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SUSTAINABLE IRRIGATION IN SOUTH AFRICA: EVIDENCE FROM HISTORY

IRRIGATION DURABLE EN AFRIQUE DU SUD : EVIDENCE FROM HISTORY

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ABSTRACT

As a net food exporter, South Africa has a productive agricultural sector. Arable land is restricted to about 15% of the agricultural land area of 102.8 million ha, of which about 10% is under irrigation. A brief overview and description is provided of the country's history in terms of irrigation development. The pre-requisites for sustainable irrigation can be deduced from case studies namely the Vaalharts, Lower Olifants and Loskop irrigation schemes. In addition to dams and canals, water, soils and crops, the past and present requirements are availability of markets, financing of capital, managerial and entrepreneurial capacity. A crisis in terms of a turning point for national and household food security can be averted if priority in future is given to investment in human, social and financial capital on existing irrigation schemes.

RÉSUMÉ

Comme un exportateur net de produits alimentaires, l'Afrique du Sud possède un secteur agricole productif. Terres arables est limités à environ 15 % de la superficie de terres agricoles de 102,8 millions ha, dont environ 10 % sous irrigation. Un bref aperçu et la description est fournie de l'histoire du pays en termes de développement de l'irrigation. Les pré-requis d'irrigation durables peut être déduite des cas études à savoir les schémas d'irrigation Vaalharts, Olifants inférieur et Loskop. En plus de barrages et canaux, eau, sols et cultures, les exigences passées et présentes sont la disponibilité des marchés, financement du capital, capacités managériales et entrepreneuriales. Une crise en ce qui concerne un point tournant pour la sécurité alimentaire nationale et domestiques peut être évitée si à l'avenir la priorité est donnée aux investissements dans le capital humain, social et financier sur les systèmes d'irrigation existants.

Keywords:irrigation development; historical trends; irrigation schemes; case studies; South Africa

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1. Introduction

In terms of irrigated agriculture, South Africa is among the top five countries in Africa regarding land area under irrigation, the other countries being Egypt, Morocco, Madagascar and Sudan (FAO, 2005). Of the estimated 1.55 million hectares under irrigation (1.5% of total agricultural land), about 50 000 ha are smallholder irrigation schemes (DAFF, 2012). Irrigated agriculture, while being the largest single user of surface and groundwater in South Africa, contributes more than 30% of the country's gross crop production (Backeberg *et al*., 1996).

An important consideration is the sustainability of irrigation. Sustainable irrigation requires that benefits are realised for the present population without compromising benefits to future generations (Backeberg, 1996).

2. History of irrigation development in South Africa

South Africa does not have an ancient irrigation history such as Egypt, India, Iran and Turkey, yet irrigated agriculture forms an important part of the country's agricultural sector. The combination of influences varying from traditional African to European, combined with the country's unique agricultural challenges provides an interesting history (Beinart, 2003; Kanthak, 1910; Van Vuuren, 2012).

In addition to importing European water engineering technologies, the descendants of the first European settlers also adopted traditional African technologies. A traditional water storage method that not only survived the arrival of European settlers but was adapted and used extensively by them was that of 'saaidams' (loosely translated as 'sowing' or 'planting dam'). From the eighteenth century farmers in the arid Northern Cape were particularly keen to follow this system of constructing low (one metre to two metre) earthen walls across large, shallow basins to retain floodwater over large tracts of land to plant grains and later lucerne (Hopwood, 1922). This technology is still in use today over the more arid parts of South Africa (Denison and Wotshela, 2009).

From the 1860s, the discovery of diamonds and gold provided significant impetus to bulk water infrastructure development in South Africa. An interesting stimulus to the South African irrigation sector was the emergence of the ostrich feather export market in South Africa to feed the fashion stores of Europe. When these wild African birds were paddocked to meet the global demand for feathers for the fashion industry, irrigation had to be employed to grow the preferred fodder – lucerne. In the early twentieth century, ostrich feathers were the fourth-largest export product in the Cape – after gold, diamonds and wool, and by 1910 ostrich numbers had reached 800 000 (Van Vuuren, 2010b). Overall these irrigation schemes remained small and rudimentary, employing mostly surface irrigation methods.

It was the period following the First World War and prior to the Second World War (1939-1945) that the country's largest irrigation schemes were constructed (three of which will be discussed in more detail in the case studies below). In addition to food production, these irrigation schemes had a dual purpose – to address the country's joblessness problem caused by the after-effects of the Great Depression and a prolonged drought period and, following the war, to settle returning soldiers. As a result, these schemes used manual labour almost exclusively, resulting in the construction of large labour camps (Union of South Africa, 1946). As South Africa's mining and industrial economy grew exponentially in the post War-period so did the number of dual-purpose bulk water infrastructure schemes in line with the international trend. Irrigated agriculture was no longer the sole recipient of large dams and related infrastructure. The high growth in demand for water from the mining, industrial and urban sectors highlighted the limitations of available water resources, resulting in Government efforts to start curtailing the water use of the irrigated agriculture (DWA, 1986). One way in which this was done was to upgrade and improve many of the old historic irrigation schemes (Bruwer, 1991).

South Africa's democratisation in 1994 hailed in a new era for the country with a strong focus on the equitable and sustainable use and management of water resources. Government's focus has moved away from the construction of large bulk water schemes towards optimisation of existing use. This means conserving water through the irrigation process, reducing water losses in water storage and distribution systems to using water more efficiently on farm. Many former irrigation boards have now transformed to water user associations, becoming more inclusive of catchment water users and decentralising the management of water resources. With most of the country's available water having been allocated, the South African government, through the Department of Water and Sanitation is now considering the re-allocation of water from the agricultural sector, to activities with a higher economic value, such as mining and industry (Van Rooyen et al, 2011).

3. Sustainability of irrigation schemes – three case studies

While South Africa has numerous successful irrigation schemes, the following three case studies represent a good sample of the typical sustainability issues that these scheme face.

3.1 Vaalharts Irrigation Scheme

Vaalharts comprises two main canals – a North Canal and a West Canal. In total, the network of canals covers a distance of more than 100 km supplying water to more than 1 800 abstraction points through pressure regulating sluices. With a scheduled area of 29 181 ha, Vaalharts is the largest irrigation scheme in South Africa.

Little was known about which crops would be most suitable and in the early years of the scheme, farmers mostly grew lucerne, ground nuts, potatoes, grains and vegetables. Today, farmers also grow pecan nuts, cotton, olives, citrus, apricots, grapes, watermelon and peaches (Van Vuuren, 2010a). All major forms of irrigation are used on the scheme, including surface irrigation, sprinkler and micro irrigation.

The Vaalharts Water Association (Vaalharts Water) took over the water management of the management of the scheme from the South African government in 2003. Like many irrigation schemes in South Africa, Vaalharts works on the demand system. This means that farmers only receive water once they order it. Farmers order water from Vaalharts Water through a farmer representative. This system is quite unique in South Africa. There are 240 such representatives at Vaalharts (Van Vuuren, 2009b).

Vaalharts is one of many irrigation schemes in South Africa applying the ICID award winning, locally-developed, computerised Water Administration System (WAS) to assist in its water distribution. In the first year after implementing the programme, the scheme managed to decrease water losses from 32% to 26.7%, a significant achievement considering most of the infrastructure has been in operation for over 60 years. Ageing infrastructure is a challenge, particularly were water loss control is concerned, and ongoing rehabilitation is required to keep the old weir and canals in working condition (Van Vuuren, 2009b).

3.2 Lower Olifants River Irrigation Scheme

The Lower Olifants irrigation scheme as it is known comprises the Bulshoek and Clanwilliam dams, as well as a main canal split into a left bank canal of 136 km and a right bank canal of 123 km. A total of 1 052 sluices are used to draw off water for a scheduled area of 9 510 ha. The scheme is operated by the Lower Olifants River Water User Association (LORWUA), which has been in operation since 2001. The scheme is subdivided into eight sub-districts or wards managed by seven water control officers. Each water control officer serves around 150 clients (Van Vuuren, 2011).

A significant challenge for this scheme is the fact that the canal is physically too small to transport all the water required (Van Vuuren, 2011). In addition, the capacity of the Clanwilliam Dam is insufficient to meet the water requirements of the scheduled area. While the annual water quota is 12 200 m^3/ha, the limited capacity of the canal allows for a maximum extraction rate of 325 m^3/ha each week, resulting in an annual deficit of 55 million m^3 (Holtzhausen, 2006). Between October and middle-May the scheme is only able to supply 8 200 m^3/ha. As a result irrigators have had to become more water efficient. Surface irrigation on the scheme has largely been replaced by drip irrigation, resulting in substantial water savings per hectare.

Despite these challenges the water user association has managed to reduce water losses from 48% (in 2002) to 24% (2011), mainly due to improved irrigation water distribution (Van Vuuren, 2011). Water is now mainly lost to breakages and leaks in the system. Evaporation out of the canals caused by hot temperatures and winds also contributes to water losses. Plans to raise the Clanwilliam Dam are well advanced, although most of this additional water will be used to support smallholder irrigation (Holtzhausen, 2006).

3.3 Loskop Irrigation Scheme

Following repeated requests from the growing farming community in the district the Loskop Dam and associated canals were constructed between 1934 and 1945. At the time of its construction, Loskop Dam was the largest single concrete structure in South Africa, and is still considered large by international standards. Like so many other state construction projects at the time the Loskop irrigation scheme was also a labour-intensive project.

The Loskop Dam comprises a mass concrete gravity wall with an ogee crest spillway. The original dam wall was 45 m high, but was raised in 1979 to 54 m. (Van Vuuren, 2008). The dam wall incorporates an interesting technical feature in the form of splitters on the lower face of the overspill section of the wall. These flat-topped concrete projections are about 8 m down from the top where they split up the sheet of overspill waters as they flow down the face of the dam.

There are 495 km of concrete canals, including two main canals of 96 km (Left Bank) and 60 km (Right Bank) respectively, with the remainder being branch canals. During peak periods up to 33 000 m^3 of water per hour can be delivered by the Left Bank main canal (Loskop Irrigation Board, 2015).

Loskop irrigation scheme is the second-largest irrigation scheme in South Africa. At present, the scheme comprises a scheduled area of 16 117 hectares, divided into 702 properties. At the allotment of a full water quota 7 700 m^3 of water per hectare is allocated. Wheat, vegetables, tobacco, peanuts, cotton and citrus fruit are cultivated, many for the export market. The scheme is managed by the Loskop Irrigation Board, a private organisation. Loskop was the first irrigation scheme in South Africa to make use of the WAS water management system.

Unlike the two schemes above the greatest challenge to the sustainability of the Loskop irrigation scheme is not the quantity of water or the age of the works, but water quality. The dam receives poor quality water from upstream industrial, mining and human settlement sites, and as a result is showing signs of becoming hypertrophic (Van Vuuren, 2010c). Massive fish kills have been experienced in the last few years, with great concern being expressed over the falling numbers of crocodile and terrapin populations. The Loskop Irrigation Board has been working with the Olifants River Forum and other stakeholders in the catchment to collectively find solutions to this issue and improve water resource management in the catchment (Van Vuuren, 2013).

4. Conclusion

Like other agricultural sectors in the world, the South African sector also faces the challenges of producing more food with limited resources to feed a growing population. The availability of water has been singled out as the most important factor that limits agricultural production in South Africa (WWF, 2014). As demand from other sectors of the economy place more pressure on the country's scarce water resources, South Africa's farmers will have to find new ways of not only remaining sustainable, but producing more with less. Through entrepreneurship and management, new developments in improved irrigation technologies and farming practices are regularly adopted and implemented.

The country's irrigation history has shown that South Africa's farmers are innovative and adaptable to difficult circumstances. The case studies presented here demonstrate that sustainable irrigation is achievable through adaptation to changing markets, changes in investment and adjustment in the size of farming as well as improvements in management (Backeberg and Groenewald, 1995). Through the support of knowledge generating agencies such as the Water Research Commission in partnership with universities and research councils, the sector is poised to remain a cornerstone of the South African economy.

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