AFRICA FOR RESULTS INITIATIVE

EFFICIENT USE OF WATER RESOURCES Lessons from Niger on GSM based technology for irrigation control

From the African Community of Practice on Managing for Development Results at the African Capacity Building Foundation (ACBF)

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SYNOPSIS

In Sub-Saharan Africa, rainfed agriculture accounts for more than 95% of farmed land. The situation is worse in sahelian regions where annual precipitation could drop under 100 mm/year, one of the lowest in the world (in comparison to 3,000 mm in Guineo-congolean regions). As such, irrigation is adopted as a key option for food production and animal watering but unfortunately as traditionally practiced, irrigation in Sub-Saharan Africa leads to important water wasting and carries many constraints. In the context of water scarcity, there is an urgent need for efficient management of water resources. This implies to go beyond the traditional irrigation techniques and develop innovations that promote the efficient use of water resources while reducing constraints so as to facilitate adoption by thousands of farmers in need.

Key findings: Using a case study approach, this knowledge product presents a Global System for Mobile communication (GSM) based technology on the efficient use of water resources in Niger and draws some lessons likely to guide appropriate policies. The technology is used by over 200 farmers in Niger to control the irrigation of their farms and to provide crops with timely appropriate quantity of water. The cost of the kit is the main constraint for its large adoption. To address this constraint, partnerships with financial institutions are established to assist smallholder farmers.

Main lessons: The case study shows that mobile communication market is a niche of opportunities to address many development issues but some countries need more investments to improve mobile communication penetration. Another lesson from the case study is that innovations with high investments require assistance to be scaled up in rural areas.

Main recommendations: This technology on irrigation control is consistent with ongoing efforts of regional African institutions (AU, AfDB, ECOWAS, etc.) for integrated and efficient water resources management. It represents a ready to use tool for African governments, alliances and regional cooperation on maximizing water use for agriclutuarl purposes. Therefore, there is need for capacity reinforcement for African governments not only for the application of best practices but also to reinforce the culture of Managing for Development Results (MfDR) in water resource management and for the development of clean technologies likely to reduce water wasting.

Introduction

Rainfed agriculture is the most common farming practice in Africa. It accounts for more than 95% of farmed land in sub-Saharan Africa (International Water Management Institute, 2010). However, there are many constraints in rainfed agriculture including water scarcity, fragile environments, drought and land degradation due to soil erosion by wind and water, low rainwater use efficiency, high population pressure, poverty, low investments in water use efficiency measures, poor infrastructure and

inappropriate policies (Rockström et al. 2007, Wani et al. 2009).

These constraints of rainfed agriculture are of great concern in sahelian regions such as Niger where the annual precipitation could drop under 100 mm/year (Nicholson 2013) and where the populations are consistently among the poorest in the world (UN 2015, IMF 2015).

In a context of increasing water scarcity and climate change, and considering the need for increasing food production, there is need for more effective management of water resources. Clean irrigation technologies are therefore of high importance as they allow an efficient use of water resources while enabling crop production off the rainfall seasons.

The initiative of mobile based irrigation control is in line with the above mentioned vision. It has been developed in Niger by Abdou Maman Kané and has been intensively adopted by producers in Niger since 2013. Because of the capacity of this initiative to make Niger's agricultural sector more resilient to climate change while enhancing food security, this technology is analyzed and showcased here for possible scaling up in other African countries, which are also experiencing long droughts.

This case study aims firstly to disseminate the technology on efficient use of water resources developed in Niger and facilitate its extension through African countries where water management is a challenge. Secondly, this case study aims to acknowledge efforts of an African engineer who developed an innovative solution with outstanding outcomes. Finally, this case study seeks to draw lessons and policy implications likely to inspire, guide, and encourage other African engineers in developing innovative technologies to solve local problems.

Water resources challenges and irrigation in Niger

The Republic of Niger is a landlocked country of almost 1,270,000 km2, making it the largest country in West Africa but with over 80 percent of its land area covered by the Sahara desert (International Business Publications 2007). Because of its latitudinal position and also climate change, the rainfall is low and irregular with rainfall totals of no more than 500 millimeters per year on average (USGS and USAID 2012).

According to Work Bank (2000) and Guede (2011), water resources in Niger are composed of:

- Surface water mainly represented by the Niger River, which is an international shared resource and which has been known to dry up completely at Niamey;
- Large groundwater reserves, which are generally far below ground and receive virtually no recharge; and
- A negligible to modest amount of rainfall.

Water resources also include wetlands for which potential has been estimated in 2013 to 4 317 589 ha (FAO, 2015). The renewable water resources were estimated to 31 km^3/year from which only 1 km^3/year is provided by internal sources (FAO, 2015).

Over the past decade, water resources in Niger globally decline with important withdrawal mainly due to agriculture[1] (FAO, 2016).

Because of the declining trend of water resources with long droughts, irrigation has been considered as strategic factor for crops production in Niger (Lausanne 2007). Therefore, the government supported irrigated agriculture mainly through collective irrigation system, as solution to boost food production. The irrigation potential of Niger was estimated in 2005 at 270.000 ha (RN 2005) from which 99.89 000 ha are equipped for irrigation (FAO, 2016). Irrigation is used to grow off-season crops comprising:

- Rice, largely in the valley of the river;
- Millet, cotton, and wheat on the irrigated lands of Maggia, and Goulbi; and
- Rice and pepper on the Komadougou.

[1] 657 million of m3/year was used in 2005 for Agriculture

In this context of water scarcity, the government of Niger and international partners like World Bank group are working conjointly to elaborate strategic policies for improved management of water resources for both agriculture and domestic uses. Over the past two decades, the government of Niger assisted by the World Bank group is promoting small irrigation throughout the country. The objective is to increase access to irrigation in order to enable farmers to protect their crops and livelihoods despite longer dry seasons and unexpected weather events.

Global System for Mobile communication based irrigation control: a solution for efficient use of water resources in Niger

The problem (where does the idea come from?)

The Global System for Mobile communication (GSM) based irrigation control was developed by Abdou Maman Kané, an IT engineer, living in Niger. As he is from rural regions of Niger, he has an extensive knowledge on the situation of farmers especially during long droughts. Following the exceptional droughts of the 1980s, irrigation has been developed in Niger as a solution for improving food security. Unfortunately, investments on irrigations have drooped due to lack of funding and land related problems (Global Water Initiative, 2016). With the traditional techniques of irrigation as those used in Niger (Coulibaly 2012), there are many constraints including fuel supply, frequent pump breakdown, low stream flow, and well dry ups, and high labor requirement (Ogudjimi and Adekula 2002). Also because the literacy rate is very low in this country[2] (UNICEF, 2013), farmers lack basic knowledge of water requirement, irrigation scheduling and skills in maintaining and operating the pumps. These constraints affect the yield of crops (as the crops are either over- or under-irrigated) and lead to wastage of the scarce water resource. With increasing water scarcity and crisis in the energy sector, these techniques become unstainable and unprofitable solutions for farmers. Against this background, Abdou Maman Kané decided to fix the main constraints associated with irrigation systems and to provide farmers with an improved irrigation technology.

The opportunities used by the investor

The IT engineer based his technology on two realities in Niger: the increasing penetration of mobile phone and the high insolation. Indeed, even if Niger has one of the lowest mobile penetration rates in Sub-Saharan Africa, below 35% by the end of 2014 (Business Monitor International 2015), mobile subscription is growing as in other countries in these regions.(GSMA 2015; ITU 2015). With regards to insolation, because of its latitudinal position, Niger is considered as one of the sunniest areas in the world, characterized by an extreme and permanent insolation with an average insolation of about 6.92kWh/m2/day (CDC 2009). Therefore, Niger is one of the world's favorable areas for solar energy as already stated by Stine and Geyer (2001).

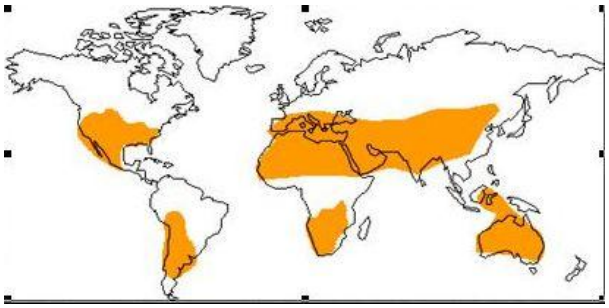

Figure 1: The world most favorable areas for solar energy (Stine and Geyer, 2001).

According to the inventor, with these two assets, the constraints abovementioned could be sustainably and efficiently fixed.

The solution proposed

The innovation proposed by the engineer is in three steps:

- Exploiting the natural insolation potential using photovoltaic panels to produce energy for hydraulic pumps. At this step, the problem of fuel is fixed
- Using GSM to remotely control the irrigation system. By dialing 142 (in Niger), farmers are connected to a database which connects them to their respective gardens (farms). For illiterate

[2] The total adult literacy rate (%) 2008-2012 was 28.7%

farmers, the voice service is also available. At this second step, the problem of time wasting is fixed as farmers could control the irrigation from elsewhere.

- Collecting meteorological parameters (temperature, humidity etc.) at the plot scale as to deliver the appropriate quantity of water required. At this third step, the watering is smart and avoids wastes.

The kit is composed of a pump (for water pumping), solar panels (for energy), a mobile phone system (for remote control), meteorological equipment (for collecting weather data) and watering equipment.

Limits of the technology

There are some limits for the large adoption of this innovation for efficient use of water resource. Firstly the technology is expensive. The kit of GSM based irrigation control is between CFA Franc 1.000.000 ($1800) and CFA Franc 2800.000 ($5000), depending on the characteristics of the farm/garden. This is slightly expensive and not affordable for most of the farmers in Niger where about half of the population (48.2%) is poor and the income per capita estimated at $410 (World Bank, 2014). However, according to the engineer, even if slightly expensive compared to traditional irrigation system, the return on investment is short as farmers save money for fuel and use their time for other activities.

Secondly, because the system is based on GSM, some regions not already covered by GSM could not use the technology. Niger is well known to have the lowest mobile penetration in Sub-Saharan Africa (Business Monitor International, 2015).

Outcomes and overall assessment

Many farmers adopted the technology

The GSM based irrigation control moved from pilot phase to commercialization. An enterprise - Tech-Innov SARL (http://www.tele-irrigation.net/) - was created for the commercialization of the innovation. The commercialization began in 2013. In 2015, the technology was estimated to be adopted by about 200 farmers in Niger. Because of its cost, the kit is not accessible for smallholder farmers. The engineer is developing in partnership with financial institutions and agricultural banks coping strategies to provide financial assistance to smallholder farmers.

Additional services have been developed

From the GSM based irrigation control, three services have been developed as an extension from the first one. These services are: automatic animal watering, kiosk for drinking water and mobile meteorological service. With these services, farmers who adopted the technology use efficiently their time and reinvest it on other activities along the agricultural value chain. Even if there is no quantitative data for real impact of the innovation, according to the inventor, the GSM based irrigation control with associated services lead to an increase of the production due also to an increase of the irrigated areas, an increase of income and an efficient use of water resources.

The originality of the innovation was internationally recognized

With the GSM based irrigation control, Mr Abdou Maman Kané received many awards including the “Best African entrepreneur Award” from France Telecom and Africom in November 2011, and “King Hassan II Great World Water Prize” in April 2015. The innovation received the third prize during the New York Forum Africa in 2015 and was nominated among the top ten innovations of 2015 during the ceremony of African Innovation Prize.

There is an increasing interest in the system in Niger

Many African countries especially those in sudano-sahelian regions are experiencing long droughts and scarcity of water (FAO 2016). Farmers from Mali, Burkina and Nigeria are targeted in priority because of their proximity to Niger. There is no official data on the kits exported out of Niger but according to the inventor, interviewed on TV5 monde in March 2016 during the TV programme “The moving Africa”, (TV5 Monde, 2016) there is an increasing demand of the kit in Africa and the technology is already exported to neighbouring countries.

This innovation is in line with the ongoing efforts of African governments and regional African institutions with regards to efficient use of water resources. It stands as a practical tool for the

Integrated Water Resources Management (IWRM) approach promoted by the African Union (AU), the African Development Bank (AfDB), the Economic Community of West African States (ECOWAS), etc., which has already reached important achievements like regional alliances and cooperation on water (e.g. African Ministers Council On Water (AMCO), Niger Basin Authority, Global Water Partnership etc.) (Global Water Partnership 2012).

Lessons learned and policy implications

The innovation of GSM based irrigation control in Niger is relatively recent and an impact assessment could not be objective. However, important lessons could be learned from the experience and could guide policy formulation on mobile based solutions for efficient use/management of natural resources.

Mobile market is definitely a niche of opportunities in many fields but some countries need more investments to improve mobile penetration.

The originality of the innovation 'GSM based irrigation control' is the possibility given to farmers to control the watering from everywhere. This was possible because of mobile phone. Unfortunately, there is a discrepancy on mobile penetration between urban and rural regions in Africa. In a country like Niger which already has the lowest penetration of mobile in Sub-Saharan Africa, the gap is alarmingly significant. Consequently, innovations like the GSM based irrigation control could not be scaled up everywhere in Niger. Therefore, there is an urgent need for investment in mobile market in Niger as to improve the coverage area and penetration. Operators should develop initiatives to facilitate subscription and invest in infrastructure as well as in the quality of the services. As for the government, there is need to create an adequate environment for private investments and also to pursue reforms in the energy sector.

Innovations should reduce dependence on foreign materials and focus on local materials

The kit of GSM based irrigation control is composed of photovoltaic panels, mobile phone system, and meteorological system, watering equipment, all from Chinese and European markets. Consequently the kit is expensive and not affordable for smallholder farmers. Obviously, in the case of this innovation, working with local materials is not realistic as the required materials could not be substituted with local ones. However, to reduce the cost, the kit could use recycled materials. Finally, as current market conditions do not provide irrigation equipment on a fully commercial basis, it is important to promote and encourage establishment of enterprises specialized in making locally and commercialize low cost irrigation equipments to small and medium sized farmers. Governments could facilitate the establishment of these enterprises through appropriates incentives (guarantee, tax exemption).

For innovations with important initial investment, assistance is required for scaling up in rural areas

The solution proposed by the engineer is expensive and most smallholder farmers could not afford it. In general, for innovations with important initial investment, the scaling up in rural regions requires intervention of partners to facilitate the adoption. Therefore African governments must play a prominent role, inciting partners including Non Governmental Organizations, financial institutions, and commercial banks to develop initiatives which will allow smallholder farmers to get the technology at a more affordable rate. This role of African government will facilitate the scaling up of elaborated and tested solutions.

African governments and regional African institutions as well as alliances and regional cooperation on water (African Ministers Council on Water, Niger Basin Authority, Global Water Partnership etc.) should consider the proposed technology as a ready to use tool to boost their ongoing efforts on integrated water resources management. More globally, for an effective implementation of integrated and efficient water resources management approach promoted by AU, AfDB, ECOWAS etc., there is need to strengthen capacities of African governments not only for the application of best practices but also for the development of clean and smart technologies likely to reduce water wasting.

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