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Providing irrigation water as a public utility to enhance agricultural productivity in Uganda

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ABSTRACT

Vagaries of weather remain a significant challenge to enhancing agricultural productivity, farmers' incomes, and economic growth for most developing countries. In Uganda, strategies for intervention are hindered by lack of countries with similar socio-economic, environmental, and economic characteristics from which to draw experience. This paper proposes the provision of supplemental irrigation water as a public utility to enhance agricultural productivity among smallholder farmers in Uganda. It uses nationwide surveys, administrative data, and expert consultation to explore the rationale for irrigation, the potential of supplemental irrigation, and the commercial and operational basis for adopting the proposed system.

1. Introduction

Vagaries of weather are observed as the single factor that influences the economic performance of Uganda and the welfare of its people (OPM, 2012; UBoS, 2010). The frequency of droughts in the country as a whole or in some geographical regions has become a major bottleneck to economic growth (Mwaura and Okoboi, 2014; Maidment et al., 2013). Provision of water for agricultural production is considered a major intervention to ensure achievement of the country's long-term and mid-term economic goals of transformation to a modern and prosperous society (GoU, 2010; GoU, 2012). Moreover, the same interventions will help mitigate the threat to the country posed by climate change (Thornton et al., 2010; Kabubo-Mariara and Karanja, 2007).

A need exists to design agricultural and economic strategies to overcome the ecological and socio-economic barrier to welfare advancement (GoU, 2010; GoU, 2012). In Uganda, agricultural provides a unique opportunity considering the country's potential presented by fertile soils, weather factors, and geographical position. Policy interventions to enhance agricultural production will have a major impact on the country's economic growth as the sector is the largest employer and has potential to transmit tremendously effects to other sectors including services, manufacturing, and construction (MAAIF, 2013). This study was designed to propose an effective irrigation system to address high agricultural losses associated with frequent drought in Uganda.

A consensus among agricultural stakeholders has been reached on the critical role that irrigation will play in increasing crop's yield, reducing poverty, and improving food and nutrition security in the world's poorest regions (Rosenzweig and Parry, 1994; You et al., 2011). Moreover, irrigation could substantially improve returns to labour, management, capital, and land; reduce risks of crops' production failure; and provide linkages to multiple local markets (Burney and Naylor, 2012; Hanjra et al., 2009).

Despite its potential for ameliorating agricultural, employment, poverty, and economic growth challenges, efforts for implementing irrigation have generally performed very poorly in the Sub-Saharan Africa (You et al., 2011). Reports of dysfunctional public financed irrigation schemes are rife across the region (Douxchamps et al., 2014). Efforts to transfer the schemes to farmers, following recommended strategies (Yoder, 1994; Ostrom, 1992) have not fared any better (Douxchamps et al., 2014). Irrigation schemes transferred to farmers require regular financing from the government to remain functional (Yokwe, 2009). Ongoing challenges facing irrigation schemes in Sub-Saharan Africa include water reliability and reticulation problems, deterioration of physical infrastructure, and management problems, as well as farmers' governance constraints (Mwendera and Chilonda, 2013). In this context, a proposal for revitalizing the existing irrigation without a need for expansion has been supported by financial institutions (Douxchamps et al., 2014). Governments faced with budget constraints need to find irrigation development approaches that are highly productive and economically efficient to ensure shorter payback periods (Perret, 2002). Efficiency lessons from other utilities, including electricity and domestic water, indicate that the government should

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invest in transmission systems while the customers benefiting from the service pay for distribution and the connection (Devkar et al., 2013). Interventions that involve utility user payments avoid sub-optimal allocation of scarce resources and enhance effective pricing leading to sustainable use of water (Alcon et al., 2014). Within such a system, there are a number of management alternatives that farmers can take to improve their position in balancing water requirements while considering the available water supply (Karlberg et al., 2007). Alternatives for farmers include the adoption of more efficient irrigation technology, such as drip irrigation technology, and deficit irrigation operation.

Irrigation schemes systems are conceived as an aggregate of three components including water access, distribution, and use (Burney and Naylor, 2012). A survey of a number of interventions by government and other development agencies has prioritized access of water to farmers through irrigation projects, including public-private partnerships (Friedlander et al., 2013; Burney and Naylor, 2012). However, the potential for irrigation investments in Africa is highly dependent on geographic, hydrologic, agronomic, and economic factors that should be taken into account when assessing the long-term viability and sustainability of planned projects (You et al., 2011). Recommendation for water provision as a utility arises from the fact that despite its critical role in enhancing agricultural production, irrigation investment require substantial amount of capital (Douxchamps et al., 2014).

Uganda's desire for policy intervention in agriculture through the provision of water for production is in line with the recommendations by the Comprehensive African Agriculture Development Programme, CAADP (Kolavalli et al., 2010). CAADP aims to ameliorate the prevailing food and agricultural crisis in Africa. Despite the urgency of irrigation intervention in Uganda, queries on the strategy for effective and sustainable management of irrigation facilities exist (MWE, 2011; MAAIF, 2010). While cases of successful strategies elsewhere have been reported (Ostrom, 1992; Pokhrel, 2013; Huang et al., 2010), Uganda has unique socio-economic and environmental characteristics that may require consideration for successful implementation of irrigation facilities.

First, the land is privately owned in smallholding averaging 1.3 ha per family (PMA, 2009), limiting the type of irrigation that can be implemented and the ability to practice various types of facilities economically (Giordano, and deFraiture, 2014). Second, the adoption of high yielding agricultural technologies has been low (Okoboi and Barungi, 2012), necessitating the use of innovative approaches. Third, society has not sufficiently evolved to be independent of government's direct financial support (Sserunkuuma et al., 2000), implying that system design requires some attention to the role beneficiaries could play from the project initiation stage. And finally, the country reports high rainfall variability that has been illustrated as seven-years' patterns of very low rainfall, medium and absolutely high rainfall (Mwaura and Okoboi, 2014). The pattern of rainfall variability may make it difficult to sustain the impetus for water provision, especially during peak rainfall years. Moreover, the lack of empirical evidence on the economic impact of drought and the potential benefits of intervention make it difficult to prioritise irrigation during the national budgeting process. For these reasons, Uganda seems less likely to expand irrigation, its large potential notwithstanding (Neumann et al., 2011).

The social components of the provision of water for production appear to be the main constraint in achieving the government goals (MWE, 2011). Intervention is compatible with the priorities of a number of development partners, implying that financing of irrigation facilities is achievable (FAO, 2004). The country is well endowed with water resources both surface and ground reserves (Nile Basin Initiative_NBI, 2012). Total renewable surface water (actual) is estimated at 29 billion cubic metres per year while the groundwater is 66 billion cubic metres per year. Although the country has a total renewable per-capita potential of 2085 cubic metres per individual per year, only 11.5 cubic metres is withdrawn annually per individual. The water resource is distributed within eight water bodies or basins, with seven having a rich nexus of permanent rivers, streams, and wetlands that allows yearlong harnessing (MWE, 2011).

Although the country's annual precipitation is estimated at 1133 mm (FAO, 1995), higher evaporation rates are recorded (NBI, 2012) resulting to a net precipitation being negative and severe cases of soil moisture stress. While no detailed analysis of soil moisture analysis has been done, episodes of droughts and famines are reported regularly across the country (NEMA, 2010). Due to existing patterns of rainfall in the country, cost implications and call for efficiency, supplemental irrigation provides an appropriate intervention for most agro-ecological zones (Wortmann and Eledu, 1999). Proponents of both the public choice theory (Ostrom, 1992) and stakeholder capacity building (Yoder, 1994) converge on various aspects of a sustainable irrigation system.

Despite the government' interest in developing and expanding irrigation systems in Uganda, little is research on the required interventions that will facilitate farmers to adopt irrigation; and factors that will influence successful expansion and sustainability of water production facilities.

The specific objectives of the study are to enumerate the high agricultural losses associated with reliance on rain-fed crop production among farmers in Uganda; provide insights on productivity levels that could be achieved by irrigation; estimate irrigation adoption rate among farmers; and highlight lessons from local domestic water supply and water harvesting for livestock that are applicable to the case for supplemental irrigation in Uganda.

2. Research approach

The study used both primary and secondary sources of data. Secondary data include survey conducted by Uganda National Bureau of Statistics (UBoS); data available with the Food and Agriculture Organization of United Nation (FAO) and other data collected by government and private agencies.

2.1. Secondary data

Three nationally representative datasets collected by UBoS were used in this study: Uganda National Household Survey (UNHS III) data collected in 2005–06; Uganda National Panel Survey (UNPS) of 2009/10; and the Uganda Census for Agriculture (UCA) of 2008/9. The UNHS and UNPS datasets have agricultural production statistic collected in each of the two seasons that are influenced by the rainfall patterns. Uganda's agricultural production seasons are between April to July (Season 1) and August to November (Season 2). Information on agricultural produce loss due to various factors including droughts is included in the agricultural modules. There are, however, slight differences between the UNHS and UNPS questions concerning drought. While UNHS queried farmers on the proportion loss of expected yield attributed to drought, UNPS requested them on instances of the total crop failure as a result of drought.

The census survey was conducted between the months of September 2008 to August 2009 and covered 80 districts with a focus on agricultural families. Through two-stage sampling procedures, 31,340 agricultural families were surveyed across all four geographical regions of the country. The census captured information related to families' agricultural management activities, including irrigation and non-irrigation water control activities. During the UNPS (2009/10) and UNHS (2005/06), UBoS collected information from 2566 to 7421 families respectively.

Food and Agriculture Organization of United Nation (FAO) Statistical Database (FAOSTAT) available at http://www.fao.org/faostat/en/#data/GT accessed in 2013 was used to compare yields achieved for various crops in Uganda and Egypt. Yields in these two countries were compared, as both are riparian members of the Nile Basin (NBI, 2012). While Uganda is an upstream member, Egypt is a

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