ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 9, Issue 2, pp: (108-113), Month: April - June 2021, Available at: www.researchpublish.com

"From rain-fed farms to irrigated farms": Irrigation technology for smart farming in Lira city, mid-north Uganda

[1]Victor Okuna, [2]David Mwesigwa

[1]MA student, Discipline of Public Administration and Management, Lira University, Uganda

[2]Senior lecturer, Discipline of Public Administration and Management, Lira University, Uganda

Abstract: **Smart farming offers a potentially beneficial prospect for farming in Uganda and beyond. Nonetheless, there is no adequate methodical inquiries on what smart farming essentially denotes and the different openings through which it can be boosted in this perspective. This study aimed to look at one of the different opportunities by which smart farming can be enhanced in mid-north Uganda, that is, irrigation technology, through an experiential analysis of the success stories and observed patterns of those that have implemented the technology. The outcomes appear to describe fundamentally interrelated and reciprocally underpinning components that facilitate irrigation technology to enhance smart farming even where several issues of socioeconomic background remain restrictions. The issues involve initial capital investment as well as abilities and information necessary to operate as well as sustain the technology. Also, the source of water, pipe used to direct the water to the sprinkler, the pump used and the sprinkler used to irrigate the land are key attributes for keeping irrigation technology afloat while at the same time enhancing the much sought for smart farming. We conclude that the above elements echo with the ideas of food security as well as sustainable agricultural practices. This study offers a valued abstract for agricultural extension workers serving local communities in Uganda to promote ecologically responsive farming technologies.**

Keywords: **Smart farming, irrigation, water, sprinkler, Ober.**

1. INTRODUCTION

Agriculture is an important industry in the world since it feeds the population, contributes to national income and employment, creates raw materials and capital for other sectors, directly and indirectly impacts on exports, biodiversity and ecological balance. It is known that world population exceeded 7 billion in 2018 and it is estimated to reach 9.15 billion by 2050 (Zaman et al., 2017). These figures on population highlight the role of increase in agricultural productivity in the increase of the world population. To feed the potential population, it is necessary to ensure agricultural productivity and agricultural sustainability. 17% of the world's agricultural land is irrigated and 40% of the world's agricultural production is obtained from irrigated agriculture (FAO, 2002). The earliest archaeological evidence of irrigation in farming dates to about 6000 B.C. in the Middle East's Jordan Valley (Hill 1994. It is widely believed that irrigation was being practiced in Egypt at about the same time (Worster1985), and the earliest pictorial representation of irrigation is from Egypt around 3100 B.C (Hill 1994).

Globally, irrigation accounts for more than 70% of total water withdrawals and for more than 90% of total consumptive water use (D¨oll, 2009; FAO, 2010; Shiklomanov et al., 2000). Irrigation is the most important water use sector accounting for about 70% of the global freshwater withdrawals and 90% of consumptive water uses. While the extent of irrigation and related water uses are reported in statistical databases or estimated by model simulations, information on the source of irrigation water is scarce and very scattered. Irrigation can be broadly defined as the practice of applying additional water (beyond what is available from rainfall) to soil to enable or enhance plant growth and yield, and, in some cases, the quality of foliage or harvested plant parts. The water source could be groundwater pumped to the surface, or surface water diverted from one position on the landscape to another. Development of irrigation water often entails development of large-scale, geographically significant dams and water impoundments and/or diversions that can provide additional functions apart from crop growth enhancement, e.g., flood control, recreation, or generation of electricity.

Large-scale irrigation started in Uganda in the 1970s. However, long periods of political crisis and violence following independence led such schemes to be left aside mainly until early 2000s. In post-conflict northern Uganda, the irrigation schemes of the Olweny Swamps (Lango region) and at the foot of the Agoro Hills (Acholi region) reflect strong strategic issues: developing marginalized areas, capturing votes in reluctant regions, promoting irrigation as a stepping stone towards wealth creation and adapting climate change, etc., (Gay & Torretti, 2015). Irrigation has attained increasing importance the world over because of the growing demand for food by a rapidly growing world population. The current global population stands at 7.2 billion, growing at a rate of around 1.14% per year and is projected to increase to about 9.6 billion by 2050 (United Nations 2013). Africa, which has a population of 1.1 billion today, is projected to increase to about 2.1 billion by 2050 (Bogaards, 2009). In Uganda, the population is estimated at 34.9 million people, with an average annual growth rate of 3% (Uganda Bureau of Statistics, 2015). Correspondingly, pressures on Earth's finite natural resources, of which arable land is one, are rising in tandem with the growing human population. The agricultural sector in Uganda contributes about 24.6% of the gross domestic product (GDP), provides livelihood for over 72% of the economically active population, and provides most of the raw materials to the mainly agro-based industrial sector (Uganda Bureau of Statistics, 2015). Agriculture in Uganda, which is predominantly rain-fed, is increasingly adversely affected by the climate change and variability manifested in erratic rain patterns, prolonged dry spells, and floods. As a result, farm-level productivity is far below the attainable potential for most crops (Fermont and Benson 2011). Under these conditions, irrigation is critical in aiding farmers against climate change and plays an integral role in transitions from subsistence to commercial farming by ensuring year-round production and farm employment (Machethe et al. 2004; Ngigi 2009; Van Averbeke et al. 2011; Kadigi et al. 2012; Haile and Asfaw 2015; Megersa and Abdulahi 2015). The national policy framework for the development of irrigated agriculture in Uganda guided by the National Water Policy, 1999, is anchored on poverty alleviation and economic growth (GOU 2010). The drafted National Irrigation Master Plan (NIMP) for 2010–2035 (MWE 2011) identifies drivers of irrigation development in Uganda, which include; Vision 2050, which calls for "a transformed Uganda society from a peasant to a modern and prosperous country within 30 years"; climate change and variability; new markets; and an increasing number of major international investors looking to establish commercial agricultural assets in the region.

Despite previous efforts by the Government of Uganda (GoU) to promote irrigation, less than 1% of agricultural households practice irrigation in Uganda (Uganda Bureau of Statistics, 2010; MAAIF 2011). The area equipped for irrigation is less than 3% of the total potential irrigable area in Uganda estimated at 567,000 ha (MWE 2011). Therefore, there is still an opportunity to exploit the irrigation potential, which would ensure that Uganda is not only food secure but also an exporter of agricultural products. In comparison with neighbouring East African countries, Uganda is fairly well endowed with vast natural water resources (Nsubuga et al. 2014), which is the base resource needed for irrigation. Major water bodies include Lakes Victoria, Kyoga, Albert, George, and Edward while major rivers include the Nile which is the world's longest rivers Kagera, Rwizi, Katonga, Kafu, Manafwa, Sio, Mpologoma, and Aswa. About 11% (26; 571 square kilometres) of the country is covered by wetlands (swamps), of which one-third is permanently flooded (MWE, 2013). About 98% of Uganda's total area lies in the Nile basin, while a fringe of 5; 849 square kilometres along the country's border with Kenya lies in the Rift Valley Basin (FAO, 2015). It is thus crucial to consider the basin level implications of a major allocation of water to the agricultural sector in Uganda, in the likelihood that downstream riparian states (Sudan and Egypt) have concerns. According to MWE (2011), full development of Uganda's irrigation potential would require withdrawals of just over 4% of Sudan and Egypt's combined irrigation water abstractions. In reality, very little of the water flowing out of Uganda into Sudan actually makes it to the major irrigation areas of Sudan and Egypt, north of the Sudd swamps.

Typology of irrigation systems provides an objective appraisal and comparison of irrigation systems, according to their common physical, management and social characteristics (Namara et al. 2011). The systematic classification of irrigation systems is crucial for identifying appropriate interventions for improving performance and productivity in this sector and for improving the planning of future irrigation development initiatives (Namara et al. 2010). Typology of irrigation in Uganda is classified by the size or scale of the irrigated area; ownership of the irrigation infrastructure; source of water (rivers, lakes, reservoirs, and swamps) and power; water conveyance and distribution (by gravity or pumps); and the in-field water application technique. The subsequent subsections expound on the irrigation typologies in Uganda. Size of the Irrigated Area There are three typologies defined by the size of the irrigated area: large-scale (more than 500 hactares), medium-scale (100–500 hactares) or small-scale (less than 100 hactares). Based on the readily available data

The issue under study is the sprinkler irrigation system which Albert is using for irrigating his crops especially during dry season. Just like how rainfall distributes water, sprinkler irrigation is a system that allows water distribution through a system of pipes. The water is passed through the pipes by pumping and with the help of sprinklers the water is sprinkled into the air. The water is then converted into small droplets like rain which then falls on the crops in a field. After observing various technologies at Albert Okello's farm in Ober Kampala, I got interested in the sprinkler irrigation. This is because, it can help one to grow crops throughout the year. This can help one earn more revenue because prices are better in dry season especially vegetables. Consequently, the specific aspects considered in the study were the source of water, pipe used to direct the water to the sprinkler, the pump used and the sprinkler used to irrigate the land.

We visited Okello Albert on his farm in Ober Kampala, Lira West Division and produced an introductory letter that was given from the University requesting for any assistance from whoever we would go to practicing farming by use of any appropriate technology. The visitors were introduced as students of Lira University studying smart technology for farming and who needed practical information and knowledge of the technology being applied in his farm land. We further assured him that the information will be strictly for academic purposes. We used majorly two methods for collecting data from Okello Albert. The methods were interview and observation methods. Interview is a face-to-face discussion or communication via some technology like the telephone or computer, between an interviewer and a respondent to obtain accurate information. It provides in-depth data which is always not possible to obtain using questionnaires (Mugenda & Mugenda, 2003). Unstructured interviews were used, where the information that needed to be obtained from the respondent was obtained. Another method that I used was observation. This helped me to view several activities especially species of crops grown in the farm, the operation of the water pump and how the sprinkler works. That is to say adjustment of the sprinkler by the farmer to enable water reach every parts of the farm land, the behaviour, the culture, and physical features such as vegetation among others.

2. THE OUTCOMES

Okello Albert, an innovator in Ober-Kampala, was visited on 13th March 2021. He specialises in fish farming, Crop production and fruits majorly oranges. The technology identified is Irrigation which he uses for making sure his plants are properly watered.

Source of water: The source of water at Albert's farm is a shallow well about ten feet deep. He sunk the well personally basing on the information he generated from the internet through his smart phone. To ensure that he gets enough water, two drums with a capacity of two hundred litres were immersed with some holes to allow water collection. A pipe is immersed in the water. The shallow well can be operated both manually and automatically. The manual operation is very tiresome though it uses a pulley system and it is not very effective in supplying enough water to the whole farm land at the same time the pressure will be low hence reducing on the radius coverage. He started pumping water from the shallow well using a fuel pump which could not last for long about only three months' life span when submerged in the water. He later bought a submergible pump. The pump has got a propeller that helps to move water through the pipe when an electric source is switched on. The water then moves through the pipe to the sprinkler. The pipe (horse) is about fifty meters long. The length is just enough to reach the farm. The sprinkler as explained by Okello rotates at 360 degrees with a radius coverage of 30 meters of water. This enables his plants to receive enough water especially in the dry season when it is very hot and there is no rain falling. He says that a sprinkler goes for thirty thousand shillings only though it does not last for a long time.

Albert says that he gets most of the information about irrigation through the internet. He uses a smart phone. The information helps him improve on his knowledge about irrigation at the same time he also gets more insight on how to improve on his innovation skills. The use of the sprinkler in irrigating his crops has enabled him to practice farming throughout the year with constant supply of his farm products. According to Albert, the benefits of the irrigation system are that;

- It is affordable and completely easy to set up. You will not be needing to spend much on labour cost for setting it up.
- There is no requirement of using many areas of your field for setting up the sprinkler irrigation.
- The interference with cultivation for setting up the sprinkler irrigation is very less. So, you will not face a huge loss.
- Frequent application of water can be supplied to the plants you will not need to do it yourself.
- The water distribution will always be equal.
- The amount of water being supplied can be controlled so you will be also able to save water depending on the necessity and requirements of plants.
- The sprinkler irrigation is suitable for setting up in all types of soil.

However, the major challenge is the cost of repair of the sprinkler and replacement of the pump in case it gets spoiled. Another challenge is irregularities in power supply as UMEME is always on and off. The water level sometimes goes down which is problem as he sometimes fails to draw enough water. He needs to have another reservoir tank to help him save the situation. He plans to buy a solar system in the near future to allow him have a constant supply of water even if UMEME is off. He also prays to acquire a 3D printer which will help him do more fabrication since he has his own workshop. This development will help him to save some money since he has the skills of fabricating a better sprinkler than the ones he always buys.

Challenges facing irrigation technology in Ober-Kampala

Despite the success stories observed and recorded in this article, a number of challenges are hindering attainment of full success, namely;

a) There was dearth of reference literature or document written to support the process of research and other learning aid.

b) The researcher was faced by tough weather, especially too much heat from sunshine.

c) The student was faced by time factor especially from the farm manager because he was busy pruning the banana suckers and pumping water to supply in the banana plantation and had little time for the student.

d) There was fear by the farmer to release/reveal some confidential information on the challenges and achievements of the smart farming.

e) There was fear from the farmer to reveal all information on how he assemble and manage the technology used in practicing the irrigation.

3. RECOMMENDATIONS

The study makes the following recommendations:

a) Training of irrigation technicians at certificate and diploma levels at technical institutions to operate and maintain irrigation systems.

b) There is need to increase water storage through the construction of valley tanks, dams, and farm ponds and develop bulk water transfer infrastructure to harness unutilized reservoirs as a strategic intervention.

c) Deliberate efforts should focus on promoting widespread culture of household-level rainwater harvesting coupled with soil and water conservation.

d) Government should work toward consolidating land, providing irrigation infrastructure on this land, and allocating to farmers with clear tenure agreements and management. In Uganda this will require deliberate acquisition of land from the current occupants through compensation.

e) There is need to operationalize government policy on irrigation by developing national guidelines on irrigated agriculture.

4. CONCLUSION

From the study, we can conclude that the irrigation technology that we have studies has a direct contribution to smart farming as testified by the farm owner as well as observed by the researchers. Hitherto, we recognise that a number of challenges are still hindering greater success of the technology. Although such hindrances do persist, efforts were being sought to mitigate further impact of the hindrances as well as their future occurrence. With the current trend in climate change, there is need to intensively implement the use of irrigation. This will enable the production of enough food which can help to fight both hunger and poverty in line with the sustainable development goals one and two.

REFERENCES

[1] Bogaards, J. (2009). "Human population growth and the demographic transition." Philos. Trans.

[2] D¨oll, P. (2009). Vulnerability to the impact of climate change on renewable groundwater resources: a Global-scale assessment, Environ. Res. Lett., 4, 035006, doi:10.1088/1748-9326/4/3/035006.

[3] FAO (2010). AQUASTAT – FAO's global information system on water and agriculture, Rome, Italy. http://www. fao.org/nr/aquastat, accessed: 14 March 2021.

[4] FAO (Food and Agriculture Organization). (2015). "FAO's information system on water and Agriculture." Rome.

[5] FAO 2002, Agricultural drainage water management in arid and semi-arid areas, Irrigation and Drainage Paper No. 61. Rome.

[6] Fermont, A., and Benson, T. (2011). "Estimating yield of food crops grown by smallholder farmers: A review in the Uganda context." International

[7] GAY L., TORRETTI C. (2015), "Territorialisation des marais d'Olweny en Ouganda: luttes de pouvoir, politiques agricoles et environnementales", *L'Espace Géographique, 45*, Belin, pp. 147 159.Saharan Africa." The MDG centre, east and southern Africa, The Earth Institute at Columbia Univ., New York, 189.

[8] GoU (Government of Uganda). (2010). "National development plan (2010–2035)." Kampala, Uganda.

[9] Haile, G. G., and Asfaw, K. K. (2015). "Review paper irrigation in Ethiopia: A review." Acad. J. Agric. Res., 3, 264–269.

[10] Hillel, D. *Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East;* Oxford University Press: New York, 1994; 355.

[11] Kadigi, R. M. J., Tesfay, G., Bizoza, A., and Zinabou, G. (2012). "Irrigation and water use efficiency in Sub-Saharan Africa." Global Development Network Agriculture Policy Series-Briefing Paper Number, Global Development Network, New Delhi, India, 1–8.

[12] MAAIF (Ministry of Agriculture, Animal Industry, and Fisheries). (2011). "Statistical abstract." Kampala, Uganda.

[13] Machethe, C., Mollel, N., Ayisi, K., Mashatola, M., Anim, F., and Vanasche, F. (2004). "Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo Province: Management transfer, productivity, profitability and food security." Water Research Commission, South Africa.

[14] Megersa, G., and Abdulahi, J. (2015). "Irrigation system in Israel: A review.*" Int. J. Water Resource Environ. Eng*., 7(3), 29–37.

[15] Ministry of Water and Environment. (2013). "National water resources assessment report." Directorate of Water Resources Management, Kampala, Uganda.

[16] Namara, R. E., et al. (2010). "Typology of irrigation systems in Ghana." International Water Management Institute, Colombo, Sri Lanka.

[17] Namara, R. E., Horowitz, L., Nyamadi, B., and Barry, B. (2011). "Irrigation development in Ghana:Past experiences, emerging opportunities, and future directions." Ghana Strategy Support Program Accra, Accra, Ghana.

[18] Nsubuga, F. N. W., Namutebi, E. N., and Nsubuga-ssenfuma, M. (2014). "Water resources of Uganda:An assessment and review." *J. Water Resource. Prot.*, 6, 1297–1315.

[19] R. Soc. B: Biol. Sci., 364(1532), 2985–2990.

[20] Shiklomanov, I. A. (2000). Appraisal and assessment of world water resources, *Water Int.*, 25(1), 11–32.

[21] Uganda Bureau of Statistics. (2010). "Summary report on Uganda census of agriculture 2008/2009." Kampala, Uganda.

[22] United Nations. (2013). "World population prospects: The 2012 revision, key findings and advance tables." New York.

[23] Van Averbeke, W., Denison, J., and Mnkeni, P. N. S., (2011). "Smallholder irrigation schemes in South Africa: A review of knowledge generated by the Water Research Commission, South Africa." Water SA, 37(5), 797–808.

[24] Zaman, A., Zaman, P. De Maitra, S., (2017). Water resource development and management for agricultural sustainability, *Journal of Applied and Advanced Research*, 2 (2), 73-77.