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# **The Continuous Quest for Control by African Irrigation Planners in the Face of Farmer-Led Irrigation Development: The Case of the Lower Moshi Area, Tanzania (1935-2017)**

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**ABSTRACT:** Although much has been written about the indigenous irrigation systems of Tanzania, there has been no comprehensive historical study of state irrigation planning. This article fills this gap by analysing irrigation development policy in Tanzania between 1935 and 2017. Based on archival research, and using the Lower Moshi area in Kilimanjaro Region as a case study, it contains an analysis of 80 years of irrigation policy and state intervention. It distinguishes between four periods, based on changes in the perceived role of irrigation and the different actors that were considered important. It notes that the belief in the necessity of state intervention and formal engineering for proper irrigation development ran through all the time periods, and that these were the key factors defining the state's attitude towards irrigation development planning, regardless of the political situation. This article argues that, ultimately, the development narrative of 'modern' irrigation as a driver for agricultural transformation has been successful in depoliticising irrigation interventions and has succeeded in closing the debate on whether state-controlled irrigation development is really the best way to reduce poverty and stimulate economic growth. To provide space for reflection on the possible role of governments in promoting, supporting, and regulating farmer-led irrigation development, future debates on African irrigation should start by recognising the unique contributions that can be made by farmers in realising the continent's development targets.

**KEYWORDS:** Irrigation history, rendering technical, farmer-led irrigation development, Africa, Tanzania

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## **INTRODUCTION**

Tanzania has a rich irrigation history, and scholars have written extensively about the pre-colonial farmer-initiated canal systems on the Kilimanjaro (Stump and Tagseth, 2009), Usambara (Huijzendveld, 2008), and Pare mountains (Håkansson, 1995), as well as those in Engaruka (Westerberg et al.; 2010). So far, however, no comprehensive study has been done on public irrigation intervention, or on how colonial and independent governments interacted with farmers' irrigation initiatives. This is surprising, as Tanzania has seen almost a century of state irrigation planning, during which the state has acted upon irrigators, technology, and the landscape as a whole. The lack of reflection on the policies and actions of the state is even more surprising when compared to the extensive work that has been done on the state's role in nature conservation (Neumann, 1998, 2001; Leader-Williams, 2000; Levine, 2002; Mkumbukwa, 2008). Furthermore, after almost two decades of relatively low public investment, the Tanzanian government recently rekindled its irrigation ambitions through a range of irrigation development programmes (URT, 2006a, 2009, 2016a; Big Results Now, 2013). In fact, investments in irrigation have increased across the African continent (NEPAD, 2009; You et al.; 2011). However, scholars have remarked that the new irrigation policies and programmes ignore what they call 'farmer-led irrigation development', "a process in which farmers drive the establishment, improvement and/or

expansion of irrigated agriculture, often in interaction with other actors" (Woodhouse et al.; 2017; Veldwisch et al.; 2018).

With these developments in mind, I aim to provide a historical analysis of public irrigation development in Tanzania since 1935 in order to shed light on the continuity and changes in the state's attitude towards irrigation development over the last 80 years. While doing so, I will evaluate the impact that state interventions have had on the landscape, and how the state has related to farmers' irrigation initiatives. I take 1935 as the start of a consolidated state policy on irrigation and water management, with the publication of Teale and Gillman's *Report on the investigation of the proper control of water and the re-organization of water boards in the Northern Province of Tanganyika Territory* (Teale and Gillman, 1935). Using the Lower Moshi area in Kilimanjaro Region as a case study, I conclude that, in spite of certain policy changes, the belief in the necessity of state intervention and formal engineering for proper irrigation development ran through all time periods and was the key factor defining the state's attitude towards irrigation development planning, regardless of the political situation. At the same time, I show that state interventions based on this approach have not resulted in the anticipated growth in irrigated area, while farmers' irrigation initiatives have expanded in spite of the state's negative attitude towards them.

In the next section, I position this research within previous scholarship on the history of irrigation and water management in Africa. I then engage with other work on state intervention, expert knowledge, and development, focusing specifically on how the "rendering technical" (Li, 2007) of problems and solutions shapes state intervention. I continue by elaborating upon my methodology for data collection and analysis, and explain my choice for the case study area. The analysis of policies and plans that were drawn up and/or implemented since 1935, as well as their underlying assumptions and convictions, caused me to define four different time periods. Each time period is characterised by a different emphasis in the narratives on irrigation development (resettlement; productivity; state withdrawal and decentralisation; renewed interest and private sector engagement). These periods do not follow the different government regimes that commonly define Tanzania's history (colonial, socialist, and neo-liberal), emphasising the point that irrigation development has primarily been a technical endeavour influenced by international trends in development policy. At the same time, the continuity in the state's approach to irrigation shows that its ideas about the role of the state and of farmers in irrigation development, and in agricultural development as a whole, have remained remarkably similar across the broader shifts in politics. After outlining the different periods and the matching irrigation development activities in the Lower Moshi area, I continue by relating my findings to literature on state intervention, specifically in the field of irrigation, and the role of engineers in both colonial and post-colonial periods. In doing so I at least partially explain how and why the irrigation paradigms remained stable in the face of failure, and how the dominance of these paradigms excluded alternative narratives on agricultural development and irrigation. I conclude by reflecting on what this means for irrigation development in Africa and what the future role of farmer-led irrigation development can be.

## **HISTORICAL RESEARCH ON AFRICAN IRRIGATION**

There are two major strands in historical irrigation research in Africa. The first focuses on farmers' irrigation initiatives and their role in agricultural systems. Scholars point out that many irrigation systems in Africa are of pre-colonial origin and that they have supported, or still support, intensive forms of agriculture (Adams and Anderson, 1988; Niemeijer, 1996; Widgren, 2004; Stump, 2010). Much of this research aims to contradict ideas of African agriculture as unproductive, static, and isolated.

A second strand of research engages with state intervention in irrigation, with several authors analysing colonial irrigation-planning efforts and their legacies in post-colonial Africa (Diemer, 1990; Van Beusekom, 2000; Bolding, 2004; Ertsen, 2008, 2016). Similar research on British colonial water

management and irrigation has also been done in South Asia (Gilmartin, 2003; D'Souza, 2006; Beattie and Morgan, 2017) and shows the importance of engineering knowledge in shaping what D'Souza calls a "colonial hydrology" (2006: 625). In African studies, much of the attention has gone to large-scale resettlement schemes, both geographically and thematically. The Gezira scheme in Sudan, the Office du Niger in Mali, and the Mwea scheme in Kenya are some of the most documented cases (Chambers, 1969; Chambers and Moris, 1973; Diemer, 1990; Van Beusekom, 2000; Ertsen, 2008, 2016). Those authors covering both the colonial period and the decades immediately following, have noted the continuity in irrigation engineering approaches. Ertsen (2008) for instance, describes the similarities between the colonial Mwea and Gezira schemes and the post-colonial Kano River Project in northern Nigeria. He concludes that "post-colonial ideas on proper irrigation development were influenced by colonial perceptions of good irrigation practice" (ibid: 213), primarily pointing at the urge of both colonial and post-colonial engineers to control all aspects of production within the scheme. Diemer (1990) similarly shows how irrigation expertise became an export product for former colonial powers. He notes how most schemes that fit the typical colonial "engineering paradigm"<sup>1</sup> were actually built after independence. This fits the wider observation by, for instance, Hodge (2007) that colonial agrarian doctrines laid the foundation for later development policies in much of Africa.

### STATE INTERVENTION, DEVELOPMENT AND EXPERT KNOWLEDGE

The previous section has already hinted at the importance of knowledge, specifically colonial engineering knowledge, in shaping post-colonial irrigation planning. The power of formal experts to define the problem and suggest the solution – whether they work for the government, international organisations, or foreign donors – has been discussed by various scholars. Ferguson (1990), in his work on development interventions in Lesotho, showed how a development discourse was created in which Lesotho was portrayed as a peasant society isolated from the cash economy and in need of an agriculture-oriented national development programme. This discourse translated poverty into a technical problem, which called for specific state interventions that were part of the institutionalised options within the development agency. As such, it depoliticised both state intervention and poverty (Ferguson, 1990: 256). As I will show in the rest of this paper, the parallels between this process and the narratives underlying past and current irrigation development in Tanzania (and probably the world) are striking, with a similar technocratic paradigm shaping most government interventions.

Where Ferguson focused on the development industry, Scott (1998) analysed state intervention and (failed) large-scale social engineering projects, which he claimed rely on simplifications, an unwavering faith in science and technology, an authoritarian state, and a weak civil society. For this paper, the process of simplifying reality and the faith in technology to solve problems are especially significant for understanding the role of expert knowledge in state planning. First, Scott describes the process through which the state, in order to control and plan, simplifies or schematises a complex reality. He argues that the state can only intervene when a phenomenon is made legible, and that the language used in the simplification signals the objective of the state (ibid). For instance, the replacement of 'nature' with 'natural resources' (or, in this case, 'water' with 'water resources') illustrates a purely utilitarian vision. Similar to Ferguson, Scott shows that the way in which a situation is problematised is functional, and accords with the objectives and capabilities of the intervener. Second, in the term 'high modernism' Scott captures the faith in science and technology that he observes in many development schemes: "a particularly sweeping vision of how the benefits of technical and scientific progress might be applied – usually through the state – in every field of human activity" (ibid: 90). By claiming that only those

<sup>1</sup> The engineering paradigm prescribes the use of formal engineering structures to control water, in order to use it as efficiently and productively as possible. Irrigation schemes are likened to factories, in which farmers are largely ignored or function as workers tasked with securing the maximum level of production.

activities based on scientific knowledge can contribute to a better society, other forms of knowledge are disqualified and excluded from the debate.

In different settings and with different emphases, Ferguson and Scott both show the power of technical experts to define problems, which are often in line with the solutions they can offer and with their own interests. More recently, Li built on the work of Ferguson and Scott, identifying two necessary, interlinked processes by which a government's, or a development agency's, "will to improve" is translated into interventions: problematisation and "rendering technical" (Li, 2007: 7). After identifying a problem in society, "an arena of intervention must be bounded, mapped, characterized, and documented; the relevant forces and relations must be identified; and a narrative must be devised connecting the proposed intervention to the problem it will solve" (ibid: 126). In other words, the problem is rendered technical and thereby becomes apolitical.

Following the work of the three authors above, and building on the two strands of historical irrigation literature outlined in the previous section, I study Tanzania's irrigation intervention history and the state's attitude towards farmer-led irrigation development. I look beyond the continuity and change in irrigation technology or management regimes and include the state's rationale for developing irrigation and the role farmers were expected to play in irrigation development. In other words, I analyse what problems were identified at different times and how a narrative was designed to connect specific irrigation development interventions to these problems, which thereby were rendered technical. While doing this, I discuss what role different kinds of actors and various types of knowledge played in this process, and specifically look at technical experts and their views on irrigation development planning and farmers' irrigation initiatives.

## METHODS

The historical analysis in this paper is primarily based on archival and library research in Tanzania and the United Kingdom, supplemented with fieldwork in the Lower Moshi area, and the analysis of current policy documents. I collected historical publications on irrigation development in Tanzania at the Kilimanjaro Zonal Irrigation Unit and the Pangani Basin Water Office in Moshi, the library of the University of Dar es Salaam, the Tanzania National Archives in Dar es Salaam, the Bodleian Library in Oxford, and the National Archives in London. More recent policy documents were retrieved from governmental websites or obtained from government officials in Tanzania.

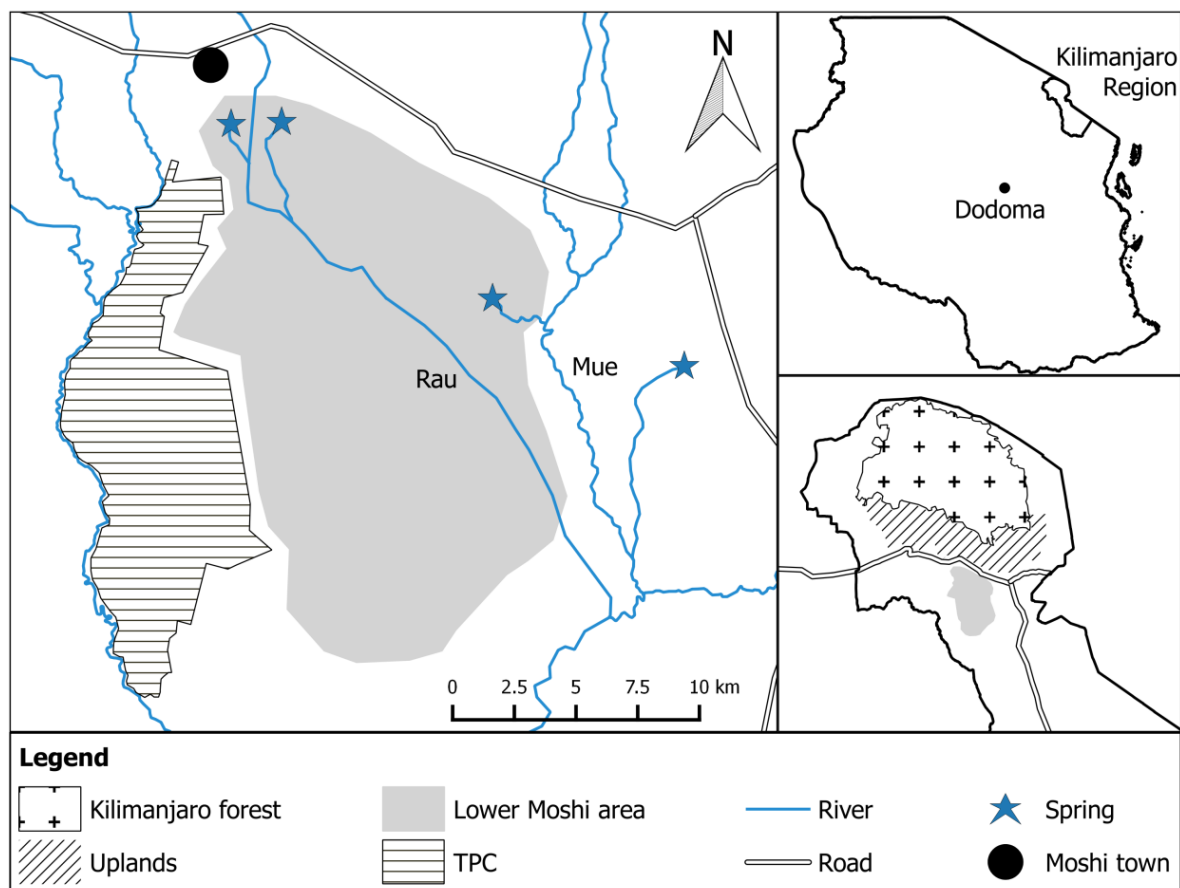
All documents used were either published by the Tanzanian/Tanganyikan government or were the result of state-ordered investigations. I therefore assumed that they gave a representative view of the governmental attitude towards irrigation development. I recognise the difference between policy on paper and implemented policy (Thomas and Grindle, 1990), but the focus of this paper is on prevailing national narratives concerning irrigation development at different times in history. I attempt to enrich the paper policy by focusing not only on the published documents but also on project plans that have (or have not) materialised. By analysing the discrepancies between the two, I avoid as much as possible having a too-narrow interpretation of the state's vision on irrigation development, and challenge the idea that policy is something which is developed in isolation to be imprinted on the landscape.

I analysed each document by coding the text along five different themes: what problem is irrigation development supposed to address; what is considered good irrigation; what kind of knowledge is needed to develop good irrigation; what are the expert opinions of farmers' irrigation initiatives; and what are the proposed interventions. For each decade, I categorised quotes belonging to these themes into common threads, allowing for a comparison over time. Subsequently, I grouped or separated decades based on the absence or presence of certain categories in each of the themes. For instance, the difference between the first and the second period was established by the disappearance of resettlement as the primary motive for irrigation development.

Observations and interviews from a total of five months of fieldwork conducted in the Lower Moshi area during 2015 and 2016 were used primarily to get more insight into farmers' irrigation initiatives in the area, and to assess the current presence and legacies of certain (planned) public irrigation schemes in the landscape. The fieldwork also helped in assessing the descriptions of existing farmers' irrigation initiatives in the different archival documents, as some authors have overlooked this kind of irrigation. While this article focuses on public irrigation investment, the fieldwork data is used to emphasise that this was not happening in an empty landscape void of settlement, agriculture, or irrigation.

In this article, the name Lower Moshi is used to indicate the area south of Moshi town, bounded by the sugar estate of the Tanganyika Planting Company (TPC) in the west and the Mue river in the east (see Figure 1). The perennial Rau River and several large springs are the main water sources in the area. The Lower Moshi area is located in the Kilimanjaro Region and part of the Kilimanjaro lowlands, which were named in contrast to the much cooler and wetter uplands on the slopes of Mount Kilimanjaro. The area is also part of the Kikuletwa catchment which in turn is part of the Pangani River Basin.

Figure 1. Location of the Lower Moshi case study area.



The Kilimanjaro area is one of the most densely populated areas of Tanzania, and intensive, irrigated agriculture has been practised on the slopes since pre-colonial times (Stump and Tagseth, 2009). There are many small streams and bigger perennial rivers that start on the mountain and drain into the lowlands, as well as a number of springs of varying discharges. During early colonial times, the lowlands were deemed unsuitable for habitation due to lack of rainfall and domestic water supply and the

presence of tsetse flies.<sup>2</sup> Nevertheless, Teale and Gillman (1935) reported at least one settlement in the lowlands by 1935, and the 1977 Water Master Plan Team recorded six canals on the lower reaches of the Rau River which they estimated were roughly 60 years old and supported about 6000 people (Water Master Plan Team, 1977). This indicates that while the population was small, irrigated agriculture was initiated by farmers in the Lower Moshi area in the early 1900s. The number of canals only increased over time, as illustrated by a map from the 1977 Kilimanjaro Integrated Regional Development Plan on which 26 'traditional furrow' intakes were marked on the lowland stretch of the Rau River (URT/JICA, 1977: 17).

The perennial rivers, springs, and low population density also made the Lower Moshi area a prime location for the government to develop irrigation and settlement schemes. In addition, there has been hydropower generation downstream of Lower Moshi since 1936. The attempts to secure sufficient water for these hydropower plants has shaped public irrigation planning: the government has continuously attempted to curb upstream water use by limiting water use by smallholder farmers through regulations or by infrastructural upgrading (Komakech et al.; 2011). As such, there has been a continuous stream of public and private investment in the Lower Moshi area since the 1930s. This history of both farmer-led irrigation development and government irrigation planning makes the Lower Moshi area a great site for a historical analysis of government irrigation development intervention and the state's attitude towards farmers' irrigation initiatives.

### **IRRIGATION FOR RESETTLEMENT (1935-1955)**

In the 1930s, smallholder agriculture by the native Chagga people was dominant in the uplands, with colonial settlers primarily cultivating estates in the transition zone between lowlands and uplands. At this point in time, there was little difference in irrigation technology between these two groups, with earthen canals supplying both settler and native farms. In early studies, colonial officials and researchers expressed appreciation for the "primitive though remarkable system of well-constructed and wonderfully graded water channels" (Teale and Gillman, 1935: 19).<sup>3</sup> At the same time, there was agreement, including among those who were impressed with the existing irrigation systems, that they were wasteful and in need of rehabilitation. This is strongly represented in the 1936 report by Kanthack, who was tasked with coming up with a plan for how best to manage water for the benefit of Tanganyika. He advocated improving "primitive, wasteful and inefficient native irrigation" (Kanthack, 1936: 12) in order to have efficient irrigators who understood "that irrigation water in the Territory is a natural commodity of the greatest national value and that its use for irrigation will only be permitted on condition that it is conveyed and applied to the land in the most economic matter practicable" (ibid: 8). This kind of terminology of water as a natural commodity/resource which needs to be used efficiently and economically becomes stronger as time goes by, but was already present at the very beginning of public irrigation planning. The pervasiveness of this idea becomes clear from a letter to the governor of Tanganyika in 1936, in which policies written by officials in colonies such as Palestine and Rhodesia are referred to as sources of inspiration for the Tanganyikan management plan.<sup>4</sup>

<sup>2</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 24/17. 1947-1950. File title: Development of lower areas. Meeting 18 October 1948.

<sup>3</sup> See also the citation of the Provincial Commissioner for the Northern Region on the "excellent irrigation systems on the slopes of Kilimanjaro" in the Annual Report of 1934, and the description of the Chagga irrigation system as "remarkable" in that same document (Colonial Office, 1935: 13,19).

<sup>4</sup> The National Archives, London; Public Record Office: CO 691/151/1. Investigations into and proposals concerning the problems connected with the development and conservation of the water and forest resources of the territory, 1936-1937, pp. 60-62.

Generally, there was a sense that water was being abstracted at will, with little control by the government, leading to suboptimal use. This was deemed problematic for two reasons. The first was the existence of a hydropower installation at Pangani Falls, which relied partly on the rivers originating on Mount Kilimanjaro (Teale and Gillman, 1935). The second reason was the growing Chagga population which needed more land to cultivate. The lands directly bordering the upland cultivation zone had been alienated and given to colonial settlers, thereby eliminating them as logical expansion areas for the Chagga population. In order to avoid conflict, the colonial government sought to open up other areas for the native population through settlement schemes.<sup>5</sup> To safeguard water supply for these planned schemes in the lowlands, the government attempted to control its use on the mountain.

The reports of both Teale and Gillman, and Kanthack recommended collecting more data and establishing formal institutions as a first step towards gaining that control. Their suggestions were to map the existing irrigation canals, to carry out a topographic and hydrographic survey, and to establish a Water Executive to oversee water use and irrigation development. These activities were started in 1937 with grants from the Colonial Development Fund (Colonial Office, 1938) but ended by 1941 due to World War II.

After the war, Britain started its "second colonial occupation" (Low and Lonsdale, 1976) and activities were resumed with a new urgency. The Water Executive was replaced by the Department of Water Development,<sup>6</sup> and the topographic and hydrographic surveys were resumed (DWD, 1946: 8; Halcrow and Partners, 1962: 2). A grant was also obtained for the "improvement of furrows"<sup>7</sup> in the uplands, which was the first of many state efforts to modernise existing farmer-initiated canals. In addition, pre-war plans for a settlement scheme between the Rau and Mue Rivers were revived (see Figure 2). The plan as presented in 1939 consisted of 14,450 ha, out of which 1530 would be irrigated. The remainder was designated for use as grazing land or for rain-fed agriculture. After delays due to World War II, the project was revived in the late 1940s. The objectives were multiple but it was primarily about resettlement, as expressed by the Assistant District Officer in Moshi: "it will relieve congestion in part, show an act of faith by Government, and exemplify or teach the methods by which the bigger area with some three times as many landless should be tackled".<sup>8</sup> The construction of the main furrow finally began in 1950<sup>9</sup> but the project was never finished. Upstream soil erosion caused siltation of the canals and as a result the project was abandoned.<sup>10</sup> The idea of resettlement persisted however, and attention shifted to the west side of the Rau River with the Uru Chini scheme (see Figure 2).<sup>11</sup>

<sup>5</sup> Rhodes House Collection, Oxford: Mics Afr. 472. Reel 3, Kilimanjaro (Moshi) District Book, Vol I; Native Agriculture Moshi District, R.J.M. Swynnerton, 1945.

<sup>6</sup> Rhodes House Collection, Oxford: MSS.Afr.S.1006. Water development and irrigation in Tanganyika, 1961, J.C. Ramsay.

<sup>7</sup> The National Archives, London; Public Record Office: CO 691/208/1. Ten year development and welfare plan for Tanganyika, 1950, p. 24.

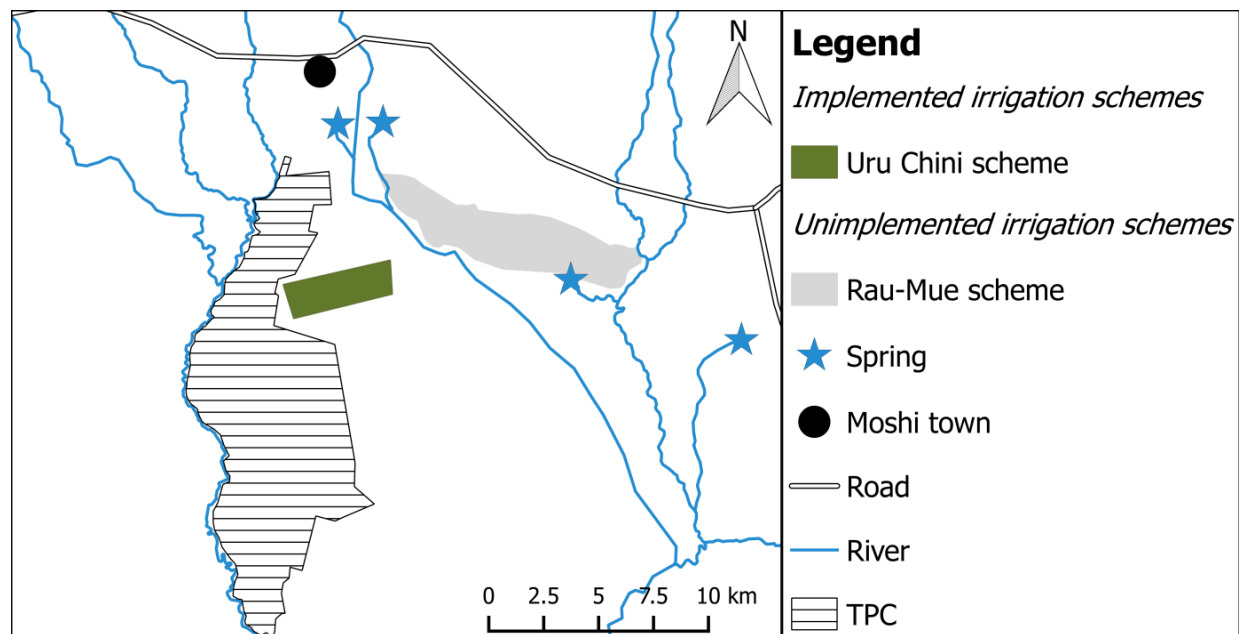
<sup>8</sup> Tanzania National Archives, Dar es Salaam: Acc No. 5, file no. 24/17, 1947-1950, File title: Development of lower areas: Notes on a brief survey carried out in March 1949 of the area affected by the proposed Rau-Mue irrigation and settlement scheme. To the Provincial Commissioner. From the Assistant District Officer, Moshi, 15 March 1949.

<sup>9</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 24/17. File title: Development of lower areas. Letter from M.G. Lewis, District Commissioner, Moshi, to the Waitori of Hai and Vunjo, Wachagga, Moshi, 13 February 1950.

<sup>10</sup> Rhodes House Collection, Oxford: MSS. Afr. S. 1001(2). Report of the land use survey team on the Chagga expansion area south of Mt. Kilimanjaro, 1956. Stubbings, B.J.J. (team leader of the survey team), pp. 4-5.

<sup>11</sup> For a more elaborate historical narrative on the Uru Chini resettlement scheme, see Chuhila (2016)

Figure 2. Location of the planned Rau-Mue and the implemented Uru Chini schemes (the former based on a 1939 map from the Tanzania National Archives: Acc. No. 5, file no. 24/17).



The complete Uru Chini resettlement scheme was supposed to cover about 1000 ha, of which one third was planned to be irrigated.<sup>12</sup> The pilot scheme, construction of which started in 1954, covered a much smaller area (about 200 ha)<sup>13</sup> and received some mixed reviews. While the Divisional Engineer Northern Province wrote to the District Commissioner to comment on the "clean and neat state of the channel" and the "well designed and adequate" channel layout,<sup>14</sup> an FAO employee wrote that the results were "far from being satisfactory" and that he did "not think that the local population if left alone, [could] make a success of the irrigation project".<sup>15</sup> Interestingly enough, both these men wrote these comments after going on the same field visit. In the end, the scheme failed to attract farmers, largely due to disagreements about water and land fees (Halcrow and Partners, 1962: 59). In 1957, it led the Mangi of Uru<sup>16</sup> to remark that "if it hadn't been for this scheme, there would be nothing but [fields] here as far as you can see".<sup>17</sup>

<sup>12</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 20/16 I. 1955-1959 Vol III. File title: Expansion of Chagga lands (Uru Chini, Rau-Himo areas). Letter from the District Commissioner, Moshi, to the Provincial Commissioner, Northern Province, Arusha, 6 July 1956.

<sup>13</sup> Tanzania National Archives, Dar es Salaam. Acc. No. 5, file no. 20/16 II. 1954, Vol II. File title: Expansion of Chagga lands (Uru, Rau, Himo). Lower Uru Area, Moshi District, N.P. Pilot Scheme, stage 1. To the Engineer Hydrologist, Water Development Department, Moshi, 9 July 1954.

<sup>14</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 20/16 I. 1955-1959, Vol III. File title: Expansion of Chagga lands (Uru Chini, Rau-Himo areas). Letter from Divisional Engineer Northern Province to the District Commissioner, Moshi, 26 October, 1956.

<sup>15</sup> Tanzania National Archives, Dar es Salaam: Acc.no. 4, file no 45/4. 1952-1958. File title: Irrigation. A. De Vajda, Fao, Rome. Notes on a short visit to the Pangani project area on the 24th to 25th October, 1956.

<sup>16</sup> A Mangi was a chief of the Chagga people, in this case of the Uru area.

<sup>17</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 20/16 I. 1955-1959, Vol III. File title: Expansion of Chagga lands (Uru Chini, Rau-Himo areas). Letter from the District Commissioner to the Provincial Commissioner, Arusha, 13 May 1957.



The justifications for interventions proposed during the 1930s, 1940s, and 1950s illustrate the narrative that supported state irrigation planning during those decades. The two irrigation schemes in the Lower Moshi area show the priority that resettlement had over other development objectives in the early days of government irrigation development planning. The elaborate surveys and designs that preceded the (attempted) implementation of the schemes can be seen as attempts of the state to make the area legible and thereby ready for technical intervention. Both schemes were designed to combine rain-fed agriculture, cattle raising, and irrigated farming, in order to accommodate as many people as possible. They were not meant to irrigate as much land as possible, or to raise productivity of high-value crops. The political issue of land shortage on the mountain slopes due to land alienation by colonial settlers was translated into a technical problem: the unsuitability of lowland areas for agriculture. This could be remedied by irrigation-based settlement schemes which would benefit the local population. This is a narrative specific to this period.

However, many later irrigation development narratives which link the problem of water shortage to technological upgrading and institutional formalisation, have their roots in this period as well. The Uru Chini project, for instance, gives an indication of how important technology was for the involved engineers, with one even proclaiming success before a single crop was grown. This emphasis on engineering, together with the conviction that more control would help to save water, led to the start of 'improving' earthen canals by lining them with concrete and installing division boxes, permanent intakes, and measurement structures. By conceptualising farmers' irrigation initiatives as wasteful due to their inferior technology, interventions to 'improve' them were justified. At the same time, the assumption that water could be saved through technical interventions meant that political questions about water allocation could be avoided. This kind of project continues until today, although there is little evidence that 80 years of improvement projects have led to a more equitable distribution of water between upstream and downstream users, or to a more productive use of water resources (Lankford, 2004; Machibya and Mdemu, 2005). The Water Executive, and subsequently the Water Development Department, were the start of formalising irrigation development and controlling water use, both at a regional and national level. They culminated in today's water basin authorities, the Ministry of Water and Irrigation and the National Irrigation Committee. The attempt to levy water fees and charge rent for land was a first try at implementing cost recovery measures within an irrigation scheme, an idea that persists among policy makers globally today (Easter and Liu, 2007).

### **PRODUCTIVITY AND DEVELOPMENT (1955-1988)**

After 1955, the government narrative shifted away from portraying irrigation development as a way to alleviate population pressure and avoid unrest. Instead, it became a way to increase productivity and to contribute to the economic development of the nation. The colonial state ordered large studies that were to investigate the suitability of different areas for irrigation development, and irrigation was part of regional development plans. These studies formed the basis for the irrigation development policy and interventions of the independent government after 1961, which have had a lasting effect on shaping the current landscape of the Lower Moshi area.

The investigations into the possibilities for large-scale water development in the Pangani River basin had already started in 1950,<sup>18</sup> but initially all major projects were rejected because of lack of hydrological data, the inability to control upstream abstractions, and the unsuitability of soils in a large

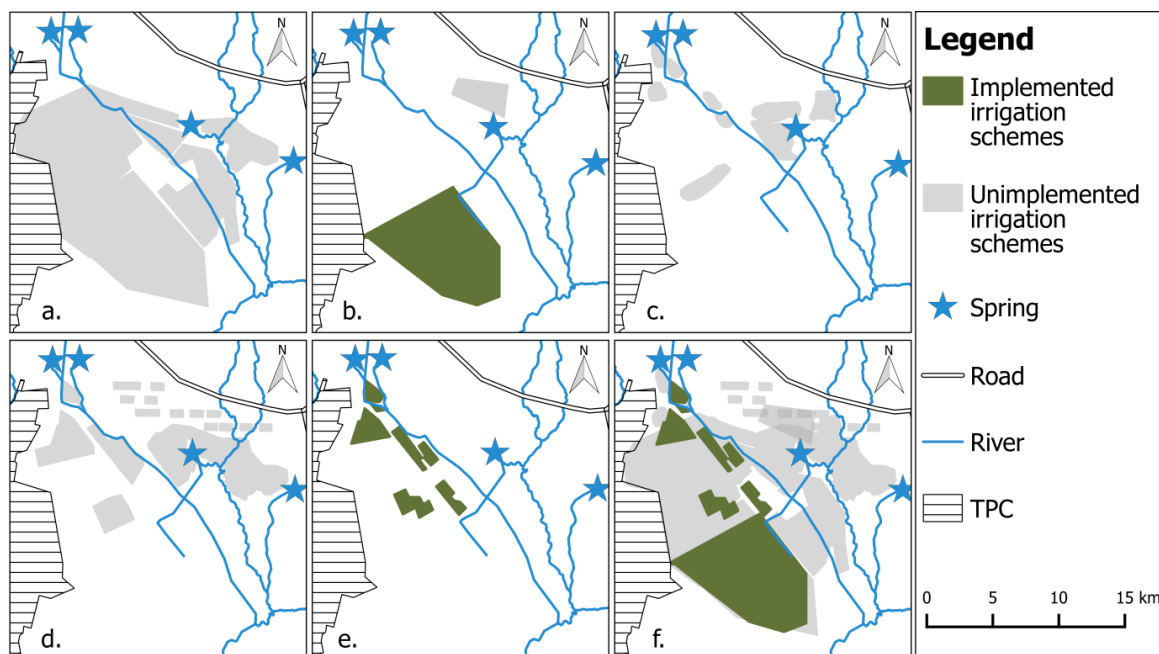
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<sup>18</sup> The National Archives, London; Public Record Office: CO 691/208/1. Ten year development and welfare plan for Tanganyika, 1950, p. 30.

part of the basin.<sup>19</sup> In 1955, it was decided to create a reservoir for hydropower generation and irrigation at Nyumba ya Mungu (DWDI, 1956). The water storage in this reservoir during the rainy season enabled irrigation development in the Lower Moshi area, where before none was possible due to the obligation to secure water for the downstream Pangani Falls hydropower plant (cf. Lein, 2004). Construction started in 1964 and was completed in 1966 (WDID, 1966).

The consultancy firm of Sir William Halcrow and partners designed the Nyumba ya Mungu dam and was asked to assess where best to develop irrigation schemes after the dam was built. They gave the highest priority to the Lower Moshi area, where they deemed large tracts of land suitable for irrigation (see Figure 3a) (Halcrow and Partners, 1962: 68). After more than ten years of various studies, their report was published in 1962. The newly independent government applied for funds from the United Nations to conduct a four-year study for further investment in the Pangani basin, including two pilot schemes (Kahe and Miwaleni) in the Lower Moshi area as the start of larger irrigation development. The 3200 ha project in Kahe would use water from a spring, while the 800 ha site in Miwaleni would depend on groundwater (see Figure 3b). Initially, the crop rotation was planned to be a mix of food (maize, beans, millet), cash (cotton, kenaf), and fodder crops (lucerne), and was to be used to settle smallholder farmers from the uplands (WDID, 1969). It was not just a settlement scheme however, as the elaborate research into irrigation methods and crop rotations shows: this scheme was meant to boost the regional economy, with decongestion of the mountain as an added benefit. As Halcrow and partners put it, the agricultural research was necessary "if the degradation of the new projects into *mere subsistence schemes* [was] to be avoided" (Halcrow and Partners, 1962: 11, emphasis added).

Figure 3. Maps illustrating the different (proposed) irrigation schemes from 1955-1988: a) Halcrow and partners, 1962; b) Kahe canal scheme and Miwaleni groundwater scheme, 1968; c) Kilimanjaro Water Master Plan, 1977; d) Lower Moshi Agricultural Development Plan, 1980; e) Lower Moshi; f) All projects over the 1955-1988 period combined, illustrating that only a few of the planned/suggested schemes were implemented.



<sup>19</sup> Tanzania National Archives, Dar es Salaam: Acc. No. 5, file no. 45. 1950. File title: Water policy general. Report on the results of the surveys of the Pangani River Basin by Sir William Halcrow and Partners, 15 May 1952.

In spite of initial plans to make Kahe a smallholder scheme, the government decided to hand over the project to the National Development Corporation to grow the fibre crop kenaf on a commercial basis. The main motivation for this shift was the government's desire to produce its own natural fibre sacks for storing crops, rather than importing them. This was the start of the East African Kenaf Industries Ltd (EAKIL) (Rudengren, 1981). Of the planned 3200 ha, only 1600 ha were in fact taken up by EAKIL and only 570 ha had been developed for irrigation by 1974. In 1975, the northern half (about 2000 ha) was transferred to the National Agriculture and Food Corporation, which started maize and dairy farming in that location (*ibid*). Currently the land is used for sugar cultivation by the Tanganyika Planting Company and smallholder farmers have developed an irrigation system downstream using the same canal.

The Miwaleni groundwater scheme of the 1960s was never implemented due to the high costs of pumping (Boeree, 1972: 72). The idea did resurface again in the Lower Moshi Agricultural Development Plan of 1980 but was rejected for the same reason. Since the early 2000s however, smallholder farmers have individually started using groundwater for irrigation in the area previously destined for the Miwaleni scheme. They rely on shallow dug wells and petrol-fuelled pumps, and cultivate maize, beans, tomatoes, and onions.

In 1977, the Kilimanjaro Region Integrated Development Plan was published, of which the Kilimanjaro Water Master Plan was an integral part. These plans again focused on the Lower Moshi area (see Figure 3c) and formed the foundation for the Lower Moshi Agricultural Development Project (see Figure 3d). The project plan proposed increasing the total area of arable land by just under 600 ha, while building infrastructure to irrigate 6320 ha. Most of the land covered by the Lower Moshi Irrigation Scheme was previously rain-fed (4075 ha), but 1650 ha were already irrigated by farmer-initiated canals, which were meant to be replaced by 'modern' irrigation technology. The overall objectives of the scheme were to contribute to food self-sufficiency and to stimulate rural development by raising farm income, providing better infrastructure, and creating employment opportunities (URT/JICA, 1980: 41). Parts of this project were realised with the completion of the Lower Moshi Irrigation Scheme (LMIS) in 1987 (see Figure 3e). The gravity canal schemes on the Rau River were selected over groundwater or pump schemes due to the higher internal rate of return, a lower construction cost per hectare, and lower operational costs (URT/JICA, 1980: S1). The resulting LMIS is a smallholder scheme in which rice is the dominant crop. The project introduced the use of high-yielding varieties and input-intensive agriculture to the Lower Moshi area, practices which were quickly adopted by farmers in the surrounding areas. This has led to the expansion of irrigated areas and the intensification of cultivation upstream of the Lower Moshi Irrigation Scheme. These developments have in turn led to water shortage in the scheme itself.

From the Kahe Kenaf estate, to the Lower Moshi Irrigation Scheme, to the unimplemented groundwater schemes, all projects in this period were built or rejected on the grounds of their expected ability to turn a profit. There was increasing attention to what was needed to grow cash crops and to connect these areas to markets. In the case of the Kahe scheme, a conscious decision was made to operate it as a state farm, in order to maximise production of a commodity which would otherwise have to be imported. Self-sufficiency and economic development were the main goals throughout. Underlying all these interventions and objectives was the assumption that existing agriculture in the Lower Moshi area could not be profitable or productive without a transformation through irrigation scheme development. This seems not to be based on research as much as on the conviction of the engineers and officials involved, as none of the studies included a profitability or productivity assessment of the existing farmer-initiated schemes.

The investigations leading to all the schemes in this period were already started in the 1950s but were only completed in the early 1960s. When Tanzania gained independence in 1961, the new government continued its work based on these colonial surveys, a fact which illustrates the continuity in irrigation policy between the colonial and post-colonial state. The Arusha Declaration in 1967, and the following decades of African socialism under Julius Nyerere, emphasised agriculture as the

foundation for development (Nyerere, 1967). The role of irrigation in this strategy, together with the use of improved seeds and fertiliser, was to "trigger a revolution in agriculture" (Lwegarulila, 1974: 11) which would help the development of the country's economy. In this respect, the emphasis on irrigation and the heavy investment in it matches the country's political strategy. However, the same Arusha Declaration praises the hard work of rural communities who have built their own development projects, such as canals, without waiting for government assistance (Nyerere, 1967). Contrary to what one might expect, this did not lead to a changed attitude towards farmers' irrigation initiatives, nor did it change the state-centred approach to irrigation development.

The problem that irrigation development was to tackle in this period was no longer land shortage but rather lack of economic growth. The narrative was that the increased production of cash crops relying on irrigation in organised schemes where production and marketing could be controlled would lead to more efficient use of water, producing more value per drop. The faith in these formally engineered schemes as the engine of national development excluded farmers' irrigation initiatives as a viable option for agricultural production. Ideas of farmer-built canals as inefficient and primitive persisted, and during the construction of the Lower Moshi Irrigation Scheme existing canals were demolished to make room for the formal scheme.

### **DECENTRALISATION AND WITHDRAWAL OF THE STATE (1988-2006)**

The Lower Moshi Irrigation Scheme was the last main public irrigation project in the Kilimanjaro Region. It was followed by 20 years of reduced government interest in irrigation, accompanied by the decentralisation of agricultural planning, the rising popularity of participatory approaches, and the prioritisation of rehabilitation over the construction of new schemes.

In the Lower Moshi area, the lack of interest in irrigation was reflected in the absence of new project plans. The biggest project proposal was for a second phase of the Lower Moshi Irrigation Scheme, which would depend on the transfer of water from the Kikuletwa River some eight km away (Nippon Koei and Pasco International, 1998). However, due to opposition from downstream water users, primarily the hydropower plants, the water abstraction was rejected by the Pangani Basin Water Office in 1998 (Lein, 2004). There were attempts to revive the project in 2003 (URT, 2003a), but these were unsuccessful and the project never materialised. A much smaller project took place in the southern part of the Lower Moshi area, where farmers who had lost access to water from the Rau River after the LMIS was built (Beez, 2005) asked the NGO Environcare to help them with the construction of a weir and intake structure on the Dehu River. The 2004/2005 budget speech of the Ministry of Agriculture claims that this intervention led to the Kimwangamao Irrigation Scheme, covering 1200 ha of irrigated agriculture (URT, 2006b), but in reality no more than 150 ha are irrigated.

Nationally, the general participatory and decentralised approach to irrigation planning followed international trends in development programmes, which responded to disappointing results in African irrigation projects in the 1970s and 1980s (Diemer, 1990; Diemer and Vincent, 1992). These led to strong criticism of large public irrigation schemes and the reluctance of donor agencies to fund such projects. The failures were largely attributed to a mismatch between farmers' and government's perceptions of what irrigation should be, and the exclusion of farmers from the planning process of development projects. This led to an emphasis on farmer participation and bottom-up/demand-driven development. In Tanzania, the 1994 National Irrigation Development Plan (NIDP) reflected this attitude when stating that "three main irrigation development priorities [had] been identified *based on a grass roots demand-driven approach*" (URT, 1994: 11, emphasis added). The first of these priorities was the "rehabilitation or upgrading of traditional irrigation schemes" (ibid: ii). The World Bank-funded River Basin Management and Smallholder Irrigation Improvement Project (1996-2002) drew on this plan and aimed (among other things) to "reduce the Government's involvement in smallholder traditional irrigation to a more 'hands off' approach" (URT, 1996). Other large-scale projects were the Participatory

Irrigation Development Programme (2000-2007) and the Participatory Agricultural Development and Empowerment Project (2003-2010), which focused on rehabilitation and water user association strengthening (IFAD, 2007).

Alongside the shift to participatory approaches and rehabilitation rather than new scheme development, the 2001 Agricultural Sector Development Strategy devolved irrigation planning from the national to the district level. District Agricultural Development Plans were drafted to guide investment, and 70 to 80% of public funding was meant to go directly to the districts to "[empower] local government and communities to reassume control of their planning and implementation process" (URT, 2003b: 1).

Although irrigation development in this period had a less prominent position in national planning, the idea of irrigation as the engine for economic growth persisted. However, contrary to the previous period, the envisioned solution was as much organisational as technical. Influenced by the international development discourse, donor-funded projects and national policies followed a nominally participatory approach. While this gives the impression that farmers' irrigation initiatives would be positively recognised at the regional and national levels, and that any interventions would be aimed at empowering farmers, I would argue that this is not the case. First of all, the continued emphasis on infrastructural upgrading of existing farmers' irrigation initiatives shows that these were still considered to be inefficient and unable to contribute to agricultural development, unless they received external intervention to "arrest the (...) trend towards infrastructural inadequacy" (URT, 1994: ii). Secondly, the construction of standardised irrigation structures became strongly tied to the formalisation of water management institutions and water use rights. The 1996 River Basin Management and Smallholder Irrigation Project for example, selected sites for intervention based on a list of criteria, with the first one being "scheme organisation development and formalisation activities" (URT, 1996: 9). This approach to the improvement of farmers' irrigation initiatives in which formalisation of existing institutions is a key condition is still dominating Tanzanian irrigation policy today (URT/JICA, 2010). Finally, it is telling that the 1994 NIDP states that the "major and strategic objective" (URT, 1994: ii) underlying interventions in farmers' irrigation initiatives was the "conservation of water for the nation" (ibid: ii), not the improvement of the performance of such systems.

In spite of the rhetoric, policies and interventions in this period were not aimed at empowering farmers or even necessarily at improving irrigation performance, rather they were still part of the ongoing attempt by government to control water use by farmers' irrigation initiatives. Instead of an ideological shift, the withdrawal of the national government should be seen in the light of the structural adjustment programmes that started in the 1980s and the reduced amount of funding that donors made available for agriculture in general. What did change was the increased attention to the design and formalisation of water management institutions, a development which reflects the cementing of social science as part of the expert knowledge deemed relevant for irrigation development.

### **RENEWED STATE AMBITIONS AND ENGAGEMENT WITH THE PRIVATE SECTOR (2006-2017)**

In 2006, the Tanzanian government published a document outlining the Agricultural Sector Development Programme (ASDP) for the period 2006-2013 (URT, 2006a). This programme was designed to support the implementation of the 2001 Agricultural Sector Development Strategy (URT, 2001) and outlined the different interventions to be funded from an agricultural-sector basket fund. The focus on irrigation development in this programme is unmistakable: 79% of the US\$2 billion budget was allocated to either district or national irrigation development planning, with 60% going to irrigation projects at the district level, and 19% going to national-level projects. This clearly shows that the decentralised approach to irrigation development was still dominant, but also that the state had renewed its ambitions in the field of irrigation. In the 2016 second Agricultural Sector Development Programme, the budget share for irrigation decreased to 19%, with large sums of money going to value

chain development, improving access to agricultural inputs, and improving food security (URT, 2016b). This reflects the ambition to incorporate smallholders into international cash crop value chains.

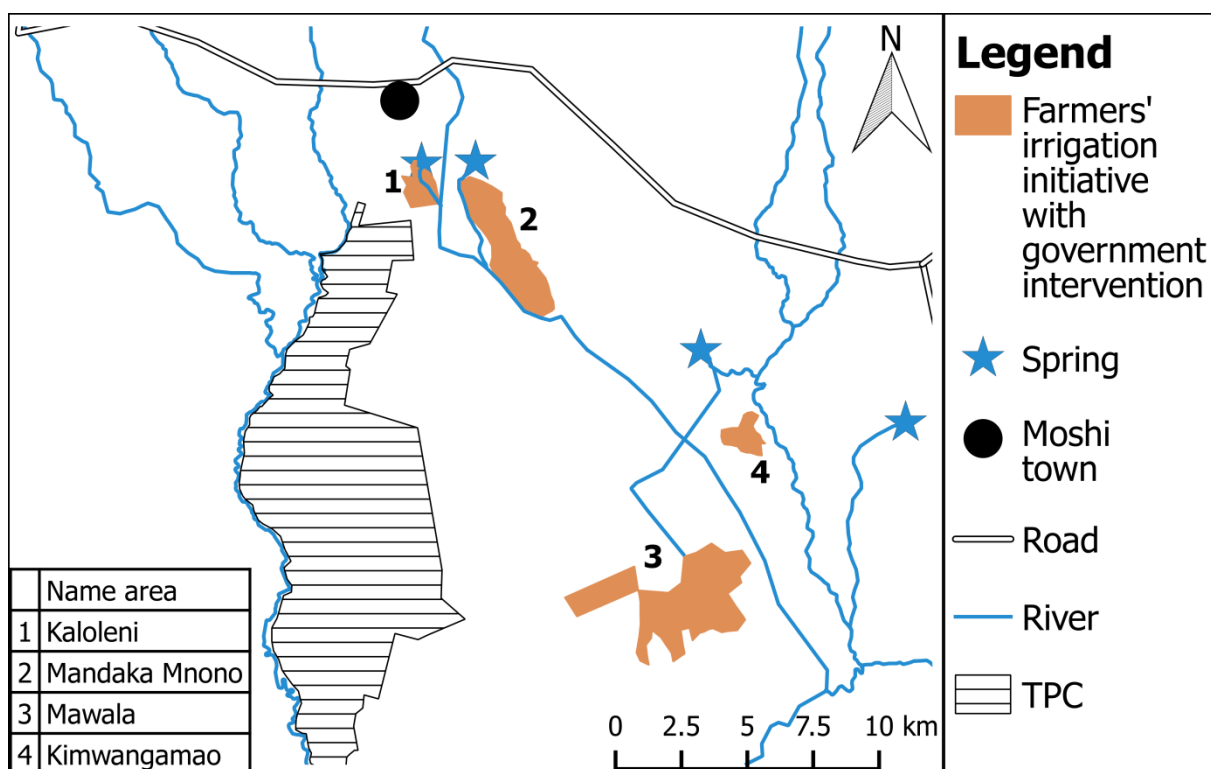
Besides the increased funding for irrigation, the first and second ASDP also brought a new emphasis on the importance of the inclusion of the private sector in financing irrigation development. This new emphasis was in line with the promotion of public-private partnerships (PPPs) in the global irrigation and development sector (FAO, 2016; Playán et al.; 2018), and largely the result of a strong push by donors contributing to the ASDP basket fund, with the World Bank being the largest (Therkildsen, 2011). As part of the inclusion of private actors, national-level irrigation funds were not only expected to lead to an additional 441,000 ha under improved water management, but were also meant to increase the share of private capital investment in irrigation to 75% (URT, 2006a). To facilitate this, Tanzania adopted the Public-Private Partnership Act in 2010, in which irrigation is explicitly named as one of the sectors in which PPP projects are to be undertaken (URT, 2010a: 8). New irrigation targets were formalised under the 2009-2015 Kilimo Kwanza (Agriculture First) programme, which aimed to "modernise and commercialise agriculture for peasant, small, medium and large scale producers" (URT, 2009: 1). Part of this modernisation and commercialisation was to happen through irrigation development, and the programme had the ambition to expand irrigated agriculture in Tanzania to 7 million ha. Kilimo Kwanza was followed by the 2013 Big Results Now Initiative, which strives to implement 78 "professionally managed irrigation schemes" in order to raise rice production and commercialise smallholder farming (Big Results Now, 2013). Most recently, the 2016 National Irrigation Development Strategy is meant to support the development of irrigation on 300,000 ha annually (URT, 2016a).

In all these programmes and policies, involvement of the private sector was put forward as the best way to increase the level of investment in irrigation development in Tanzania. However, in spite of the strong donor push towards the PPP strategy, the more traditional state-centred approach was in no way marginalised, especially when it came to smallholder irrigation. The 2016 National Irrigation Development Strategy still defines farmers' irrigation initiatives as 'traditional': "characterised by poor infrastructure, poor water management and low yields" (URT, 2016a: 7). This means that farmers 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" (ibid: 11, *emphasis added*). 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). The state's negative attitude towards irrigation development by smallholder farmers is further showcased in the 2013 National Irrigation Act, which states that: "no works shall be constructed until the proposed scheme of the undertaking has been submitted to the Commission for approval and such project is subjected to the Environmental Impact Assessment as provided for under the Environmental Management Act" (URT, 2013: 22). In addition to the environmental impact assessment, an applicant is required to provide a design report, a list of drawings, a bill of quantities, and a water use permit. These requirements, for which no exceptions are made, make it virtually impossible for farmers to legally develop irrigation. Although it is unlikely that this law will be enforced rigorously when it comes to smallholder farmers, it does show that the state's envisioned relationship with farmers has not changed.

In the Lower Moshi area, this continued ambition to formalise the infrastructure and management of farmers' irrigation initiatives, combined with the increased funding and renewed attention for irrigation, was translated into a range of improvement projects for existing farmer-initiated systems (see Figure 4). In the irrigated rice areas in the Kaloleni and Mandaka Mnono villages upstream of the LMIS, concrete intake structures and lined canals were built in 2009 to control abstractions and prevent water losses (URT, 2008). The hope was that this would free up water for the LMIS and reduce conflict

between the scheme and the upstream farmers. Similarly, water division structures and lined canals have been put in place in some parts of the farmer-initiated Mawala Irrigation Scheme since 2011, in an attempt to reduce conflict within the scheme and between the scheme and the upstream sugar estate of TPC. Finally, the main canal of the Kimwangamao irrigation system was lined in 2011 (PPRA, 2011) to enable irrigation over a larger area. In all these irrigation areas, the government also set up formal organisations for scheme operation and maintenance and issued formal water use permits. These interventions show that the modernisation strategy aimed at water savings and technical and organisational control that was first used during the colonial period is still present in Tanzanian irrigation planning.

Figure 4. Farmers' irrigation initiatives in the Lower Moshi area that were the target of government intervention.



The best expression of the new PPP policy direction for agricultural and irrigation development is Tanzania's main agricultural development project of recent years: the Southern Agricultural Growth Corridor. First initiated in 2010, it received the bulk of its funding in 2016 and covers a large area along the railway running from Dar es Salaam to the northern parts of Zambia. It is a public-private partnership "explicitly designed to achieve higher rates of income growth and job creation through the development of competitive agribusiness value chains across the Southern Corridor" (World Bank, 2011: 1). The underlying idea is to modernise smallholder farmers by connecting them with agribusinesses in projects that are largely funded with private capital and supported by donors and the government. Implementation has been slow (World Bank, 2017), but this has not reduced the ambitions of donors or the government, and it can be expected that the PPP approach to development will remain dominant in the upcoming years.

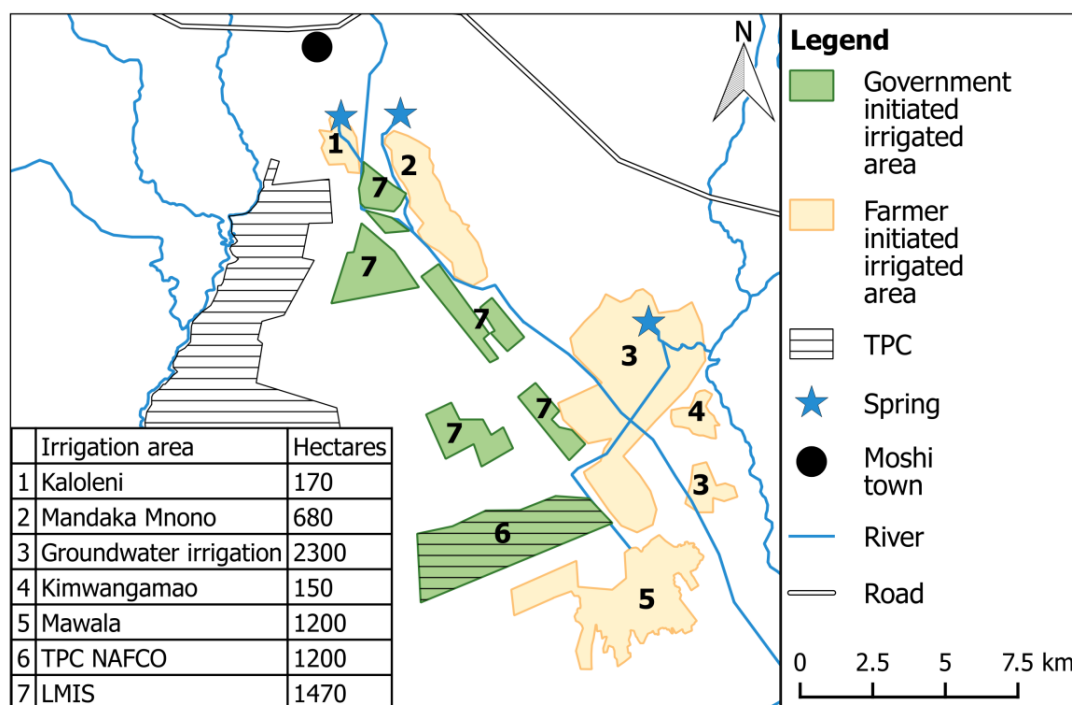
Similar to the previous period, the biggest shift is not in how things are problematised but rather in what way they are rendered technical and what kind of experts are required. The problem, still defined

as low agricultural and economic productivity, now requires the involvement of the private sector. A new group of non-state actors is called upon to facilitate the modern, productive irrigation systems that are still at the core of intervention. At the same time, irrigation improvement projects in which farmers' irrigation initiatives are formalised, both technically and institutionally, are also still ongoing. While the private sector is a new actor in Tanzanian irrigation policy, its inclusion is more of an addition to the state-centred approach than a radical break with previous attitudes.

### THE LOWER MOSHI AREA IN 2017

After eight decades of state intervention and continuous farmer-led irrigation development, the Lower Moshi area has been transformed from a sparsely inhabited dryland area to a hotspot for irrigated agriculture. However, when comparing the areas currently under irrigation resulting from state irrigation planning, with those areas where irrigation was developed by farmers in the same period, it is clear that farmers have been more successful: the irrigated area initiated by farmers is 1.7 times larger than that initiated by the government (4500 ha vs 2670 ha). When excluding the TPC NAFCO estate, which is not serving its original purpose as a national estate but has been transferred to a Mauritius-based company, the area developed by farmers is three times larger (4500 ha vs. 1470 ha) (see Figure 5).

Figure 5. State-initiated and farmer-initiated irrigation areas in the Lower Moshi area in 2017.



Note: Area 6 was state-initiated and is now operated by TPC. (based on field observations, satellite images, and mapping exercises in 2015-2017, as well as irrigation development plans – excludes very small or seasonal schemes)

The state's plans and interventions have had questionable results at best, both because they have not materialised and because the expected outcomes of implemented projects (in terms of productivity increase, for instance) were not realised. The Lower Moshi Irrigation Scheme is the only area that is still farmed by smallholder farmers. The area that was developed as part of the Kahe irrigation scheme was transferred to the Tanganyika Planting Company in 1999 and is now used for large-scale sugarcane



production. Meanwhile farmers have developed irrigation systems upstream and downstream from the state-initiated irrigation areas. Contrary to the government irrigation schemes, farmers' investments were gradual and responded to water availability, changes in technology, and emerging markets. The surface irrigation areas upstream from the Lower Moshi Irrigation Scheme (Mandaka Mnono and Kaloleni) and downstream from the Kahe irrigation scheme (Mawala), for instance, copied the rice cultivation system and the rice varieties that were introduced in the LMIS. In Mawala, farmers began digging canals once the main canal for the upstream estate (now TPC) started carrying water from the Miwaleni Spring. In the area neighbouring the LMIS, individual farmers developed shallow groundwater irrigation as pumping technologies became available and the market for vegetables grew in nearby cities. Where the government's new irrigation schemes were generally large-scale one-time investments, farmers' schemes developed organically and opportunistically within the existing landscape. While doing this, they also built on the knowledge and infrastructure brought by government schemes, showing again that farmers do not develop irrigation in isolation (cf. Woodhouse et al.; 2017).

Whether the main crop is rice, vegetables, maize, or beans, all the farmer-initiated schemes are contributing to the government's targets of food security and rural development. In spite of this, they are undervalued (canal irrigation) or ignored (groundwater irrigation) in national policies. Maize yields in the Lower Moshi area are a case in point. While the Tanzanian irrigation policy states that farmer-initiated irrigation schemes do not produce more than 1 ton/ha (URT, 2010b: 7), a recent study on farmer-initiated groundwater irrigation in the Lower Moshi found farmers harvesting up to 5 tons/ha, although most harvested around 2 tons/ha (de Bont, 2018). In addition, the same study showed that the months of food shortage among irrigators were one third those who did not have access to irrigation. Due to the dominant technocratic paradigm, policy definitions of farmer-led irrigation development and expectations of its possible contributions to national development have remained consistently negative, and based on assumptions rather than research.

## CONCLUSION

In this paper, I have outlined four distinct periods of state irrigation planning in Tanzania. I identified both stability and change in the state's attitude towards irrigation development by posing five questions: what problem irrigation development was supposed to address; what was considered to be good irrigation; what kind of knowledge was considered necessary for the development of good irrigation; what the 'expert' opinions about farmers' irrigation initiatives were; and what interventions were proposed. I showed how state-led irrigation development was proposed repeatedly as a solution but that the problems it was meant to address varied over time. In the narratives on state irrigation planning, water shortage was continuously framed as a problem caused by farmers' wasteful and inefficient irrigation initiatives which could be solved by technological and institutional interventions. Additional narratives varied over time as to what problem irrigation development was meant to solve. Before 1955, land shortages and overpopulation were the main reasons for developing irrigation, while since then low agricultural and economic productivity have been the focus. The major changes in later decades concerned who should be involved in irrigation development, with the role of the state decreasing in the late 1980s, and the private sector becoming included in the 2000s.

In spite of the different identified challenges, and the later questions regarding what roles different actors should play, the way in which they were rendered technical always led to the justification of similar state-controlled irrigation interventions: the construction of formally engineered irrigation systems and the 'improvement' and formalisation of existing farmers' irrigation initiatives. The type of knowledge that was considered relevant also did not undergo major changes: similar (feasibility) studies focusing on hydrological and agronomic conditions preceded all interventions. Land shortage due to colonial land alienation was translated into a problem of uninhabitable drylands, which could be

made accessible and profitable by irrigation. Water shortages, experienced because of increased downstream demands for hydropower, were framed as caused by unplanned expansion of wasteful farmer-initiated canals. The envisioned solution was based on prohibiting new canals, mapping existing canals, constructing intake structures, measuring abstractions, and taxing water users. Low agricultural and economic productivity was considered to be caused by traditional farming practices (including farmers' irrigation initiatives), which could be transformed by introducing irrigation schemes for cash crop cultivation. Similar interventions are still proposed today, although with a new emphasis on integrating smallholder farmers into international markets.

In spite of the dominant paradigm condemning or ignoring farmers' irrigation initiatives, these initiatives expanded at a faster rate than any public irrigation scheme. Reacting to opportunities created by increased water availability, new technologies, or new agricultural practices, farmers developed both surface and groundwater irrigation. In the cases where government did engage with these systems, the uniform interventions were guided by the ambition to formalise and control water use rather than to actually engage with the needs of different irrigation areas to improve their performance.

As early as 1987, Moris mentioned that modern irrigation had become a "privileged solution" in many African countries: "material and organizational technologies which seem self-evidently suited for dealing with problem needs" (Moris, 1987: 99). In Tanzania, a fixed type of irrigation intervention centring on formalisation and state control has been the privileged solution for a range of problems including overpopulation, low yields, and water shortage. Together with rather disappointing results, the many unimplemented schemes, and the success of farmer-led irrigation development, the question is raised: why has irrigation development based on formal engineering expertise been a focus point for the Tanzanian state over the last 80 years, often to the detriment (or at least not to the benefit) of farmers' irrigation initiatives?

I would argue that this question should be discussed in the wider frame of irrigation development planning in Africa, rather than as just a question of Tanzanian irrigation planning. The formal, institutionalised engineering expertise so overly present in Tanzanian irrigation development planning was first developed in British India as engineers were trained to serve the nation and achieve "scientific control over nature" (Gilmartin, 2003: 5058). From the start, the link between state intervention, science, and irrigation was firmly established, and engineers and engineering knowledge became prestigious because of it (*ibid*). As in this article, others have also argued that colonial ideas influenced post-colonial water management in the decades following independence (Diemer, 1990; Ertsen, 2008; Beattie and Morgan, 2017). Although Tanzania has had its own irrigation policies and master plans since independence, the country still functions within a network of international experts and donor agencies. This is not only evident in the national irrigation development plans which were funded by the UNDP and FAO (URT, 1994), and JICA (URT/Nippon Koei, 2002), but is also reflected in the changes in specific proposed interventions over time, which can largely be attributed to international shifts in irrigation and agricultural policies and donor priorities, and the knowledge paradigms linked to these. This emphasises the link between Tanzanian national politics and the international 'expertise' which has been able to define problems, solutions, and intervention processes across countries and environments.

The first shift from resettlement towards productivity and efficiency thinking aligns well with the start of 'development thinking' that emerged after the disappointing results of the second colonial occupation and during the transition of African countries towards independence. Partly to make communist ideas less attractive to developing countries, the international community was looking to support the emerging nations in transforming into 'modern' (capitalist) economies, and the rural population had to be lifted out of poverty through productive and commercial agriculture (Hodge, 2007). The withdrawal of the state that characterises the next shift can largely be explained by the structural adjustment programmes Tanzania went through, and follows general trends in rural

development as outlined by Ellis and Biggs (2001): less state involvement, more NGO activity, and participatory approaches. The return of irrigation to the policy agenda in the mid-2000s is also observed at a larger scale. The World Bank has doubled loans for irrigation development between 2000-2005 and 2006-2010 (You et al.; 2011), for instance, and the New Partnership for Africa's Development (NEPAD) identified irrigation development as one of the focus areas for pursuing increased and sustainable productivity in agriculture (NEPAD, 2009). Finally, the current emphasis on private sector involvement is in line with the multi-stakeholder or public-private partnership approach that has gained ground since the 2002 World Summit on Sustainable Development in Johannesburg, South Africa (Biermann et al.; 2007) and also became popular in the irrigation sector worldwide (Playán et al.; 2018). Following these international trends, many of the processes and policy shifts in this paper will be familiar to those scholars, practitioners, and policymakers dealing with irrigation in the Global South. As such, Tanzania is not an isolated case of irrigation planning, but rather is an example of the broader persistence of certain types of expert knowledge and state-centred approaches to irrigation development. The recent introduction of the private sector into irrigation policies might have shifted the sole responsibility for irrigation development away from the state but, like previous changes, this seems to have been strongly donor influenced rather than a shift of conviction by Tanzanian policymakers.

In a broader sense, post-colonial African governments inherited not only colonial engineering knowledge but also the state-centred ideologies in which social problems were rendered technical and where technological optimism prevailed. It was this ideology that was most persistent, as is reflected in the continuity of the state's view that irrigation has to be planned by the state and based on formal engineering knowledge in spite of evidence of farmer-led irrigation development and the failure of many formally planned schemes.

The development narrative of 'modern' irrigation as a driver for agricultural transformation has been successful in depoliticising irrigation interventions and has succeeded in closing the debate on whether state-controlled irrigation development is really the best (or only) way to reduce poverty and stimulate economic growth. Re-politicising irrigation development requires foregoing the technocratic, privileged problems and solutions that are now prevalent, and instead making these the topic of debate. This would highlight how solutions that are promoted by formal experts as part of international development trends do not automatically result in the outcomes they promote. In addition, it would show how the focus of the state on controlling irrigation development does not maximise the area under irrigation, while farmers manage to develop irrigation in spite of a negative policy environment. Ultimately, to provide space for reflection on the role governments could possibly play in promoting, supporting, and regulating farmer-led irrigation development, future debates on African irrigation should start by recognising the unique contributions that can be made by farmers in realising the continent's irrigation development targets.

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