrigation Project (BIP) which were selected for this study.

Tono Irrigation Project (Figure 1) is in the Navrongo Municipality of the Upper East Region and is the largest irrigation scheme in Ghana. TIP lies between latitude 10° 45’ N and longitude 1° W. TIP was established by the Ghana Government to promote the production of food crops by small scale farmers within organized and managed irrigation schemes. TIP construction started in 1975 and was completed in 1985. It has a potential area of about 3840 ha, with a developed area of about 2490 ha. The source of water is from the River Tono. Some upstream settlements were displaced due to the development of the reservoir, as well as eight downstream communities. Tono Irrigation Scheme is managed by Irrigation Company of Upper Region (ICOUR).

Bontanga Irrigation Project (Figure 2) is in the Kumbungu District in the Northern Region and has a potential irrigable land area of 800 ha, but only 495 ha are developed. About 255 ha of the uplands is used for maize and vegetables and 240 ha of lowlands for rice cultivation. Bontanga Project has eight villages whose farmlands were affected by the establishment of the scheme (Figure 3). The dam was constructed on river Bontanse, a tributary of White Volta. Bontanga Irrigation Project is managed Ghana Irrigation Development Authority (GIDA).

Methods

A detailed study of the traditional ecosystem management and access to ecosystem services in irrigated landscapes was conducted using Participatory Rural Assessment (PRA) methods and semi-structured questionnaire interviews. Six (6) communities in each of the landscapes thus Tono Irrigation Project and Bontanga Irrigation Project were selected using stratified random selection method. The PRA tools used include;

- Ground trothing was conducted to identify communities and observe local protocol in selected communities.
- Focus Group Discussions (FGDs) was conducted with a checklist on the thematic areas (management system before and after 1982 constitution amendment) with different age groups (youth, between 25 - 45 years and elderly (<45 years) and grouping based on gender (men and women).
Identification and interviews of key informants and opinion leaders using snow ball method and checklist.
Interviews were conducted with traditional authorities (Chiefs, Tindana/Temdemba and Landowners) as well as with farmers and various interest groups, such as youth and women.
40 households were selected through stratified random sampling of households in each community and questionnaire administered to selected households.

RESULTS AND DISCUSSIONS
Traditional CPR Management in the Study Communities

Before and at the start of the independence period (up to 1971) lands and other natural resources were managed through the various traditional institutions at both Bontanga and Tono Irrigation Projects. Land ownership and tenure was entrenched in the traditional common property system with land administration vested in the community chief, family or clan head.

Bontanga Irrigation Project Traditional Area
In the Bontanse River catchment in the Northern Region, land and resources were managed by well-organized local institutions, such as council of elders and sub-chiefs. A typical management structure is shown for example, at Zangbalung, a community of BIP (Figure 3).

Figure 3: Dagbon Traditional Resource Management (Zangbalung Traditional Area)

Zangbalung used as an example here, has five (5) suburbs with relevant land within the BIP. These suburbs are Yipelgu, Yepalsi, Bulpiel, Blesi, Dohi, and Bamaha. The overlord of Dagbon (Yaa-naa) enskins paramount chiefs and gives them authority to rule a community and to be his representative in the community.

All paramount chiefs have Council of Elders and sub-chiefs (enskinned by the paramount chief). Sub-chiefs, apart from their social responsibilities in the community, ensure that there is sustainable use of resources under their jurisdiction by regular monitoring the landscape under their jurisdiction. Access to some ecosystem services such as hunting, fishing, harvesting of some fruits (e.g. dawadawa and shea) and wood are controlled by sub-chief. The sub-chiefs are supposed to brief paramount chief every Monday and Friday on the state of the land and its resources at meeting in the Paramount Chiefs palace. Failure to do so attracts sanctions which include losing your title and attracting levy (cow/sheep with fowls). When a paramount chief or sub-chief dies, in order not to create vacuum, a regent (Gbanglana) is enskinned until a substantive paramount chief or a sub-chief is enskinned. Land lease to households is done traditionally according to their needs. The right of use of land is inherited patrilineal and tenure is generally secure as long as the land is actually cropped.

Harvesting trees and shrubs is also controlled by the local chiefs under this system. Control measures include prohibiting cutting of economic trees, making it a ‘taboo’ to visit certain places (such as river side, farming etc.) on certain days of the week and/or using unwashed pots (e.g. cooking pots) to fetch water from streams, to
control pollution. Harvesting and felling of economic trees are determined by the sub-chiefs and announcement is made when the time is due.

Tenure arrangements at Tono Irrigation Project (TIP)
In Upper East Region, where TIP is situated, lands generally belong to families and clans, held in trust by the Tindana (traditional general overseer and custodian of communal lands). The Tindana performs sacrifices and purification of the land in times of disease outbreak, drought and has good knowledge of various land holding demarcations and hence is the person relied upon by the chiefs during land conflicts. Chiefs do not own lands, in contrast to the situation in Dagbon, described above.

Unlike in Dagbon, with the Kasena/Nankani and Builsa speaking people of the Upper East Region, women can manage land and its resources (trees, water etc.) under their control for the benefit of the family members. A female family head made the following remarks:

‘Since I have married into this community, I have every right to hold the land in trust for the family when my husband dies. I have held this responsibility for several years, sharing lands to family members’

Communities on the TIP include Bonia, Wuru, Biu, Gaani, Chuchuliga, Korania, Yogbania and Yigbwania (Figure 4). There is no paramount chief for the communities which lie within TIP, except the Chief of Navrongo and all the community chiefs are of the same status and rank (Figure 5). The Korania chief, however, has the responsibility of leading the Navrongo Chief (Navoro Pio) to all social and public gatherings. This position is recognised only within the Navrongo paramountcy.

Access to land and resources is through clan or family heads. Trees, fruits and herbs are harvested from landowner’s field by his/her household. The land can be taken back by a family/clan head if it was observed that the resources in a holder’s field were over exploited (harvesting of premature dawadawa, shea, inappropriate land use etc.). Felling of trees and other woody species from communal lands is allowed with permission from the Tindana and/or the family/clan head if the resource is on the family land. Sacrifices are conducted by the Tindana in consultation with the Chief before land is given to non-citizens of the community. Lands are not sold to non-citizens.

Management of Resources on Irrigation Schemes during the Period under the Governmental Control (1975 - 1992)
Management system of Bontanga and Tono Irrigation schemes during this period was similar. Though TIP was managed by ICOUR, a semi-private company, some of the staff on the scheme was from Ghana Irrigation Development Authority (GIDA), a division of the Ministry of Food and Agriculture. According to the management at BIP and TIP, irrigation implementation and management guidelines came from GIDA head office in Accra. The two irrigation schemes were purposely built to add value to land and water for the irrigation, domestic, livestock and fisheries purposes to meet household needs of community members in and within the project catchment area. However, decisions taken regarding the management of the schemes were made solely by the executive of BIP.
and TIP, respectively, with executives of Farmer Based Organisation (FBO) acting as a link of communication between farmers and the management. Eventhough the Chiefs and Tindanas were the traditional custodians of the lands in the project areas, land allocation and balloting for plots were supervised by BIP and TIP, without their involvement.

Land allocation and redistribution on the projects was carried out every season by balloting, based on the farmers’ performance, except for those lands allocated to chiefs, which were in permanent custody. Women were allowed to ballot for plots at TIP, whereas at BIP they were denied this opportunity, because they were considered as members of the male household. Women outside this niche (ex. widows, single mothers, etc.) were not taken into account in land allocation considerations.

Water bailiffs distributed water among the laterals. Tractor services, bank loan incentives in the form of farm inputs (seed, fertilizers weedicides and pesticides) were provided by the scheme management, but were facing financial and managerial challenges, which made GIDA embrace the 1992 constitution amendment.

On schemes, chiefs, tindanas, elders of the communities and landowners were not considered in the management of the schemes, and this generated conflict and misunderstanding between management and the communities.

**Current Resource Management**

After 1992 constitution review, lands given back to the communities were distributed under village committees (VC) management, with a minimum interference from scheme management. The lands were not allocated to farmers on permanent bases. Lands could be retrieved by the VC, if the holder was found to be under utilising the land.

At TIP, land allocation was delegated to Village Committees (VC), but this decision was not backed by any legal framework. The farmers in the communities were organised into groups and the VC allocated lands to them in blocks. Allocation of lands and collection irrigation service fee from its members in a community block became the responsibility of the VC. Underutilised plots were taken back by TIP and given to farmers outside the community.

TIP does not offer tractor and input services to farmers anymore and this has given rise to unregistered organisations of ‘Nucleus Farmers’. These organisations offer tractor services (ploughing, harrowing and levelling) and also act as guarantors for farmers to obtain loans from local banks. Women at TIP have equal share of resources, as one female household head remarked: ‘We shall make sure that any single drop of water from the reservoir is shared equitably between male and female in our community because we all now have the right to the reservoir. We have seen to the equitable distribution of resources before the shortage of water this shortage in the reservoir. What has been agreed upon by our forefathers in the use of resources, we will continue to fight for it?’

However, Tono Irrigation Project suffers severe water shortage at present time, due to poorly maintained infrastructure, among the other problems (Adongo et al., 2015). Lateral on the project, supposed to bring water closer to farmers’ fields, have not been rehabilitated since construction of the scheme in 1985, despite the rehabilitation of the main canal, carried out in 2008. Both TIP and BIP currently suffer from inability to pay workers. This has resulted in the absence of water bailiffs and irrigation extension officers on the projects.

On BIP, there are about 600 farmers, organised in FBOs. There are between 50 - 65 farmers in each FBO, acknowledged in GIDA documents. Lands are allocated on permanent bases by the FBOs, under the supervision of BIP management. A memorandum of understanding has been reached between BIP and the farmers that lands can only be re-allocated if the owner defaults for three consecutive years in the payment of the irrigation service fee. Permanent allocation has resulted in some farmers having more than 10 acres of land. These farmers rent out land at between GHS200.00 - GHS250.00 (US$48 - US$60.7) per season.

Women on the BIP project indicate that they have sent petitions to BIP management to be considered for plots in the project area. The lowlands are predominant areas for rice cultivation and they are mostly monopolised by men. At present, only few women have plots in the lowland areas, while most
others have plots located in the uplands, where only indigenous vegetable cultivation is possible because of nematodes infestation.

Some women farming the upland plots are making efforts to convert them into rice, because of the market demands. The inability of women to access prime productive land at BIP has compelled them to use marginal lands and also made women be the source of hired labour during seeding, transplanting, weeding, and winnowing, while children labour is used during crow-scaring (driving away birds during the booting stage of rice).

The reservoir at BIP has been designed to irrigate 800 ha of land, almost double of the currently cropped area and thus, there is ample water available, but water management is very poor, therefore wasting large quantities and resulting in low water efficiency. This is mainly because of lack of the properly scheduled cropping pattern for the scheme and not because of the water scarcity; as explained by one of the respondents during the field study: ‘there is no synchronized cropping for efficient water use. For instance, one farmer will be seeding, while the other is preparing a nursery while yet another is transplanting on the same lateral’.

CONCLUSIONS

Constituents of ecosystem, such as trees and wildlife existing on the large-scale irrigation schemes in Northern Ghana have been under different management systems over time. Ecosystem resource ownership in irrigated lands by traditional custodians is with mixed results. In the present arrangement of resource ownership, the communities control very little portion of the resources. There is also lack of management skills and lack of technical knowledge. Moreover, challenges such as minimal resources available to them and also, unfair distribution of the land, left behind by irrigation project manager have a negative impact on the performance and management of resources in the irrigation schemes.

Poor performance of irrigation schemes in Northern Ghana are partly due technical, but also largely due to socio-cultural reasons. Traditional leaders’ role in resources management systems was not recognised in management and controlled in irrigation schemes.

The reversal of the natural resources management in irrigation schemes to communities do not returned automatically the situation to the previous status. The traditional resource management structure was destroyed by the change in management and was not replaced by any improved structure, rather a situation ecosystem services have diminished over time, mainly due to lack of proper management and stewardship. The introduction of the state control and its subsequent removal was not carried out in a planned manner to allow for building of the skills for farmer-based organisations.

There is the need for clear recognition of these inherent problems, as well as for considerable socio-technical changes in the rehabilitation, design and establishment approach to irrigation schemes constructed not only in Ghana, but in many other parts of Sub-Saharan Africa where irrigation systems have been established and are managed under the similar conditions. There is no clear understanding of the natural resources ownership and management and therefore a successful transition from traditional African subsistence agriculture into modern one, supported by irrigation and other technically advanced methods, with a full participation of the small-holder farmers are still lacking.

Government of Ghana and other relevant institutions promoting ‘modernisation’ and commercialisation of agriculture, which is featuring prominently in many policy documents, should take cognisance of the irrigation schemes problems and issues and build into policy documents ‘road map’ for achieving these noble objectives, without passing through stressful experiences described in this paper. Training and education of participants in the scheme offering technical change, inclusion of all social groups in participatory manner and careful consideration of financial and socio-cultural structure of the communities and their inherent values should be some of the considerations guiding project implementation. While these principles are not new and have been mentioned in relevant documents many times, it is necessary to apply them on the field to the full in order to achieve desired measure of success.

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge contribution of Veldwisch, G.J., Wageningen University, and Mr. Baba Abdulai (ADB) who substantially contributed to first draft of this
paper. Also, financial support from Integrated Water and Agricultural Development (IWAD) and Alterra Wageningen University are duly recognised.

CONFLICT OF INTEREST
On behalf of my co-authors that there is no conflict of interest.

REFERENCES


