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Modernisation and African Farmer-Led Irrigation Development: Ideology, Policies and Practices

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ABSTRACT: In both Mozambique and Tanzania, farmer-led development of irrigation is widespread, yet it is little recognised in irrigation policies and is under-supported by the government. This paper explores how this situation is exacerbated by modernisation ideas in irrigation policy and professional thinking. By means of a historical review, we trace modernisation thinking in irrigation development from the colonial period onwards, and analyse how this thinking continues to play out in contemporary irrigation policies in both countries. We then examine the relationship between modernisation thinking and practices of farmer-led irrigation development, drawing on policy documents, field studies, and interviews in both countries. Based on this analysis, we argue that the nature of farmer-led development of irrigation is consistent with many of the goals identified by state agricultural modernisation programmes, but not with the means by which government and state policies envisage their achievement. As a consequence, policies and state officials tend to screen out farmers' irrigation initiatives as not relevant to development until they are brought within state-sanctioned processes of technical design and administration.

KEYWORDS: Farmer-led irrigation development, modernisation, agriculture, sub-Saharan Africa, Mozambique, Tanzania

INTRODUCTION

For the past decade, there has been growing evidence that small-scale farmers throughout sub-Saharan Africa are themselves developing irrigation, often with a minimum of external assistance. This phenomenon of farmer-led irrigation development, although widespread, has until recently received only limited recognition from practitioners, policy makers, and researchers (de Fraiture and Giordano, 2013; Beekman et al., 2014; Woodhouse et al., 2017). In September 2018, the World Bank heralded farmer-led irrigation as a "revolution" with "the potential to positively change the fate of millions of smallholder farmers" (World Bank, 2018). While this has put farmer-led irrigation development on the

global policy agenda, questions remain about how government agencies engage with irrigation initiatives in which farmers influence the purpose, location, and design of irrigation. In this paper, we examine the relationship between government irrigation policy and farmer-led development of irrigation, using data from research in Tanzania and Mozambique. We draw on policy documents and on interviews with officials and technical advisors involved with developing and interpreting irrigation policy in the two countries. We highlight the ways in which modernisation is, on the one hand, conceptualised and promoted in policy (for example, modernist convictions, modernist interventions) and, on the other, manifests through practices of modernity in the field, in the form of farmers' initiatives in developing irrigation. In such comparisons, we recognise distinct interpretations of 'modernisation' in terms of: (a) high-modernist thinking as an ideology (Scott, 1998), (b) modernisation in terms of technology implementation and linear policy packages, and (c) the appropriation and integration of 'modern' elements into farming practices – "mutant modernities" (Arce and Long, 2000).

Modernisation has been at the core of 'development' since the start of the industrial era (Cowen and Shenton, 1995). Initially referring to the radical societal transformation taking place after the French and Industrial Revolutions (Wagner, 2014; Mahmoud, 2015), modernisation soon became seen as a goal for all societies, rather than just a phase of European history (Gilman, 2004). Scott (1998: 89-90) defines high modernism as

a strong belief in scientific and technical progress, associated with industrialization in Western Europe and North America from roughly 1830 until World War I. It is (...) characterized by a supreme self-confidence about continued linear progress, the development of scientific and technical knowledge, the expansion of production, the rational design of social order and the growing satisfaction of human needs.

The pursuit of modernisation transcended capitalist and socialist visions of progress, which diverged primarily on the means by which this was to be achieved – via individual or collective ownership of the means of production. In the aftermath of World War II the idea that a linear pathway from (agrarian) tradition to (industrialised) modernity was applicable to all societies was cemented into the modernisation theory that became popular among American scholars in the 1950s (Rostow, 1960; Gilman, 2004; Wagner, 2014; Ekbladh, 2011).

Scott associated modernisation with an ideology of state expansion and administrative ordering of nature and society through the state's monopoly on the legitimate use of force and its centralised agencies. This association of high modernism with a technocratic approach to development echoes Ferguson's (1994) analysis of project interventions as re-making rural realities to fit modernisation narratives. Subsequent work by Murray Li (2007) has analysed the modernising convictions of development planners, and their rendering of development as a matter of technical intervention to achieve societal transformation along a linear evolutionary path of cultural and material change. In much of this work the modernising mission of the state is counterposed to a resistant, if politically weak, rural population (Scott, 1987). In contrast, Arce and Long (2000) argue that ideas and practices associated with modernisation and 'being modern' are themselves appropriated and re-embedded in locally situated practices, producing a fragmentation and dispersal of modernity into various 'mutant modernities'. Irrigation development is one such typical domain in rural development in Africa in which the production of mutant modernities by farmers has always taken place (see, for instance, Dey, 1982; Carney, 1988; Diemer and Slabbers, 1992; Benouniche et al., 2015; Wanvoeke et al., 2016; de Bont et al., 2019).

In the post-independence politics of both Tanzania and Mozambique, decolonisation thinking has been strongly influenced by high-modernist ideology, as the central state (and the governing party) sought to both transform and bring under its control the diverse and potentially unruly traditional rural societies emerging after the end of colonial administration. In this paper, we argue that policies stemming from this thinking have led state agencies to ignore farmers' own capabilities and initiatives,

reducing them discursively to backward peasants incapable of innovation without the external intervention and administration of the government. We show how high-modernist thinking is reflected in past and current agricultural and irrigation policies, and how it contributes in both countries to a practice among irrigation officials of overlooking a rapid and widespread process of irrigation development through small-scale farmers' initiatives. These initiatives constitute forms of modernity, but it is not modernisation in the sense that it results from radical state-mediated transformation. Nor do farmers' irrigation initiatives fit a high-modernist binary that opposes a modernising state to a rural people embodying traditional values. We argue, therefore, that the relationship between the state and agricultural producers – a relationship that, we reckon, is important for supporting long-term, widespread agricultural development – needs to embrace a more dynamic understanding of technical and social change in rural areas.

The paper, drawing on recent projects (2015-2019) in Mozambique and Tanzania, studies farmer-led irrigation development and its policy interactions (Woodhouse et al., 2017; de Bont, 2018; de Bont et al., 2019; Liebrand, this Issue). Researchers from these projects studied policies and governance of irrigation development at the national level, as well as 18 cases of farmers' irrigation initiatives across the two countries. The main argument in this paper builds on the analysis of policy papers and interviews with policymakers at the national level, while material from the case studies is used to underpin the argument about the modernisation practices of farmers. Our focus is on an analysis of modernisation *thinking* in irrigation policy and how it leads irrigation professionals to overlook farmers' initiatives in irrigation. An analysis of how modernist irrigation policies are translated into practices and how state irrigation officials interact with farmers' initiatives lies outside the scope of this paper. In the next section, we first trace the origins of modernisation thinking in the agricultural and irrigation policies of both Mozambique and Tanzania, to illustrate the pervasiveness of a certain type of agricultural modernisation programme over time. We then focus on current irrigation policies in both countries and show how these policies continue to reflect a high-modernist ideology in the sense that they envision agricultural modernisation as a state-controlled and scientifically guided endeavour to transform a 'traditional' agrarian society. This is followed by the presentation of evidence of mutant modernities in the agricultural and irrigation practices within farmers' irrigation initiatives. In the final sections, we discuss the implications of the modernist nature of irrigation policies and the accompanying professional mind-set for *seeing* the enormous diversity of mutant irrigation practices, and we reflect on how this mind-set may impact future processes of development policymaking.

TRACING THE ORIGINS OF MODERNISATION THINKING IN IRRIGATION

The early years of colonial administration wrought huge disruption on farming and on existing practices of irrigation in both Mozambique and Tanzania. In the former, the colonial government issued licences (*prazos*) to commercial companies, authorising the exploitation of resources and people on extensive areas of land, with the goal of generating revenues for the Portuguese state (Newitt, 2017). The violence used by companies to conscript labour resulted in the migration of large numbers of rural people into neighbouring territories (Vail and White, 1980). In Tanzania (then Tanganyika), the arrival of the colonial administration in the late 19th century occurred simultaneously with the rinderpest pandemic that decimated livestock throughout East Africa and caused the collapse not only of pastoralist economies but also of farming based on draft oxen. This severely undermined existing land management, giving rise to bush encroachment and increases in trypanosomiasis infection among the rural population (Ford, 1971; Kjekshus, 1977).

These disrupted and impoverished African farming systems became the object of state modernisation policies from the 1930s onwards. Colonial administrations reflected the more interventionist stance adopted by governments in industrialised economies who were seeking to prevent the collapse of agricultural production in the wake of the post-1929 economic recession and

the slump in international commodity prices. This state-led modernisation was the foundation of colonial agricultural policies in both countries until independence. Modernisation campaigns involved promoting soil conservation and the use of agrochemicals and improved seeds, particularly for cash crops (notably cotton and maize). The promotion of modern irrigation development also played a role in these policies, especially in colonial Tanganyika. Here, the government used irrigation schemes to resettle African farmers, and provided technical support to existing small-scale irrigation systems, primarily with the aim of increasing water use efficiency and releasing water for downstream use (de Bont, 2018). In Mozambique, the strategy of the colonial government was to occupy territory by providing poor Portuguese peasants with land and livestock in more or less fortified settlements (*colonatos*). This meant that, to the extent that irrigation was developed at all, it was targeted at either these 'small-scale' farmers (as in the case of the Limpopo *colonatos*) or the large-scale (mostly sugar cane) sector (Trigo de Morais, 1951; Hermele, 1988). For small-scale African farmers, modernisation was generally experienced through forced cultivation, particularly of cotton, imposed through household quotas. In northern Mozambique, compliance was monitored by relocating households and their fields along designated roads patrolled by colonial officials authorised to rule by means of corporal and financial penalties.

After independence (Tanzania in 1961, Mozambique in 1975), modernisation thinking continued to inform agricultural policies in both countries. The new national governments in both Tanzania and Mozambique adopted villagisation programmes as the means through which to channel efforts to transform the rural population. In both countries, these programmes were linked to socialist models of investment in industrial production and state-directed modernisation of peasant agriculture, including often short-lived and unsuccessful collectivisation programmes.

In Tanzania, the Tanganyika African National Union/Chama cha Mapinduzi ruling party declared its commitment to 'African socialism', captured under the term *ujamaa*. It aimed to introduce collectivisation of labour in a way that circumvented ethnically defined hierarchies of power, in order to ultimately create a new national unity. State-administered resettlement played an important role here, based on the idea that if peasant farmers were taken away from their traditional surroundings, they would be more susceptible to new, modern ways of agriculture (Coulson, 1977). The 'transformation approach' set out by the government in its first Five Year Plan after independence (GoT, 1964), envisaged moving peasant farmers to villages where they would farm using modern technologies under the supervision of agricultural extension officers. Although the terminology later changed, the idea of transforming rural peasants into a 'modern' production force continued to dominate Tanzanian agricultural policies. Through mechanisation and scientifically guided crop rotation and soil management, the resettlement programmes had the dual role of raising agricultural productivity and bringing the rural population into the ambit of Tanzanian state administration. The state's role in agricultural development was further promoted by the large-scale state farms set up in late 1960s to produce sisal, grains, dairy, meat, and sugar. Throughout this time, irrigation was considered to be a crucial factor in agricultural transformation, and to be able to "trigger and sustain a revolution in agriculture" (Lwegarulila, 1974: 11). This viewpoint led to a multitude of large-scale studies on the feasibility of water and irrigation development for the support of commercially oriented (smallholder) agriculture, most notably in the Pangani Basin, some of which led to the construction of public smallholder irrigation schemes and a state farm (de Bont, 2018).

Driven by a similar desire to transform its 'backward' peasant agriculture into a science-driven commercial sector, the FRELIMO government in Mozambique promoted a Leninist-inspired 'worker-peasant' alliance and the creation of *o homem novo* (new man). It explicitly rejected 'tradition', which it associated both with an acceptance of ignorance and poverty and with the traditional leaders it accused of collaboration with colonial authorities (Buur and Kyed, 2006). In agricultural policy, the drive to identify independence with modernity rather than with tradition was marked in particular ways by the manner in which the government responded to the departure of Portuguese settler farmers. The

abandonment of the settlers' mechanised farms presented a double threat to the new government's modernisation project: the destruction of previous capital investment, and a reversal of the few steps towards modern agriculture that were visible in rural areas dominated by farming practices that the new government characterised as subsistence. As a consequence, Mozambican agricultural policy was dominated by a determination to recuperate the 'lost' modern agriculture of colonialism, initially by maintaining colonial settler farms in production as mechanised state farms, financed through foreign investment. This priority was associated with an underestimation of the contribution of small-scale production to overall marketed agricultural output and to the wider economy (Wuyts, 1985). This resulted not only in poor economic management, but has also been argued to have contributed to a loss of rural support for the government during an armed insurgency that lasted from the early 1980s until 1992 (Geffray, 1991). The iconic role of irrigation in making the government's project to modernise agriculture visible was evident in the prominence given to investment in irrigation schemes close to the capital, Maputo, in southern Mozambique, notably in the Limpopo River floodplain, which the government designated as the country's breadbasket (*celeiro*) (Hermele, 1988).

In both countries, along with many in sub-Saharan Africa, a reorientation of policy according to neo-liberal principles occurred in the 1980s as a result of a drop in commodity prices and state revenues. In the case of Mozambique, these factors were accentuated by the disruption caused by armed conflict. Both governments sought credit from international financial institutions which provided finance on the condition of 'structural adjustment', including withdrawal of government from direct involvement in agricultural production and from markets for agricultural inputs and outputs (Cunguara and Hanlon, 2012). In terms of irrigation, policy across Africa saw its focus switch to seeking increased financial efficiency by replacing state management with a combination of self-management by irrigators (organised as water users' associations), and more commercially disciplined management of large-scale schemes (Woodhouse and Ndiaye, 1991; Vermillion, 1991). As a consequence, public funding for agriculture in general, and for irrigation infrastructure in particular, was cut back in the expectation that private finance would replace it. Tanzania was exemplary in this respect, with a radical shift away from new large-scale investments by the mid- to late-1980s, increased decentralisation of irrigation planning and management, and a renewed focus on small-scale irrigation and the improvement of existing schemes to increase water use efficiency (de Bont, 2018). These changes in irrigation development policy were accompanied by the formalisation of water use and water management institutions, which furthered the government's objective of administration and water control.

The neo-liberal turn in the mid-1980s continued to shape agricultural and irrigation policy throughout the 1990s and the early 2000s. It resulted in the continued rolling back of the state and a reduced emphasis on publicly funded large-scale infrastructure. Instead, commercial companies were expected to replace the state as the primary actors in input and output markets, and in investment in increasing agricultural production and productivity. However, despite this change in approach, the policy vision and goal of modernising agriculture remained largely unchanged. In Mozambique, after the end of armed conflict in 1992, efforts to re-establish large-scale modern agriculture were renewed, again focused on attracting foreign investment. Unlike in the 1970s, capital investment was to be generated not through the political solidarity of foreign governments but through the incentive of opportunities for profitable commercial investment. Through the 1990s, in both Tanzania and Mozambique, governments sold off state-controlled farms, notably to South African sugar cane producers (Dubb et al., 2017).

By the turn of the century, however, the policy of market liberalisation and withdrawal of state intervention from agriculture was widely considered to have failed to raise agricultural productivity in

Africa (World Bank, 2007),¹ leading to a continent-wide initiative – the Comprehensive African Agriculture Development Programme (CAADP) – developed under the African Union's New Partnership for Africa's Development (NEPAD) initiative (NEPAD, 2003). This effort to systematically transform agriculture committed governments to an overall target of increasing agricultural output by six percent per year, and an allocation of 10 percent of the annual national budget to agriculture. The CAADP thus came to hinge on commitments by African governments to increasing their expenditure in support of agriculture, marking a change in the liberalisation agenda originating in the 1980s. These efforts were widened and intensified after the sharp increase in food commodity prices in 2007/8.²

The CAADP is organised through four pillars, of which the first is "extending the area under sustainable land management and reliable water control systems".³ This pillar resonates clearly with modernisation-inspired irrigation programmes of the past, in which engineering for water use efficiency and water control were seen as the means of ensuring long-term productive use of water for agriculture (de Bont, 2018). As part of this pillar, the CAADP promoted a review of irrigation policy by national governments (NEPAD, 2009), which in turn gave rise to ambitious new national policies for irrigation investment, including in Tanzania (URT, 2010) and Mozambique (INIR, 2015). Bilateral and other international funders also turned their attention to irrigation, and to agricultural water management more broadly (Giordano et al., 2012; World Bank, 2006). The 2008 World Development Report called for reinvesting in the agricultural sector, notably in sub-Saharan Africa, where agricultural productivity had lagged behind compared to that in other regions (World Bank, 2007). At the same time, an alliance of five influential international organisations⁴ called for large-scale new investment in irrigation (AfDB et al., 2008).

In both Tanzania and Mozambique, however, the new prominence accorded to irrigation rests on an organisational capacity whose base within both countries had become precarious over the previous two decades. In Mozambique, the *Secretariado do Estado de Hidráulica Agrícola* (SEHA), which was accountable to the president and which had driven ambitious plans for large-scale irrigation in the 1980s, was wound up. Instead, irrigation became the responsibility of a national directorate within the Ministry of Agriculture, later being further demoted to a department within a national directorate. This process was replicated in provincial government, representing a significant reduction in terms of organisational as well as technical capacity. In Tanzania, irrigation development had historically been less centralised, with irrigation staff posted at the regional level to support 'traditional irrigation' as early as 1968 (URT, 2016a). However, similar to Mozambique, the irrigation department has been characterised by institutional instability, its status changing from a section to a division, and back, and its affiliation regularly alternating between the Ministry of Agriculture and the Ministry of Water, or their equivalents (ibid). It seems worth bearing in mind this somewhat precarious institutional base within central government when considering the content and implementation of irrigation policy in both countries.

¹ A recent assessment argues that "reduction of government agricultural programmes in the context of a focus on private sector taking over of such activities (...) set back agricultural transformation in Africa by about three decades" (AGRA, 2018: 10-11).

² A meeting hosted by the World Bank in 2013 claimed that Burkina Faso, Ethiopia, Ghana, Guinea, Malawi, Mali, Niger, and Senegal had met or exceeded CAADP's target of investing 10 percent of government expenditure in agriculture. On average, public agriculture expenditures had risen by over seven percent per year across Africa (more than 12 percent per year in low-income countries), and had more than doubled since CAADP's launch (World Bank, 2013).

³ The other three are: improving rural infrastructure and market access, increasing food supply and reducing hunger, and agricultural research and technology dissemination.

⁴ The World Bank, the African Development Bank (AfDB), the Food and Agricultural Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), and the International Water Management Institute (IWMI).

In current agricultural policy in both Tanzania and Mozambique it is possible to identify two policy narratives. In one, linked to CAADP initiatives, small-scale farmers are the key focus of state budgets to improve irrigation infrastructure, food security, market access, and technical improvements. In the other, external (commercial and donor) capital is seen as essential to bringing about a major transformation of the agricultural sector, typically through large-scale (plantation) farms (cf. Smart and Hanlon, 2014). Thus, on the one hand, the importance of small-scale production has been emphasised in the agricultural policies of both countries, on the other, smallholder farmers are identified as needing transformation and modernisation through external intervention, rather than through any pursuit of commercial or technological change by farmers themselves. Below we discuss in more detail how this thinking plays out in current irrigation policy.

MODERNISATION IN CONTEMPORARY IRRIGATION POLICIES

The current irrigation policies of Tanzania and Mozambique reflect a renewed interest in irrigation, which follows nearly two decades (1985-2005) in which there had been not only a moratorium on irrigation investment but also, as we observed above, a significant downgrading of irrigation departments within governments. In Mozambique, the most influential policies are the *Estratégia de Irrigação* (EI, or Irrigation Strategy of Mozambique) (MINAG, 2013), and the *Programme Nacional de Irrigação* (PNI, or National Irrigation Programme) (INIR, 2015). The Irrigation Strategy (EI) is an integral part of the *Plano Estratégico de Desenvolvimento do Sector Agrário* (PEDSA, the Strategic Plan for the Development of the Agricultural Sector), and has the same implementation period (2011-2020) (MINAG, 2013). In Tanzania, the National Irrigation Policy (URT, 2010), the National Irrigation Act (URT, 2013), and the National Irrigation Development Strategy (URT, 2016a) are the most recent policy documents reflecting the irrigation ambitions of the state. In both countries, the newly raised status of irrigation in recent years has been reflected in yet another institutional reorganisation, resulting in new governmental bodies at the central level, including (in 2013) the National Irrigation Commission in Tanzania's Ministry of Water and Irrigation, and (in 2012) the *Instituto Nacional de Irrigação* (INIR) in Mozambique's Ministry of Agriculture. The creation of the INIR was part of the main irrigation programme in Mozambique, the Sustainable Irrigation Development Project (PROIRRI), which is heavily dependent on financial and technical support from the World Bank.

The above-mentioned irrigation policies and programmes are clearly rooted in modernist ideology and the modernisation agendas of previous decades. The ideology is manifest in the role given to irrigation development in nation-building, the prioritisation of administering and rendering legible irrigation activities, and the effort to reorder these activities through the application of science-based agricultural and irrigation engineering. All this is done to achieve the efficient and productive use of water that is a hallmark of a modernist engineering approach to irrigation development (cf. Molle et al., 2009).

The first element reflecting a modernist ideology is the role irrigation development is given in both countries, that of building the nation state by achieving national growth. In Mozambique, this is reflected in the rationale and mission of the Irrigation Strategy:

This Strategy fits into *the national development agenda* and includes interventions in rural and peri-urban areas, at the national level (...).⁵ Mission: An irrigation sub-sector that will foster a diversified and prosperous agriculture, *competitive, market-oriented aim to contribute to the achievement of the*

⁵ Translated by the authors from the original text: "A presente Estratégia enquadra-se na agenda de desenvolvimento nacional e inclui intervenções agro-pecuárias nas zonas rurais e peri-urbanas, à escala nacional (...)".

main development objectives, namely poverty reduction, food security and economic growth⁶ (MINAG, 2013: 16) (emphasis added).

In Tanzania, similarly, irrigation is expected to play a prominent role in the development of the nation, as expressed by the Minister for Water and Irrigation in the foreword to the National Irrigation Development Strategy: "The development and proper utilization of irrigation and drainage infrastructure is one of the important inputs for achieving the implementation of [the National Strategy for Growth and Reduction of Poverty]" (URT, 2016a: ii). In addition, irrigation is seen as the ultimate (and only) way of achieving national food security through country-level self-sufficiency. This is not only a matter of securing food but also an important geopolitical goal. Thus, the 2010 National Irrigation Policy states that one of the reasons for developing irrigation is that "self-sufficiency in food production enhances the national sovereignty freedom and security" (URT, 2010: 12).

The second key aspect of a modernist approach to development – the importance of making the socio-ecological landscape legible for administration in order to implement comprehensive, transformative, technological interventions – is also reflected in the policies of both countries. Both Mozambique and Tanzania show a concern for legibility in their irrigation policies and interventions, attempting to make the informal formal. In Mozambique, for instance, a senior consultant who acted as the resident team leader in Mozambique for the World Bank-supported PROIRRI project, explained that "[for development] you *need to create some order* to do things, especially when things are becoming more sophisticated [read: modern]" (emphasis added). In answer to questions about the new policy rationale to unite farmers into Water User Associations, he explained that "there is some recognition that things have to change. There is a need for formalization to develop Mozambique". He elaborated that "the more [resources] you use, the better", and further commented that it is important for users, in relation to the state, "to define themselves".⁷

In Tanzania, a similar aim to document, map, list, and formalise irrigation development is expressed in the National Irrigation Act, which not only requires that each irrigator becomes a member of a registered irrigators' association, but also stipulates that any person or group wanting to develop irrigation must obtain an irrigation certificate from the National Irrigation Commission. The relevant article reads: "[n]o irrigation works shall be constructed until the proposed scheme of the undertaking has been submitted to the Commission for approval" (URT, 2013: 22), with no exemptions explicitly mentioned. In order to obtain this certificate, an irrigator needs to show a water use permit, an environmental impact assessment, a design drawing, and several other documents.⁸ These requirements are clearly directed at formalising the process of irrigation development by putting in place specific procedures that make both the physical and institutional elements of irrigation legible to the state. In a more direct reference to mapping, the National Irrigation Policy in turn emphasises the need for "securing and protecting both potential and irrigated land resources" by "demarcating and registering all irrigation potential area and irrigated land" (URT, 2010: 16).

In both countries this high-modernist conviction that society and water use need to be made legible has been translated into a number of concrete policy packages in relation to agriculture, irrigation, and water management. Most notably, both countries introduced the concept of Integrated Water

⁶ Translated by the authors from the original text: "Missão: Um subsector de irrigação que vai impulsionar uma agricultura diversificada e próspera, mais competitiva, orientada para o mercado visando contribuir para o alcance dos principais objectivos nacionais de desenvolvimento nomeadamente, a redução da pobreza, melhoria da segurança alimentar e crescimento económico".

⁷ Interview with a senior water consultant, 27 April 2017, Maputo.

⁸ In total, those wanting to develop irrigation need to provide: design report; list of drawings; bill of quantities; water use permit; title deed in case of private sector; registration certificate issued under the Irrigation Act for aggregated farmers; any other information required by the National Irrigation Commission (URT, 2013: 22-23)

Resources Management in the early 1990s, with its key principles of water management based on river basins, decentralised water management through regional authorities, and water use registration, licensing, and taxing (see Alba and Bolding, 2016, for Mozambique; van Koppen et al., 2016, for Tanzania; and van Koppen and Schreiner, this Issue). As a result, officers of Regional Water Authorities in Mozambique, and the Basin Water Boards in Tanzania, deal with water issues in terms of 'regulated' and 'non-regulated' water use or, as one Mozambican technician phrased it, 'taxed' and 'non-taxed' water use. Unregistered/unregulated – and therefore illegal – abstractions for irrigation by smallholders are perceived as undermining planned and sustainable water resource management. In line with this, environmental conservation – strengthened increasingly by climate change concerns – is added to existing arguments for stricter administration and modernisation of irrigation that is deemed to be inefficient, as illustrated by this quote from an official of a leading multilateral development agency in Tanzania:

Nobody wants to deny any smallholder farmer the right to grow crops (...) even at a subsistence level for his or her own family and, in that respect, I think irrigation is essential. Is it efficient? (...) I think almost certainly not. I think we need to be looking much more at economies of scale. We need to be using what may be becoming increasingly scarce water resources more efficiently and effectively. And at the moment I don't think that in many smallholder farming areas it meets those criteria. I think water is being applied in a random manner and therefore a lot of that water is not being used effectively (...). I think economies of scale are the way forward. Rather than having lots of small-scale schemes we should be looking to establish more sophisticated irrigation systems alongside water conservation (From an interview on 25 January 2016).

These programmes, policies, and calls for the formalisation and improvement of farmers' irrigation initiatives illustrate the third aspect of a modernist ideology: the desire to reorder what was there before according to scientific principles. To justify this reordering, the existing situation is framed as traditional, and therefore as obsolete, old-fashioned, harmful and/or ineffective. In Mozambique, farmer-led development of irrigation does not even feature in irrigation policies, and the agrarian transformation is framed as moving from low-input rain-fed farming to productive irrigated agriculture.⁹ In Tanzania, state policy has been arguably more tolerant of farmers' irrigation initiatives which have been part of the country's agricultural systems for centuries in certain regions, but has nonetheless defined them as in need of modernisation. This is particularly evident in the 2016 National Irrigation Development Strategy's categorisation of all farmers' irrigation initiatives as 'traditional': "characterised by poor infrastructure, poor water management and low yields" (URT, 2016a: 7). This means that farmers' irrigation initiatives, *by definition*, cannot contribute to the vision of the 2010 National Irrigation Policy, which is to have "irrigation and drainage infrastructure which enables *efficient* utilisation of water and exploiting the vast irrigation potential area in the country for crop growth in highly *productive, modernised* and *commercial* irrigation schemes" (URT, 2016a: 11) (emphasis added). Essentially, traditional irrigation is disqualified on the basis of one technical principle: water use efficiency, or rather the perception of engineers that water cannot be used efficiently in irrigation schemes built by farmers. The only way to become an efficient, productive, modernised, and commercial "improved irrigation scheme" is to "[receive] interventions through support from the Government and/or Development Partners" (ibid: 16). Thus, Tanzania's National Irrigation Development Strategy defines 'traditional' irrigation in terms of whether it was designed and built by technicians approved by the state. This shows that while Tanzanian irrigation policy explicitly recognises farmers' irrigation initiatives (albeit as needing modernisation) in ways that Mozambican policy does

⁹ In theory, there are two categories in irrigation policy documents in Mozambique that can potentially allow for government recognition of farmers' initiatives in irrigation: "irrigated area of less than 5 hectares" (specifically referring to horticulture, flower production, orchards, and fruit trees) (MINAG, 2015: 12) and 'family farming' ('sector familiar') (MINAG, 2013: 6).

not, the emphasis in investment terms is still on transformative programmes to install scientific agriculture/irrigation through special planning procedures.

While for decades the policies for the reordering of agriculture and irrigation called almost solely for public investments, recent years have seen the incorporation of (foreign) private capital within government programmes (public – private partnerships, or PPPs) to achieve transformative, technological change. In Mozambique, this is evident in the Plano Nacional de Investimento do Sector Agrário (PNISA, 2013-2017). The section of PNISA devoted to a *programa de aproveitamento hidroagrícola* (plan for agricultural use of water) envisages rehabilitation of existing irrigation infrastructure (much of which is originally colonial), and construction of new irrigation. This together requires a budget of MZM25 billion (US\$379 million) of a total PNISA investment of MZM119 billion (US\$1.8 billion), which appears to be expected to be entirely funded by external assistance. There is little evidence that this will be forthcoming from established bilateral or multilateral donors. Instead, an alternative private sector expectation is that large-scale agriculture will be developed through incentives for commercial corporate investments. Such PPPs have become a means of matching private capital and technical investment with public provision of access to land and water. These commercial investments are expected to modernise the 'small-scale sector' through the provision of jobs, technology transfer, and access to markets. The model for this process is often taken to mean the 'outgrower' system promoted by sugar cane estates (Dubb et al., 2017).

In Tanzania, although there are continuous publicly funded programmes for upgrading, rehabilitating, modernising, or improving farmers' irrigation initiatives, recent policies have similarly turned towards irrigation development through private sector involvement. The biggest initiative of this kind is the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). This growth corridor is the main focus of a 10-year programme envisaged by the Agricultural Sector Development Plan Phase II (URT, 2016b), which seeks to "transform the agricultural sector (crops, livestock & fisheries) towards higher productivity, commercialization level and smallholder farmer income" (ibid: 36). SAGCOT's specific objective is to "expand investment in agribusiness leading to income growth among smallholders and employment generation across agribusiness value chains in the Southern Corridor" (ibid: 11). It aims at "catalysing large volumes of responsible private investment, targeted at rapid and sustainable agricultural growth, with major benefits for food security, poverty reduction and reduced vulnerability to climate change" (ibid: 12). To achieve this, the government will create an enabling policy environment, as well as provide some of the necessary infrastructure. The idea is that smallholder farmers will be linked to agribusinesses, and it is assumed that smallholders will benefit from support and services such as access to inputs, irrigation, and markets. As in Mozambique, contract farming and outgrower schemes are explicitly mentioned as possible models of production.

While this call for private investment can be seen as the government relinquishing some of its control over irrigation development, or even as a way for farmers' irrigation initiatives to be recognised as a specific type of private investment, we would argue that neither is the case. As Harrison and Mdee (2018) argue in their paper on public and private irrigation investment in Tanzania, the National Irrigation Commission mostly sees PPPs as a way of supplementing their underfunded budget. In the Agricultural Sector Development Plan, this is illustrated by the statement that SAGCOT is "consistent with the strategies and priorities" of existing policies (URT, 2016b: 12). The activities to be executed by private actors within the SAGCOT area are all specified by the government, including the commodities that investors are allowed to engage with (maize, rice, and sugar). Similarly, in Mozambique, the above-mentioned Plano Nacional de Investimento do Sector Agrário can best be seen as the continuation of a historic tendency by the Mozambican government to rely on foreign capital to execute its programmes for the development of modern agriculture and irrigation. In fact, the origins of the Beira Agricultural Growth Corridor, a programme that aims to provide an enabling environment for private sector investments in central Mozambique, can be traced back to colonial times. This shows that PPPs are not

only a vehicle for expanding state administration, but that they are also not a new development in Mozambican agricultural and irrigation policy.

MODERNISATION PRACTICES IN FARMERS' IRRIGATION INITIATIVES

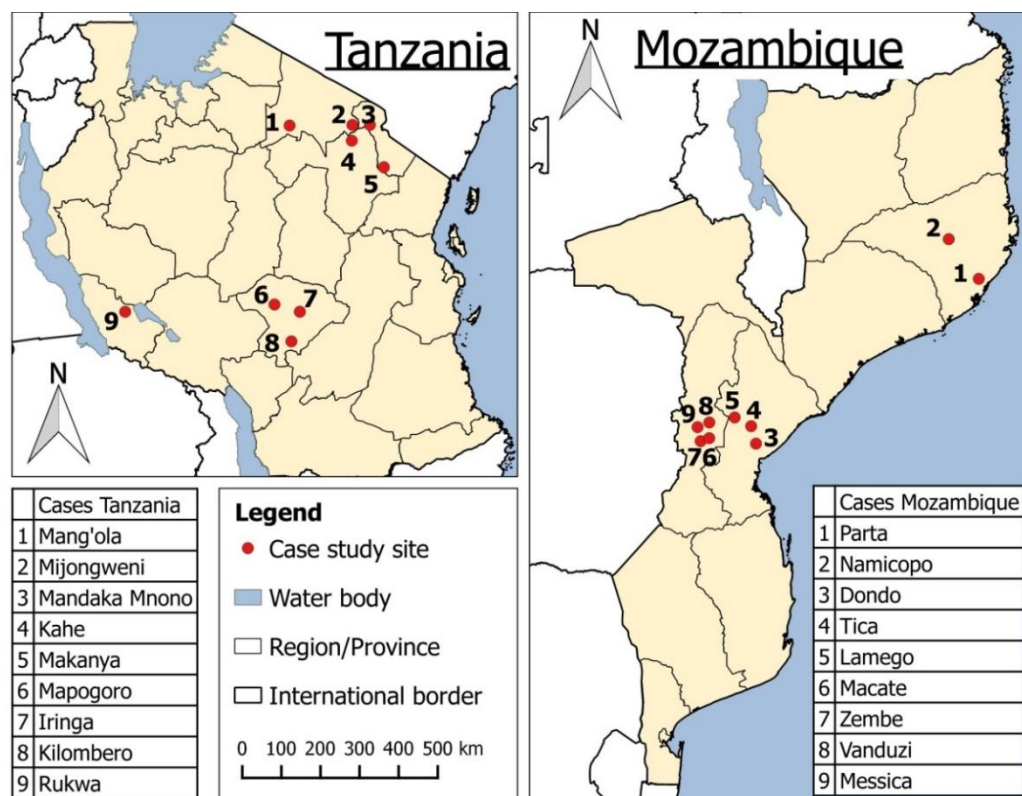
Contrary to the policy emphasis on state-controlled irrigation development by formally trained engineers, widespread observations in sub-Saharan Africa suggest a growing use of irrigation initiated by small-scale farmers (de Fraiture and Giordano, 2013; Woodhouse et al., 2017). They use a variety of technologies, including constructing weirs to divert water into canals, management of flooding and drainage in low-lying areas, and the use of small motor pumps to irrigate from surface or groundwater. These observations are consistent with evidence from new methods of detecting and mapping irrigated areas (IWMI, 2016), which show that official statistics for sub-Saharan Africa greatly underestimate irrigated areas. Taken together, these data suggest that large areas of unofficial irrigation are being developed by farmers' initiatives, with only partial or no formal recognition of them by government administrations.

The following paragraphs summarise key characteristics of 18 study sites (Figure 1) included in a survey of 2732 irrigating and non-irrigating households¹⁰ in Mozambique and Tanzania, undertaken as part of the research underlying this paper. The purpose of the survey was to obtain more detailed and quantified information on farmers' use of irrigation and its socio-economic significance for rural households. The key criterion for site selection was that they constituted cases where farmer initiative was evident in determining the purpose, design, and management of irrigation – even though some sort of input or external assistance might have taken place in the past or has followed farmers' own initiatives (e.g. 'upgrading' by government agencies). In this regard, we conceptualised the cases as sites of 'farmer-led irrigation development'. The selected sites included cases where irrigation was developed by farmers during colonial times (Makanya, Parta), others where farmers have rehabilitated and extended irrigation abandoned by colonial settlers (Vanduzi, Messica), others where technology had been copied by farmers from neighbouring government irrigation schemes (Mandaka Mnono, Mijongweni), and yet others where farmers have purchased small motor pumps to introduce irrigation in new areas (Kahe [de Bont et al., 2019], Tica, Zembe, Macate). The sites surveyed included a range of technologies (stream diversion for basin, furrow, or sprinkler irrigation; wetland management; and small motor pumping from surface or groundwater), and a variety of crops (paddy rice; maize; and high-value horticultural crops for local and regional markets – such as tomatoes, cabbages, and onions – or for export to Europe – green beans and baby corn).

Some of these areas have been recognised by the government and have received support to upgrade infrastructure (Vanduzi, Iringa, Mandaka Mnono, Mijongweni, Mapogoro), but many have not. One site has witnessed efforts by government to close down irrigation (Rukwa). Table 1 shows that areas irrigated by members of households average one to two hectares, although some individuals (for example, a customary chief in Messica and a businessman with rental property in a local town in Rukwa) may cultivate areas 10 times larger. The great majority of irrigating households in Mozambique are irrigating areas of less than two hectares, while this is less than one hectare in Tanzania. However, aggregate areas covered by such irrigation frequently reach hundreds or even thousands of hectares within an administrative district (Beekman et al., 2014).

¹⁰ The questionnaire concerned the irrigation and farming practices of single domestic units. A domestic unit was defined as everybody living within the same residence, in which both consumption and production are organised. Here, we refer to the domestic units as households.

Figure 1. Overview of case study sites in Tanzania and Mozambique.



The survey of irrigating and non-irrigating households used random sampling of a target of 150 households at each site, based on household lists obtained from administrative authorities. Random sampling was modified in order to ensure a minimum of 50 of either irrigating or non-irrigating households in the sample at every site. Table 2 presents statistics that show marked gains in crop sales by irrigating households as compared to non-irrigating households. Gross values of crop sales by irrigating households (uncorrected for production costs or amount of crop consumed by the household) are on average higher than those of non-irrigating households by factors of 5 (Tanzania) and 13 (Mozambique). That these sales constitute a key part of irrigating farmers' livelihood strategies is reflected in the finding that income from growing irrigated crops accounts for at least half of household monetary income for the vast majority of those engaging in irrigation.

The data clearly show the commercial nature of farmer-led irrigation development. Most irrigated crops are grown for the market, and irrigating households are much more likely to use improved seeds and fertilisers (Table 3), and to hire agricultural labour (Table 2), compared to their non-irrigating neighbours. Inputs are often financed by traders and corporate buyers (for local, regional, or export markets), who are important as sources of credit and in their provision of increased certainty of sale of the crop. The data are consistent with information from interviews with farmers, which make clear that irrigation is primarily oriented to producing crops for sale, that is to say, as a source of monetary income. The pattern of more modern input use summarised in Table 3 is largely consistent across all sites, but there are exceptions. In particular, the more remote site at Parta, in northern Mozambique, shows relatively little input use, reflecting weak development of the input supply infrastructure in that region. The spate irrigation site at Makanya, in Tanzania, also shows less input use, possibly resulting from the less-predictable availability of water. Elsewhere, the increase in use of modern inputs (agrochemicals and improved seeds) is markedly higher for irrigated crops, and irrigating households are more consistent purchasers of these inputs (Table 3).

Table 1. Summary of total and irrigated areas of crops grown by irrigating and non-irrigating households at 18 sites in Mozambique and Tanzania (survey data 2016-2017).

Case study site	Sample size (N)			Cropped area (ha) per non-irrigating household				Cropped area (ha) per irrigating household				Area (ha) of irrigated crops per irrigating household	
	Total	Non-irrigating	Irrigating	Mean	Min	Max	Std devn	Mean	Min	Max	Std devn	Mean area	Mean % irrigated
Mozambique	1372	574	798	2.53	0.02	38	2.86	3.68	0.2	38	3.69	1.81	49.3
Dondo	120	72	48	1.35	0.25	6	1.11	1.86	0.25	10	2.12	1.60	86.1
Lamego	192	61	131	2.79	0.5	12	2.05	2.74	0.5	7.8	1.47	1.07	39.0
Macate	197	86	111	2.86	0.5	24	3.72	4.42	0.5	38	4.62	2.15	48.5
Messica	245	94	151	3.98	0.5	38	4.67	5.69	1	38	5.37	2.92	51.3
Namicopo	43	21	22	1.48	0.2	7	1.80	1.32	0.2	3	0.55	0.82	62.0
Parta	100	39	61	1.21	0.02	8	1.26	1.73	0.3	6	1.26	0.71	41.0
Tica	136	73	63	2.10	0.5	6	1.18	2.87	0.4	10	1.96	1.44	50.3
Vanduzi	159	53	106	2.74	0.49	7.5	1.80	3.22	0.3	11	2.04	1.84	57.2
Zembe	180	75	105	2.54	0.5	15.5	2.15	4.61	1	26	3.75	1.95	42.4
Tanzania	1361	445	916	0.69	0	12	1.10	1.35	0	30.4	1.78	1.19	87.9
Iringa	151	54	97	0.76	0	4	0.65	0.82	0.2	5.4	0.84	0.82	100.0
Kahe	150	62	88	0.78	0	2.4	0.67	1.52	0	14.4	1.81	1.31	86.3
Kilombero	152	75	77	0.71	0	8.8	1.04	1.08	0.2	11.2	1.38	0.84	77.5
Makanya	149	25	124	0.47	0	4.8	1.06	2.06	0	6.7	1.36	2.02	98.0
Mandaka	152	43	109	0.32	0	1.6	0.36	1.26	0	11.4	1.46	0.92	72.7
Mnono													
Mang'ola	150	30	120	0.00	0	0	0.00	0.71	0	8	1.11	0.71	100.0
Mapogoro	153	34	119	0.54	0	3.2	0.86	1.62	0	21.6	2.10	1.26	77.9
Mijongweni	153	48	105	0.20	0	1.9	0.40	1.21	0	8	1.11	1.15	94.9
Rukwa	151	74	77	1.52	0.4	12	1.87	1.87	0.08	30.4	3.57	1.60	85.6

Table 2. Comparison of hiring of agricultural labour, and gross value of crop sales, by irrigating and non-irrigating households, and extent of contribution of sale of irrigated crops to total income of irrigating households (survey 2016-2017).

Gross value of crop sales (US\$/household/year)					Percentage of irrigating households for whom at least half of total income is derived from sale of irrigated crops	Percentage of households employing agricultural labour	
Households	Non-irrigating		Irrigating			Non-irrigating	Irrigating
	Mean	Std devn	Mean	Std devn			
Mozambique	51.9	178.4	703.8	2091.2	78.7	23.5	48.1
Dondo	37.4	92.3	249.5	693.0	87.5	22.2	50.0
Lamego	18.0	57.7	99.1	471.5	72.5	27.9	41.2
Macate	114.8	345.1	676.9	2032.1	72.1	34.9	64.0
Messica	48.1	104.9	1240.0	2790.0	84.8	23.4	41.7
Namicopo	1.7	5.4	187.2	455.3	72.7	0.0	18.2
Parta	53.2	170.1	186.0	260.6	67.2	10.3	29.5
Tica	94.1	233.9	1254.0	4250.0	92.1	31.5	54.0
Vanduzi	21.7	58.0	1049.5	1944.8	88.7	28.3	60.4
Zembe	19.5	65.2	653.3	1123.2	70.5	10.7	49.5
Tanzania	161.2	651.9	884.0	2458.4	90.8	29.9	72.6
Iringa	33.9	113.7	634.1	1153.1	96.9	9.3	50.5
Kahe	36.3	117.2	635.3	2250.5	83.0	43.5	69.3
Kilombero	350.6	1119.3	937.9	2384.7	92.2	36.0	68.8
Makanya	9.9	30.5	370.5	402.9	87.9	8.0	77.4
Mandaka	18.4	55.4	739.9	977.6	85.3	39.5	85.3
Mnono							
Mang’ola	0.0	0.0	1180.2	3303.0	92.5	3.3	70.0
Mapogoro	9.4	33.0	1237.0	1211.4	97.5	26.5	82.4
Mijongweni	0.7	4.5	541.4	1092.6	84.8	12.5	77.1
Rukwa	539.9	1012.7	1920.1	5897.8	98.7	52.7	64.9

Table 3. Use of 'modern' inputs in irrigated and non-irrigated agriculture at 18 sites in Mozambique and Tanzania (survey in 2016-2017).

	Survey sample (N)		Applied manure from own livestock		Applied purchased fertiliser		Used improved seeds		Average intensification index*	
	Non-irrigated crops	Irrigated crops	Non-irrigated crops (%)	Irrigated crops (%)	Non-irrigated crops (%)	Irrigated crops (%)	Non-irrigated crops (%)	Irrigated crops (%)	Non-irrigating households	Irrigating households
Mozambique	2323	1950	1.3	7.2	2.2	41.6	8.8	51.6	0.11	0.93
Dondo	135	79	0	1.3	2.2	34.2	5.9	36.7	0.09	0.52
Lamego	358	204	0.3	6.4	0.6	10.8	6.1	22.5	0.09	0.23
Macate	357	306	0.6	5.6	0.3	23.9	9.5	33.7	0.11	0.73
Messica	353	356	2.5	3.9	3.7	63.8	14.2	49.4	0.23	1.27
Namicopo	91	60	8.8	35.0	1.1	5.0	2.2	46.7	0.08	0.81
Parta	205	81	0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Tica	280	167	0.7	1.2	5.4	33.5	11.1	56.3	0.13	1.12
Vanduzi	256	420	3.5	8.6	3.5	63.6	17.6	83.1	0.12	1.95
Zembe	288	277	0	13.4	2.4	49.5	4.2	65.7	0.06	1.17
Tanzania	808	1786	6.1	3.6	15.2	49.1	22.3	38.2	0.75	1.51
Iringa	60	101	0	1.0	1.7	9.9	3.3	3.0	0.06	0.81
Kahe	123	174	0.8	1.7	11.4	36.8	14.6	29.9	0.63	1.15
Kilombero	127	132	0	1.5	38.6	83.3	27.6	64.4	1.39	2.32
Makanya	44	377	0	4.5	2.3	3.2	18.2	30.8	0.60	0.83
Mandaka	116	215	7.8	0.9	16.4	88.8	42.2	48.8	1.19	2.20
Mnono										
Mang'ola	29	213	0	1.9	0.0	69.5	0.0	50.7	0.0	2.13
Mapogoro	90	141	1.1	0.7	2.2	70.2	15.6	5.0	0.35	1.17
Mijongweni	82	328	0	2.4	43.9	73.2	40.2	57.0	1.49	2.30
Rukwa	137	105	28	25.7	0.7	2.9	15.3	19.0	0.52	0.75

*Intensification index is calculated for each household as: for each crop, score 1 for 'buy fertiliser' or 'buy manure' + 1 for 'use improved seeds' + 1 for 'use pesticides'. Average score across all crops grown by the household = input intensification index for each household.

DISCUSSION: MODERNISATION AND CONTROL

The data we presented in the previous section suggests that farmer-led irrigation initiatives often conform to key elements of the modern agriculture to which government policies aspire (cf. de Bont et al., 2019). Specifically, they are commercial in their production logic and they display active investment of capital in inputs (pumps, fertilisers, improved seeds, pesticides) in order to raise productivity. Further, the high level of dependence of these irrigating households on income from the sale of irrigated crops indicates that they can no longer be characterised by a 'traditionalist' or 'subsistence' logic of agricultural investment and production. The question arises: why do official policies concerning smallholder agriculture not feature what appears to be a significant and widespread movement among small-scale farmers towards agricultural intensification through their own investments in irrigation?

We argue there are three principal elements in the response to that question, of which the first two stem from the dominant ideology influencing irrigation development, and the last one is practical. The modernist ideology underlying agricultural and irrigation policies in both Tanzania and Mozambique leads to a narrow interpretation of 'good irrigation' as being that which is designed by trained engineers, and is in accordance with political priorities as defined by the government. The impact of this narrow interpretation is twofold. First, it excludes farmer-led development of irrigation as a potential strategy for agricultural intensification and commercialisation, because farmers' irrigation initiatives are conceived as wasteful and inefficient. Second, it calls for strategies of state administration and control as a necessary precondition for development. While, previously, this state administration and control was exercised through public irrigation programmes, governments are now increasingly looking for external capital in order to reach existing policy goals. While this can be considered to be the relinquishing of state control, we argue that in Mozambique and Tanzania the government remains in charge of the location (limited to specific corridors and zones) and type of investments, which, moreover, conform to the legal and engineering procedures that are associated with 'good irrigation', as recognised by government agencies. Because of this, PPPs in which (foreign) capital is leveraged to develop irrigation and to modernise agriculture do not undermine government control in the same way as do farmer-led initiatives. Instead, they can even be seen to enable state administration by implementing programmes that are in line with government policies, in locations that are sanctioned by government. The third – practical – element is the weak technical capacity and limited budgets within government agencies that are responsible for irrigation planning, which critically reduce their potential to respond adaptively, and increase dependence on importation of standard technological packages.

With respect to this third point, the technical capacity for irrigation design is markedly stronger in Tanzania than in Mozambique. Since the 1950s, the policy of constructing small-scale irrigation schemes was accompanied by the deployment of irrigation engineers at local (district) levels. In addition, decentralised centres of expertise have existed for over thirty years in the six Zonal Irrigation Units across the country. This proves that there is a legacy of local irrigation development and a capacity for the design of small-scale irrigation work. It also suggests experience in engaging with existing farmer-initiated irrigation, even if through a narrow lens of 'improvement' in the form of, for example, canal lining. Moreover, Tanzania has a firmly established political culture of decentralised village-level governance of resources such as land and forests. By contrast, Mozambique's participatory natural resources management approaches exist in paper policy (Otsuki et al., 2017), but technical capacity at district level for actual implementation is severely limited. At times, only a single trained irrigation technician or engineer is active at the provincial level (which is equivalent to the regional level in Tanzania). Even at a central level, the recently formed INIR has only about 25 staff (mostly junior) based in Maputo. They rely on provincial officials for field information, and are mainly occupied with creating a database, writing a master plan, and attending meetings with development agencies to solicit

funding. In interviews, INIR staff show an awareness of smallholder irrigation, but they have not really considered whether or how to interact with it.

This lack of expertise not only hampers the ability to evaluate the existing hydraulic functioning of irrigation schemes built and used by farmers, but also limits the capacity to identify cost-effective measures to improve them. Interviews with experienced irrigation engineers working in Mozambique graphically highlight the consequences. As one stated,

[y]ou should go to the system and ask what the problems are. Then ask what resources farmers can put in and then look at what the state needs to put in. Instead of [such an adaptive approach] the (government agency) insists on tendering, so projects become large and there is an insistence on new design. Mozambican capacity to evaluate technical designs is very weak, so contracts are signed with inadequate scrutiny. A better alternative would be budget support for district-level irrigation engineers (...). Tendency of government and other agencies involved in irrigation is you go to an area and you put there your own plan without consulting local people. If there is an existing system then you replace it because it is outdated (From an interview on 24 March 2016)

Another irrigation engineer attributes the current lack of capacity to the fact that the INIR was set up after a long period of neglect of irrigation, and expectations have been unrealistic:

Irrigation is back in the picture and now they want impossible things (...). The irrigation strategy recently approved is appropriate and relevant: all the things are there to do something, but implementation capacity is weak. The strategy itself won't solve the problem but it is important to attract funding. Now they are doing an action plan. It has a lot of weaknesses but it is good enough to do a lot of work. They are starting to accumulate experience but it is hard to find data on success and failure, so there is a need to start this. (From an interview on 25 January 2016)

Although their capacity and experience might be very different, and agricultural improvement agendas are frequently framed in terms of technological upgrading, both governments display a common priority in responding to smallholder irrigators with strategies of registration, organisation, and control – if they recognise them at all. To register and institutionalise the activities of small-scale irrigators through the formation of formal associations is a particular example of a modernisation drive, reflecting both the desire for state control and the need for standardisation and legibility (Scott, 1998) to implement projects for the transformation of society. A good example of this need for legibility and administration is found in the government's proposals for the registration of irrigators' associations in Mozambique. These proposals state that the constitution of an irrigators' association (*associação de regantes*) controls not only access to water but also to irrigable land through a collective DUAT (land title) vested in the association. However, in effect, this is a lease of land from the government, and hence any breakup of the association would also imply loss of land rights for its members. The government's draft regulation of such associations also makes clear the government's strong regulatory emphasis with regard to irrigation activities (in contrast to the market-oriented logic of the irrigation activity itself). More specifically, the *Proposta de Regulamento de Associações de Regantes* (MASA, 2015) states that the formal procedures that associations are required to follow are designed to deliver regulatory objectives concerning soil and water conservation, rather than to support an increase in the output or productivity of the irrigated areas. Moreover, the *regulamento* makes explicit that it treats irrigators as the 'beneficiaries', not agents, of irrigation development. In sum, irrigators' associations are envisaged as franchisees of central government authority, and therefore subject to direct state intervention.

In Tanzania, the set of requirements formulated by the National Irrigation Commission in an attempt to control all irrigation development in the country, makes it too costly for most small-scale producers to legally develop irrigation. This once again emphasises not only that the realities of farmers' irrigation initiatives do not fit easily with the government's vision, but also that they are likely to be inconsistent

with state-administered development that is central to Tanzanian irrigation planning. It is important to note, however, that the lack of capacity within the government to map and control irrigation activities means that the Irrigation Act is not often implemented in practice. As a consequence, the realms of farmers' irrigation initiatives and state-sanctioned water use seem destined to remain separate.

CONCLUSION

We have argued in this paper that irrigation plays an important part in state plans to achieve agricultural modernisation in Mozambique and Tanzania. It is important to note that these two cases are not exceptional. Many other countries, including those now 'developed', have also seen irrigation and the creation of associated water infrastructure as key elements of building a modern nation (cf. Reisner, 1986; Swyngedouw, 1999). As we have also indicated, policy narratives of transformative investment abound in current documentation produced by international development agencies. The point that we have argued is that the state modernisation project in these two countries (as it relates to irrigation) appears to ignore a widespread phenomenon of farmer-led irrigation development that could contribute to higher-level government goals – such as food security – even though it does not conform to the official understanding of how agricultural change should take place.

In this paper we have identified the agricultural modernisation packages, and the accompanying modernist ideology, that have been pervasive in agricultural and irrigation policies in both Mozambique and Tanzania. As a result of this modernist ideology, only irrigation developed under state control, and designed by formally recognised engineers according to the criterion of water use efficiency, is considered capable of contributing to the transformation of agriculture into an efficient and productive sector. At the same time, we have shown how modernisation practices linked to the phenomenon of farmer-led irrigation development are more identifiable with 'mutant modernities', as defined by Arce and Long (2000): initiatives that are characterised by a constant infusion of elements (such as fertilisers and pesticides) from some external source (traders, government), which are combined with existing or 'traditional' agricultural practices to create something new. The result is an enormous heterogeneity of new, 'improved', and sometimes profitable forms of irrigation – new modernities. We presented evidence that suggests that farmers' irrigation initiatives are often compatible with dominant technical and economic definitions of 'modern' agriculture in terms of market-orientation and more intensive use of inputs. There is also evidence that farmers welcome technical support and engagement from government and other agencies (de Bont and Veldwisch, 2018). To this extent, it appears that farmers' irrigation initiatives are not only consistent with government visions of modern agriculture, but also with a culture of commercial engagement. As such, they are in line with the declared government strategies to transform small-scale agriculture. However, while farmer-led irrigation development may be compatible with government modernisation goals, it does not fit the means through which government seeks to achieve these goals, nor does it match the ideology underpinning current modernisation programmes. As a result, policy is framed in ways that either ignore farmers' irrigation initiatives entirely (in Mozambique), or (in Tanzania) frame them in such a way that they cannot be legitimised as efficient or productive except through 'improvement' by experts sanctioned by the state.

This contradiction between farmers' 'modern' practices and the lack of recognition of the possible value of farmers' irrigation initiatives by governments suggests that what is at stake with farmer-led irrigation development is not its conformity with the technical or even cultural criteria of modernisation. Instead, farmer-led development of irrigation seems to locate innovation and control insufficiently within boundaries acceptable to agencies of government, with initiatives often occurring outside the realm of development projects and official planning procedures. We have observed that this distance between small-scale irrigators and government irrigation practitioners may reflect central irrigation agencies' lack of local, and hence 'adaptive', technical capacity to engage with the context-specific conditions of actual irrigation development. However, we also observe that farmer-led

irrigation development potentially conflicts with a modernising state's political priority of bringing development under the control of state planning processes. Farmers' influence over the purpose, design, and management of irrigation is also potentially (though perhaps not necessarily) at odds with a state development strategy that hinges on large-scale corporate investment and the concomitant reliance on subcontracting irrigation design to commercial interests. The latter two of these three points emerge here as perhaps the more significant, particularly if we view the position of farmer-led irrigation as an instance of development being "rendered technical" – a practice that "confirms expertise and constitutes the boundary between those who are positioned as trustees, with the capacity to diagnose deficiencies in others, and those who are subject to expert direction" (Murray Li, 2007: 7).

From this perspective, the definition in Tanzania of 'traditional' irrigation in terms of *technical* deficiencies (inefficiency of water use, lack of formal engineering design) asserts a boundary and legitimates intervention, without confronting political questions such as irrigators' rights to use the land or water. This is crucial because, as we have observed, the technical boundary of inadequate irrigation design has started to play a role in policy narratives of water scarcity and water conservation. These do more than simply recognise quantitative limits on water resources, as they also assert priorities between competing uses (Mehta, 2010; Woodhouse and Muller, 2017). With farmers' irrigation initiatives defined as unproductive and inefficient, dispossession of water and/or irrigation infrastructure becomes a real threat for these initiatives. Within such a policy narrative, it is yet to be seen whether the increasing visibility of widespread farmer-led irrigation will be accommodated within government planning and, if so, how.

While it is important to highlight the political weakness of small-scale irrigators in an arena of water resource allocation that is dominated by the interests of hydropower, urban water supply, and wildlife tourism, the phenomenon of farmer-led irrigation development suggests dynamics that do not fit the standard binary between a modernising state and a weak but resistant peasantry. In particular, the 'peasantry' in this case appears to be engaged in a transformative programme of its own which is directing significant income from urban food markets into the hands of individual households. This is likely to make these farmers capable of further investment, and to propel them along a trajectory towards capitalist agriculture and a more politically significant farm lobby, as was seen in India following the mass adoption of groundwater irrigation. Quite apart from the implications for social differentiation in rural areas, such a development would imply new challenges – both political and economic – to government modernisation policies for the agricultural sector.

As farmers' irrigation initiatives are now entering the agenda of development funders such as the World Bank, the idea of farmer-led irrigation development is already taking on new meanings. Starting off from farmer-led irrigation *development* – a concept to describe a process in which farmers are leading in developing irrigation – 'farmer-led irrigation' is now becoming synonymous with a specific type of irrigation. This means that while the wider recognition of farmers' initiatives as contributing to growth provides opportunities for policy reformulation, the narrowing of the concept may also increase political and practical challenges in recognising, regulating, and supporting the wide range of farmer-led irrigation developments within a state-controlled framework for irrigation development.

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