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Identifying the potential for irrigation development in Mozambique: Capitalizing on the drivers behind farmer-led irrigation expansion

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ABSTRACT

Smallholder irrigation in Central Mozambique predominantly takes place in an informal setting. This renders these smallholders and their activities invisible for policy purposes. Identification efforts of smallholder irrigation as well as the potential for new irrigation development are often the basis for policy setting. But the potential is often approached technocratically: the technical availability of water and land with the assumption that smallholder irrigation is not happening and should be developed. Although more and more effort is done to include social economical aspects into the identification as well, it remains a GIS exercise, based on incomplete data using large pixel sizes, analyzing countries or continents as a whole. This study describes and presents the methodology and the results of an irrigation potential identification exercise carried out in two studies in Central Mozambique. Apart from describing the identification methods used, this study highlights the extent of farmer-led irrigation development, its drivers and the potential for farmer-led smallholder irrigation development. This study demonstrates the prolific nature of smallholder irrigation, arguing for the recognition that smallholder farmers are already developing irrigation and that this should lead to changing the focus of identification efforts towards the drivers behind farmer-led irrigation development. Using these context-specific drivers to define the potential for new irrigation development should result in a better response in policy to both the technical and socio-economical potential of smallholder irrigation development.

1. Introduction

The development of smallholder agricultural to improve food security at household level and supply of regional and national markets in Africa, has returned as a main focus of international development policy since about 10 years (IAC, 2004; World Bank, 2008; Tschirley, 2011). Irrigation is pushed as an essential means to secure production (IAC, 2004; Hussain, 2007; World Bank, 2008), with smallholder irrigation development taking an important place (Burney and Naylor, 2012; De Fraiture et al., 2010), Mozambique is no exception in this case (PEDSA, 2011).

Although a body of research and literature exist on farmer-initiated smallholder irrigation and its merits (Moris, 1987; Adams and Anderson, 1988; Adams, 1990; Adams et al., 1994; Woodhouse, 2003; Widgren and Sutton, 2004; Burney and Naylor, 2012), in main stream policy environment it has remained marred in a stigmatisation of being backwards and in need of heavy external support (Smith, 2004; Hounkonnou et al., 2012). More recently there have been indications that irrigation development by smallholders is growing faster through its own faculty than irrigation development initiated by external organizations (Lankford, 2005; Woodhouse, 2012; De Fraiture and Giordano, 2014; Nkoka et al., 2014). "Small and private" (De Fraiture and Giordano, 2014) and "farmer-led" (Nkoka et al., 2014) have been suggested as terminology to characterize this type of irrigation development, shifting away from the stigma of backwardness to recognise that smallholder farmers are active changers and developers of commercial agriculture in Africa (Lankford, 2009; Van der Zaag, 2010). Documentation remains largely anecdotal and based on case studies in relatively small areas (Adams et al., 1994; Bolding et al., 2009; Veldwisch et al., 2013; Woodhouse, 2012; De Fraiture et al., 2014, Nkoka et al., 2014).

To constructively contribute to a policy re-focus, away from the assumption that the smallholder sector is backward and needs to be taken by the hand by international companies through

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outgrower schemes (PEDSA, 2011), there is a need for adequate identification of the extend of smallholder irrigation and the way farmers are leading in developing this sector (Lankford, 2005). Recently, through Remote Sensing techniques and satellite imagery, efforts have been done to identify the potential for smallholder irrigation development (You et al., 2011; Xie et al., 2014), but they operate in a very large scale and as a consequence do not show the current extent of areas in use by smallholders. Identification efforts on a more regional scale often remain the domain of development projects and as a consequence are often moulded in consultancies with a limited time frame (Beekman, 2011). As these studies have a chance of guiding policy and implementation, a pragmatic methodology for identifying the local context and realities is required (Jensen, 2013). This study examines and discusses a methodology that was developed within the PROIRRI program and tested in the context of Central Mozambique (Beekman, 2011).

In Central Mozambique a vibrant irrigation culture has emerged, varying in its technical manifestation from furrow irrigation along the slopes of mountains to pumped irrigation in the valleys and floodplain water management along the coast. These forms of irrigation development by smallholder farmers, although experiencing a recent boom, some constructions date back more than a century (Bolding, 2007; Bolding et al., 2009) if not longer. Most of these irrigation systems were developed without government or technical support and can be characterized by their informal nature. The proliferation of such small scale, informal, farmer-led systems has been reported in many different places in Africa (Lankford, 2005; Woodhouse, 2012; de Fraiture et al., 2014). Following Nkoka et al. (2014) this study uses the term *farmer-led irrigation development* to indicate smallholder irrigation that is initiated, operated, maintained and usually constructed by local people, using local materials and ideas. Farmer-led irrigation manifests itself in a variety of forms including (1) horticulture in well drained depressions (dambos in Southern Africa, baixas in Mozambique) using buckets/watering cans and/or pumps, (2) horticulture along the shores of rivers, lakes and reservoirs using buckets/watering cans and/or pumps, (3) rice production in rainfed swamp/wetland areas (improved rainfed and flood irrigation), and (4) furrow irrigation in mountainous areas. Farmer-led irrigation development is intentional development by smallholder farmers that can stretch out over thousands of hectares, which is why this study chose to avoid the terms "unplanned" (De Fraiture et al., 2014), "spontaneous" (Veldwisch et al., 2013) and "small and private" (De Fraiture and Giordano, 2014) irrigation.

A study on gravity-fed furrow irrigation in Tanzania (Lankford, 2005) has pointed at a sustained expansion of up to 4% annually of "informal" irrigated area by smallholders during the period 1995–2005. The growth of the informal irrigation sector compares favourably to annual growth rates between 0.5% and 0.7% of overall irrigation expansion in Tanzania (including government and donor funded projects) during the same decade (Lankford, 2005). In Mozambique a study by Bolding et al. (2009) estimated an annual increase of 3.5% in command areas of furrow irrigation systems in the mountainous areas of the Manica District between 1991 and 2008.

Apart from high growth rates, the contribution made to the total irrigated command area by small and private irrigation systems (mainly small pumps and bucket irrigation) turns out to be in excess of 50% as documented in Niger and Nigeria (Burney and Naylor, 2012; De Fraiture and Giordano, 2014). Although the above studies point at the large extent of smallholder irrigation, its sustained growth and its potential for economic development and agricultural production, the general rhetoric in Mozambique around smallholder irrigated agriculture often focuses on its supposed backward and subsistence farming nature. Although smallholders feature prominently in government policy documents, they are not considered the key changers of the agricultural sector. The Government of Mozambique (GoM), through the PEDSA[1] 2011, recognizes that agriculture is the keystone to development and engagement with smallholder farmers is a focus point. However, the catchphrase is adoption of new technologies (irrigation, tractors, fertilizers, etc.) through outgrower modalities led by (foreign) large scale agro-business estates, demonstrating the government's faith in a technocratic approach to development based on the assumption that smallholders need be taken by the hand when it comes to developing irrigation (Beekman and Veldwisch, 2012). Although these programs focus on agriculture and smallholder farmers, they seem to underestimate the existing contribution of smallholder farmers to irrigation development and display a limited understanding of the dynamics and situations in which these smallholder farmers operate (Lankford, 2005).

This underestimation leads to a situation where the potential of the current realities of smallholder farmers is disregarded and substituted by the theoretical potential of new technologies and foreign investments. To identify the potential for smallholder irrigation it is therefore important to consider the socio-economic dynamics through which these systems developed (Lankford, 2005; Woodhouse, 2012; Giordano and De Fraiture, 2014).

The question of irrigation potential is often approached technocratically, whereby knowing where water and land are available is the first step. FAO Aquastat (2012) pegs the irrigation potential for Mozambique on 3.1 million hectares with only an estimated 118,000 hectares presently equipped with irrigation infrastructure, of which systems smaller than 50 hectares make up only 5%. However, the FAO Aquastat data base only considers formally recognized irrigated areas, making use of so-called 'improved' or 'modernized' technology, thus ignoring informal smallholder realities.

Remote Sensing is a commonly used tool in identifying the potential for growth. Some recent studies try to combine socio-economic analyses with biophysical characteristics identified through Remote Sensing techniques. Apart from the biophysical analysis, You et al. (2011) also include crop performance and water delivery costs to optimize revenue and internal rates of return and estimate a potential of 190,000 ha of smallholder irrigation in Mozambique, based on grid cells of 50 km^2 or 5000 ha. They estimate a run-off surplus per grid cell, on which they base the smallholder irrigation potential as part of the estimated rainfed area of the same grid cell. Recently, Xie et al. (2014) performed a similar type of analysis based on a grid size of 0.25 km^2 or 25 ha, limiting the potential area for smallholder irrigation by assessing biophysical characteristics like soils, slope and runoff, and including population densities and distances to markets, estimating the area by rating[2] these different characteristics and only considering a grid cell for its biophysical potential if it surpasses a preset threshold value. Further economic modelling on crop optimization and the price effect on expansion resulted in a final estimation of potential expansion area. According to this method, an estimated potential of 3.7 million hectares for irrigation exists in Southern Africa for communal river diversion, or a total of 13.3 million hectares including those serviced by small reservoirs, motor and treadle pumps.

All these studies present large numbers on potentials for irrigation expansion and compared to the formal constructed systems suggest a gross underutilization of the potential, e.g. according to the FAO, Mozambique has equipped only 3.8% of the potential area with infrastructure, of which only 1.3% is actually irrigated. Although all these numbers underscore the necessity

[1] PEDSA (Plano Estratégico de Desenvolvimento do Sector Agrário) is the strategic plan for the development of the agricultural sector by the Ministry of Agriculture.

[2] For example, 0–5 km distance to the market gets more points than 5–10 km.