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Development Assemblages and Collective Farmer-Led Irrigation in the Sahel: A Case Study From the Lower Delta of the Senegal River

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ABSTRACT: In Sahelian countries, farmer-led irrigation development has contributed to the extension of irrigated areas in formerly state-led schemes, especially from the 1990s onwards. It has usually consisted of individual approaches, revealing the unequal capacities that farmers have had to develop irrigated agriculture. However, in some cases, farmers have performed collective practices geared towards achieving a more concerted and equitable management of resources. This article is centred on such collective enterprises. It is based on a case study from the delta of the Senegal River. In this region, where state agencies, donors, and investors have set the tone of irrigation development over the last decades, the concerted irrigation development led by the inhabitants of a small village (Thilène) can be considered to be a form of resistance. By drawing on the concepts of 'moral economy' and 'assemblage', and using 'comparative agriculture' methods, we situate the emergence of this collective action in order to understand who has governed it by what means or practices, and to know what have been its outcomes. We see these collective actions as an alternative irrigation development pathway to that led by the state and donors. The results highlight the contingent nature of these initiatives and the difficulties in implementing adapted policies to trigger or boost their emergence.

KEYWORDS: Irrigation, collective action, resistance, assemblage, Senegal

INTRODUCTION

In Sahelian countries, where irrigation development is relatively recent and has relied on massive hydraulic infrastructure and the implementation of large-scale schemes, farmers' initiatives have until recently largely gone unnoticed. While such initiatives have gained relevance in the agenda of international development organisations, recent high-level debates tend to convey the narrow idea of small-scale farmers as a homogeneous and static group waiting for adapted and accessible irrigation

technologies.¹ This trend must be seen in the light of dominant global donors' perceptions (notably that of the World Bank) of 'small-scale' or 'family' farmers. According to this approach, small-scale farmers are invited to play a central role in Sahelian agricultural development, but it is expected that they should do it in an 'entrepreneurial manner', following the example and 'spirit' of farming entrepreneurs or agribusiness firms, and creating 'synergies' with them.²

Yet farmer-led irrigation initiatives abound in various forms, including those that have emerged *within* large-scale irrigated areas. For example, in the public schemes established since the 1960s in the main river basins (including those of the Senegal and Niger rivers), farmers have performed adaptations and diverse forms of reappropriation in response to strict state supervision at different levels, from production and marketing to natural resources and hydraulic infrastructure administration. These adaptations – continually adapting to shifting ecological and social conditions – have included changes in crop choices and adjustments to the recommended agricultural operations, as well as taking advantage of gaps between state-codified resource management and the everyday web of local practices. Furthermore, from the 1980s onwards, in a context of state disengagement resulting from structural adjustment programmes, farmer-led irrigation development initiatives have also contributed to the extension of irrigated areas, a prerogative hitherto reserved to public agencies. Farmers' hydraulic initiatives have been inspired by previous state-led achievements, and have largely relied on existing primary infrastructure. They have very often involved mostly individual approaches that have brought to light unequal capacities that farmers have to develop irrigated agriculture. These processes have strengthened the view that farmer-led irrigation development is not inherently egalitarian and does not prevent exclusion (Woodhouse et al.; 2017). However, in some cases, farmers have engaged in collective practices geared towards achieving an alternative, more concerted, and equitable management of the commons, entailing a trade-off between two criteria when allocating new irrigable areas: ensuring that farmers' incomes increase without leaving anyone behind.

This article focuses on these collective enterprises. It explores both the conditions for their emergence and their economic and social performance in relation to the development goals usually set out by governments and donors, namely economic growth, food security, increasing farmers' incomes, and raising employment opportunities. Furthermore, these initiatives to some extent prevent current trends in Sahelian regions in which massive and accelerated private appropriation of land for agribusiness developments is taking place, often with the support of development agencies. With regard to this, can these initiatives be examined to show that local farmers are able to set the tone of what agricultural development is meant to be? It is from this perspective that the article also explores the contingency of these initiatives, and whether and how they can be scaled up.

In order to answer these questions, we first explore the problem of how farmers' driving role in agricultural and irrigation development can best be tackled. The ways in which farmer-led irrigation develops will be rethought according to a gradient going from almost purely individual adaptive practices, to changing socio-economic and environment conditions, to forms of deeper (collective) action or resistance. To understand how farmers and other parties are specifically involved in these contrasting ways of expanding irrigation in the Sahel, we present a case study whose analysis relies on the concept of 'assemblage' as developed by Tania Murray Li (2007b, 2014) and draws on 'comparative agriculture' methods (see next section).

¹ In this regard, see particularly the concept notes, the preparatory documents, or the diverse works resulting from, the "Water for Food International Forum // Farmer-led irrigated agriculture: Seeds of opportunity", held January 29-30, 2018 at the World Bank in Washington DC.

² It is worth mentioning that donors' approaches are diverse and evolving. Some are progressively considering the specificities of family farming and the complexity of the environment, as well as the social relations determining farmers' practices in particular contexts, including irrigation.

We then focus on those aspects of the case study concerning the development of irrigated agriculture in the lower delta of the Senegal River and, more specifically, in two neighbouring villages, Thilène and Ndelle. The following section presents the historic background of this development. As elsewhere in the delta, at the end of the 1970s the floodplains of Thilène and Ndelle were converted by the state into irrigated rice plots granted individually to all local families according to their size. However, in a context of population growth and declining public investment, irrigated areas rapidly became insufficient to generate adequate income levels, to ensure the continuation of farms, or to enable the installation of young farmers.

The following section analyses how, given these constraints, the inhabitants of Thilène have taken the lead in the development of irrigation. In particular, from the 2000s onwards they progressively set up a large irrigation scheme to grow fresh vegetables by undertaking successive hydraulic works to improve water supply. This section presents the conditions (ecological, hydraulic, and socio-economic) under which these achievements were possible. It also describes their main features and their impact on the agricultural development of Thilène. Allocation of irrigated plots will be described in detail to demonstrate how the criteria for allocation, while it remains strongly determined by the uneven distribution of resources and assets among villagers, also responded to the collective concern of satisfying the irrigable land needs of youth and land resource-poor households. The examination of the economic and social performance of the farms involved in this collective initiative makes it possible to determine whether irrigation development has enhanced its robustness or not (particularly in terms of income), and what has been the outcome in terms of differentiation or resource concentration at the village level.

The last section places the experience of Thilène in a broader context so as to determine to what extent the model it represents goes effectively against current trends of massive land appropriation by agribusiness development in potentially irrigable regions of the Sahel. Indeed, how has the very progressive land appropriation for irrigation development by and for the local population been possible in Thilène, when in other neighbouring villages a rapid and irreversible depletion of land reserves is occurring from which private investors are benefitting? The contingent nature of collective irrigation developments such as Thilène will be contrasted with the situation observed in the village of Ndelle, where a huge part of the village land reserve has been recently assigned to a farming investor. Finally, this will raise the question of whether these collective developments are reproducible or not, and under what conditions.

USING THE CONCEPT OF ASSEMBLAGE TO UNDERSTAND INDIVIDUAL AND COLLECTIVE FARMER-LED IRRIGATION INITIATIVES

Farmer-led irrigation development has been broadly defined as a "process where farmers assume a driving role in improving their water use for agriculture by bringing about changes in knowledge production, technology use, investment patterns and market linkages, and the governance of land and water" (Woodhouse et al., 2017).³ This driving role doesn't mean that other social agents (government agencies, supply companies, traders, etc) are left out of the process, but that they have a more subsidiary role. In the Sahel, farmer-led irrigation initiatives have notably emerged within rice-growing areas formerly developed by state agencies in the main valleys (Senegal, Niger, Nakambé, etc). However, they take a variety of distinctive forms and come under various overlapping domains: cultivation of vegetables and spices on the embankments separating rice fields, or in nearby parcels which illegally use water from the main hydraulic network; adaptation of planting decisions based on

³ In this paper we will use the term 'farmer' to refer principally to family farmers – those managing farms where labour is mainly supplied by members of the nuclear or extended family.

collective constraints (inputs supply, agricultural prices); informal arrangements for accessing and using irrigable lands; or the development of new irrigated areas without significant external support. In this paper we focus on this last, bearing in mind that all the above-mentioned practices are intricately linked.

Farmers' expansion of irrigated areas takes many different forms. In this article we distinguish them according to a gradient that goes from almost purely individual approaches, to more concerted and collective initiatives. Whether individual or collective, these initiatives represent, in the Sahelian context, responses to changes that have led to the erosion of farmers' income-generating capacities (recurring droughts, rolling-back of the state, market liberalisation, population growth, land pressure, etc). They never exist in a purely individual or collective form, but in many situations it is possible to identify which one is dominant.

Individual farmer-led irrigation initiatives most frequently are adaptations to the above-mentioned changing conditions. They often reflect farmers' uneven capacities to adapt, and so parallel local processes of socio-economic differentiation. While the better endowed with regard to resources, capital, and social relations can proceed easily and quickly, the costs of irrigation can be excessive for a large proportion of the less well-off farmers whose much lower accumulation rate often forces them to find more precarious ways to cope (unstable jobs as wage labourers, migration for employment, etc).⁴

On the other hand, farmers who participate in collective initiatives can bring together the necessary efforts for this type of agricultural development, which they could not carry out individually. Although the groups at the origin of these initiatives can be of very varied size (from a few neighbours to all the inhabitants of the same village) and are always characterised by varying degrees of heterogeneity, the individuals who form them share similar objectives, given the type of constraints that collectively weigh heavily on them. In other words, these initiatives emerge on the basis of a 'system of requirements' shared by the members of the group, which comes close to the concept of the 'moral economy of the peasants' (Scott, 1976). This may include imperatives such that everyone should be able to secure a sufficient income, or that common resources must be managed with the next generations in mind. Respect for this moral economy requires shared rather than individual actions in order that achievements by some individuals do not occur at the cost of excluding others. The effectiveness of such actions depends very much on the social and power structures which can strongly limit the agency of certain individuals or groups. In the Sahelian irrigation development arena, where interventions are mostly based on the prevailing power positions of state agencies, global donors, and, more recently, investors, (see next section), such collective initiatives contest the conventional 'right manners of disposing things'⁵ and create something new. Consequently, they cannot merely be described as forms of farmers' adaptation to changing conditions, but more as expressions of collective resistance and political demand.

Applying an 'analytical of assemblage', as conceptualised in other development areas by Tania Murray Li (2007b, 2014), can help to better understand the ways in which collective farmer-led irrigation initiatives emerge against the tide. In this article, borrowing from Li, we consider irrigation development in a given context as a "provisional assemblage of heterogeneous elements including material substances, technologies, discourses and practices" (Li, 2014). A range of different social agents or parties participate in irrigation development (farmers, daily workers, investors, government officials, experts, donors). However, the final shape that this assemblage takes hinges on practices or

⁴ In that regard, see for instance Woodhouse and Ndiaye (1991), Mathieu (1991), Dahou (2004), Le Roy (2006), or Adamczewski et al. (2011).

⁵ Michel Foucault described 'governmentality' as "the right manner of disposing things" to optimise the health and wealth of populations at large (Foucault, 2004, cited in Li, 2007a). These Foucauldian considerations are present in the analysis developed by Li to understand development situations (see below).

'bricolage'⁶ that stabilise, or bring coherence among, the different parties involved, and is underpinned by a social and power structure whereby some of these agents (investors, government officials, experts, donors) dominate or govern the others (see footnote 5). Using Li's approach, collective farmer-led irrigation development can be understood as a disruption of the dominant assemblage, where one of the parties (farmers), usually governed by the other parties, takes the lead in irrigation development.

IRRIGATION DEVELOPMENT ASSEMBLAGES ANALYSED WITH COMPARATIVE AGRICULTURE METHODS

Comparative agriculture aims to make sense of agricultural transformations around the world (Cochet et al., 2007). Its key concept is that of 'agrarian system' which correspond to "a way of exploiting an agro-ecosystem that is historically defined and sustainable, adapted to the bioclimatic conditions of a given area, and responding to the social needs and conditions of the moment" (Mazoyer, 1987, cited in Cochet, 2015). It explicitly incorporates the notions of 'agrarian crisis' and 'agricultural revolution', both particularly pertinent to "show[ing] the changes in the historical state and geographical adaptations of production processes, (...) to grasp the conditions of their emergence, their development, their disappearance, their linkages" (ibid).

Given the technical knowledge, and the set of rules and relationships governing market conditions, wealth distribution, and access to natural resources, the sustainability of an agrarian system depends on the ability of farmers to generate sufficient income to ensure their survival, as well as the surplus necessary to sustain their farms and to satisfy the needs of other social groups, while preserving the ecological balance of the cultivated ecosystems. Farmers intervene in the evolution of the agrarian system, with varying success and in interaction with other social agents. Their strategies evolve particularly when the circumstances become so contrary to their moral economy that without public action to prevent it the agrarian system would go into crisis.

The analysis of an agrarian system can be useful for situating assemblages such as the development of irrigation, be it individual or collective. It requires a multidisciplinary approach, integrating both the geographical and the historical dimensions of agricultural transformations. It should be done by using different scales of analysis to better understand internal heterogeneities, especially those existing between different farms, analysed as 'agricultural production systems' (Reboul, 1977; Cochet and Devienne, 2006) or 'activity systems' (Paul et al., 1994).

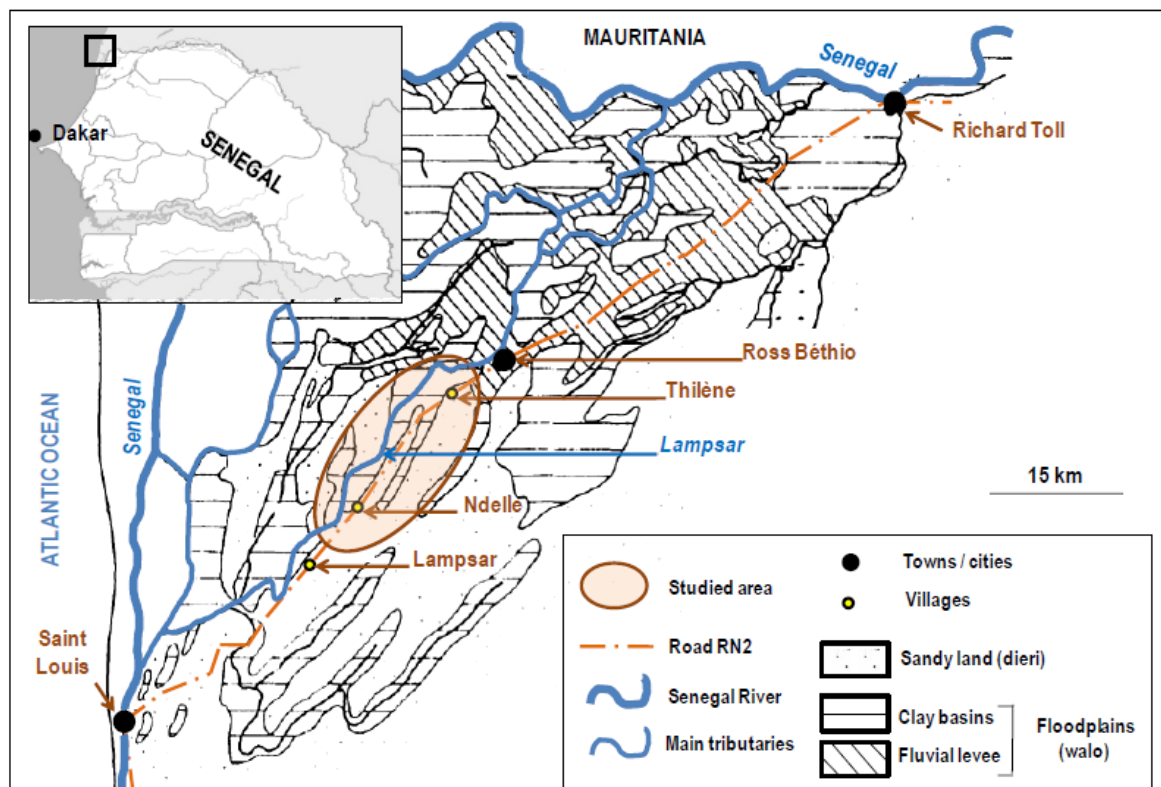
Relying on a six-month fieldwork study, this analysis of the agrarian system of the lower delta of the Senegal River (Fert and Radzik, 2016) was carried out as part of a programme developed within the Scientific and Technical Committee for Agricultural Water (*COMITÉ Scientifique et Technique Eau Agricole*, COSTEA). It first focused on the environmental conditions and the agricultural practices observed in the lower delta, using a landscape analysis mostly based on direct field observations. This was followed by a reconstruction of the evolution of agriculture since the 1950s, using about 30 life-story interviews with farmers. The processes of farmers' socio-economic differentiation during the last four decades – namely how local farmers have been unevenly affected by changing environments (droughts, public policies, market conditions, etc) – received special attention during these interviews. This has enabled us to establish a typology of the current production or activity systems in the lower delta, each representative of an historical trajectory, and corresponding to a combination of assets and resources (land, equipment, labour force, etc), farming (and off-farm) activities, and produce. Around

⁶ The notion of assemblage developed by Li is close to that of 'institutional bricolage' elaborated by Frances Cleaver: "a process by which people consciously or unconsciously draw on existing social and cultural arrangements to shape institutions in response to changing situations" (Cleaver, 2001). However, while Cleaver used institutional bricolage to describe local institutions' evolution (especially those related to natural resource management) against prevailing 'new institutional economics' approaches, Li's analytical of assemblage focuses on the agency of the subjects involved, and thus fits better with the problem set in this article.

50 technical and economic surveys were then conducted. The farms were selected according to a reasoned sampling of farmers or investors currently operating in the lower delta and representing the different production systems (or historical trajectories) previously identified. The collected data⁷ was used to model their technical and economic performance (in particular the per-hectare and per-worker value added resulting from their activities).⁸

By following the four stages described above as an iterative process, we have examined the atypical development of irrigated agriculture observed in Thilène and its consequences in terms of farming income, as well as the more conventional trajectory observed in another village, Ndelle. Both villages are located in the lower delta of the Senegal River, a region where floodplains and fluvial-deltaic levees suitable for rice cropping (*walo* land) alternate with low sandy dunes (*dieri* land) devoted to pasture but also to irrigated fresh vegetables. Road RN2 crosses the lower and upper delta, and connects the two villages with the city of Saint-Louis (see Figure 1).

Figure 1. Map of the Senegal River delta: soil types, villages, and study area location.



Source: Authors, modified from Jamin and Tourrand (1986).

⁷ Modelling technical and economic performance of production systems required detailed data collection, including information about land access (for each plot: size, and type of soil; when and how the farmer got access to it; current tenure regime); labour force (overall size and composition); equipment and infrastructure (farm tools and machines, motor-pumps, etc); crop and husbandry systems developed (technical itineraries, calendars, labour needed, inputs doses, yields, etc); and current prices and their evolution (inputs and production).

⁸ The area covered by the landscape analysis and the life-story interviews included villages irrigated with the water of the Lampsar River, situated south of Ross Béthio and north of Lampsar village. Production system surveys were concentrated in a few villages, including Thilène, Ndelle, Savoigne, Tamakh, and Polo (see Figure 1).

THE DELTA: FROM STATE-LED TO FARMER-LED IRRIGATION DEVELOPMENT

Adapted to Sahelian rainfall conditions and to the flood regime of the Senegal River, the delta's agriculture formerly combined rainfed and flood-recession crops with livestock farming. Farming income was complemented by trade activities and fisheries. The severe droughts that hit the whole Sahel region in the 1970s and 1980s brought about a crisis of this agrarian system. This manifested itself in many ways, including calls for emergency food aid, heavy livestock mortality, and massive emigration (Lericollais, 1975, 1976; Reboul, 1984; Tourrand, 2000; authors' surveys). In response to this situation, the Senegalese state reinforced large-scale irrigation development schemes undertaken in the 1950s by the colonial administration.⁹ The objective was to urgently substitute rainfed and flood-recession crops with irrigated crops, namely rice.

The rapid development of rice double cropping (*hivernage* from July to October, and off season from November to June) was made possible by the development of nearly 14,000 hectares (ha) of large irrigation schemes (Seck, 1991; Maiga, 1995); the diffusion of short-cycle rice varieties; and the construction of two large dams, one upstream of the Senegal River (Manantali, in Mali, regulating the flood regime) and one downstream (Diama, limiting salt water intrusion). From the 1980s onwards, the installation of a tomato-processing industry, SOCAS (*Société des Conserves Alimentaires au Sénégal*), stimulated the development of fresh tomato cultivation together with other fresh vegetable crops (onions, peppers, eggplant, etc). These were cultivated during the off season in the walo fields, as well as in the sandy lands of diéri.

Until the 1980s, these deep transformations of the delta's agrarian system relied on systematic state-led interventions in various areas: hydraulic infrastructure which family farmers could never have afforded as individuals, land management, access to subsidised farming inputs and services, or paddy milling and marketing. Farmers' practices were strongly supervised. They had to correspond to highly standardised techniques, including mechanisation and the use of specific chemical inputs. The state agency in charge of all these domains of intervention was SAED,¹⁰ which had total control over the delta's lands – classified as a 'zone pionnière' in the *National Domain Act*¹¹ – and over irrigation water management, which was highly centralised.

The fairly equitable distribution of paddy plots (less than one hectare per family worker), combined with guaranteed prices and market opportunities, enabled the delta's farmers to overcome the Sahelian droughts of the 1970s without increasing inequalities, though this came at the cost of a strong dependence on SAED (Reboul, 1984; Seck, 1986). Some small irrigated schemes managed at the village level (*périmètres irrigués villageois*, PIVs) were also implemented with the financial support of SAED, which provided motor pumps and carried out land-levelling works. PIVs were much less expensive and more elementary, and implied some degree of autonomy for farmers. The area occupied by PIVs in the delta was insignificant compared to the large public schemes,¹² and irrigation development interventions were largely a matter of the state agencies. However, despite the modest surface they covered, PIVs' implementation enabled the consolidation of local youth associations – *foyers de jeunes*

⁹ The first irrigation developments to produce rice in the delta of the Senegal River were a response to the high cost of cereal imports in Senegal, which had been increasing since the 1930s. Rice imports were a consequence of the development of peanut cultivation as an export crop, which came at the expense of cultivating domestically consumed staple crops (Seck, 1991; Benz, 1996). The recurring droughts of the 1970s strongly accelerated the pace of irrigation development.

¹⁰ Société nationale d'aménagement et d'exploitation des terres du delta du Fleuve Sénégal et des vallées du Fleuve Sénégal et de la Falémé.

¹¹ *Loi sur le domaine national*, enacted in 1964.

¹² In the late 1980s, while the area covered by large irrigated perimeters supervised by SAED rose to 28,900 ha, PIVs represented 1860 ha (Dahou, 2004), and were mostly concentrated in the middle and upper valley of the Senegal River.

– which have played a key role in promoting collective farmer-led irrigation initiatives ever since, including the exceptionally large one developed in Thilène (see later section).

As a consequence of the structural adjustment programme initiated in 1981 and the New Agricultural Policy enacted in 1984, the state lost some of its control over agricultural markets and irrigation water and land management. Subsequently, the roles of the different parties involved in the assemblage evolved. Throughout the 1980s and 1990s, SAED's progressive withdrawal has been accompanied by the transfer of irrigation and water infrastructure management within large schemes to farmers grouped into *unions hydrauliques* (UHs). With the equipment and maintenance of their hydraulic sector at their own expense, farmers faced increased irrigation costs. Created in 1987, the *Caisse Nationale du Crédit Agricole du Sénégal* (CNCAS) filled this gap by providing farmers grouped in UHs with cultivation credits (*credits de campagne*). At the same time, in 1987, the land regime in the delta shifted from the zone pionnière to the *zone de terroir*, in application of both the *National Domain Act* and the decentralising reforms introduced progressively after 1972. In practice, this meant that the role of SAED in the administration of land was reassigned to rural communities (*communautés rurales*) through the elected rural councils (Boutillier, 1989).

Most of the increase in the irrigated area during the 1990s (i.e. 24,000 ha, according to data obtained from SAED, which are added to the 14,000 ha of pre-existing schemes) resulted from private initiatives (*périmètres irrigués privés*, PIPs), led either by individual farmers or by economic interest groups, (*groupes d'intérêt économique*, or GIEs¹³) grouping several individuals or families.¹⁴ These involved the construction of irrigation infrastructure that is less costly per hectare, but for which financing is now only marginally subsidised by SAED and therefore remains inaccessible to the majority of farmers. Unlike the equitable distribution of paddy plots within the large schemes of the 1960s, 1970s, and 1980s, land access under these private initiatives favoured those farmers well equipped with motor pumps and with the financial capacity to develop new irrigated areas. In addition, although transferring land management to rural communities may seem laudable, this promoted clientelism and associated inequities as a result of the benefits that can be obtained from irrigated lands (Dahou, 2004).

Moreover, the reduction of taxes on imported rice, the end of subsidised inputs, and the monetary devaluation of 1994 have led to unfavourable price trends for producers. This situation further weakened the land resource-poor households which, in the event of a poor harvest, run the risk of becoming heavily indebted (Lavigne-Delville, 1993; Le Roy, 2012). Consequently, in the last three decades, the delta's agriculture has been characterised by significant socio-economic differentiation between, on the one hand, those who have managed to accumulate wealth by increasing the area under irrigation, and, on the other, the large majority of farmers who try to adapt to this new context by seeking new sources of income, such as growing vegetables on tiny plots irrigated with buckets, daily wage work on large farms or in Saint-Louis, and seasonal or long-term emigration.

Partly as a result of these evolutions, a relatively new social group composed of 'farming investors' emerged in the delta's irrigation development assemblage. While some of them are local prosperous farmers who benefitted from the above-mentioned differentiation processes, 'farming investors' have also increasingly involved national and foreign agribusiness companies (Bélières et al.; 2013). This has been particularly the case from the 2000s onwards, simultaneous with the improvement of the conveyance capacity of primary irrigation channels funded by different international development

¹³ 'Economic interest groups' (*groupes d'intérêt économique*) are legally recognised associations which group at least two individuals to develop economic activities.

¹⁴ Similar evolutions have been observed in other major Sahelian irrigated areas. In Mali, in the area administered by the Office du Niger, 10,000 ha were developed between 1995 and 2002 according to a new model where users themselves had to partially fund the hydraulic infrastructure (Coulbaly and Bélières, 2006).

agencies.¹⁵ The activities of farming investors rely on influencing the other local parties of the assemblage in order to obtain access to land, water, and capital. They negotiate land concessions with the rural communities, or more directly (and informally) with village chairmen and individual farmers. The corresponding 'deals' are diverse. In exchange for securing their access to tens or hundreds of hectares of potentially irrigable land (close to existing primary hydraulic infrastructure) investors' proposals range from funding new schemes for the affected villagers, to fuzzy material compensations and unclear job opportunities that exclude most of the farmers and jeopardise village land reserves.¹⁶ For some of the most prominent investors, these compensations are disbursed as part of their corporate social responsibility – the 'synergies' they should develop with local farmers in line with the World Bank's development models – which enables them to get access to substantial funding by major international donors.¹⁷

Although Thilène's farmers have, to some extent, suffered from the growing inequality and insecurity in the delta since the 1990s, the expansion of the irrigated area undertaken by the local farmers' organisation (the *section villageoise*, SV) has considerably mitigated its impact in terms of exclusion and precariousness.

THILÈNE, A FARMER-LED COLLECTIVE ACTION TO DEVELOP IRRIGATION 'AGAINST THE FLOW'

A response to increasing land scarcity and investors' pressure

As in many villages in the delta, SAED undertook large-scale hydraulic infrastructure projects in the flood areas of Thilène in response to the prolonged droughts of the 1970s. About 100 ha were transformed into rice fields cultivated with total water control and in accordance with the strict technical supervision described in the previous section. Nevertheless, given the population growth, irrigated areas rapidly proved to be insufficient. In this context, during the 1980s the youth of Thilène formed foyers de jeunes (youth associations) and, partially supported by SAED, they developed two small PIVs of 30 ha each, mainly devoted to rice cultivation (Woodhouse and Ndiaye, 1991). Later, following SAED's withdrawal and the decentralisation of land administration, some farmers requested floodplain lands from the rural community in order to increase, by their own means, the rice area they cultivated. Land allocated depended upon their capacity to finance irrigation infrastructure and motor pumps.

These successive stages of the development of irrigation in Thilène until the end of the 1990s were also observed in different villages of the delta. However, from the beginning of the 2000s onwards, irrigated agriculture in Thilène took an original turn. The farmers of Thilène started to gradually increase the irrigable area on sandy dieri lands, not cultivated since the decline in mean rainfall in the 1970s. They undertook this venture collectively within the SV, whose activities – similar to those of the current *UHS* – had so far been restricted to the rice-growing areas developed by SAED in the 1970s. Today, this new irrigated area covers nearly 400 ha. Before going into the details of this collective enterprise, we should first examine what the triggers were for this re-colonisation of the dieri.

¹⁵ After more than 10 years without significant public investment in the delta, some donors were back in force in the context of the 2007-2008 food crisis. They funded different projects: renovation of existing perimeters, improvement of the conveyance capacity of primary channels, 'capacity building', development of value chains, etc. The Millennium Challenge Account and the French Development Agency have been amongst the main financial contributors.

¹⁶ Section 4 and 5 propose some illustrations taken of the two studied villages and from other areas of the lower delta.

¹⁷ CASL and SCL correspond to this type of investors. *La Compagnie agricole de Saint Louis* (CASL) grows rice on over 2000 ha of land. In 2016 CASL got a €31.4 million credit from the African Development Bank and the European Investment Bank. *La Société des cultures légumières* (SCL) grows fresh vegetables for export on over 1140 ha, distributed throughout different areas. In 2013, SCL obtain a €4 million credit from the Belgian Investment Company for Developing Countries.

Sandy dieri land is abundant in Thilène. In the absence of sufficient precipitation, the rainfed crops formerly grown on these soils (including millet, peanut, watermelon, and cowpea) were abandoned in the 1970s. The development of irrigation was concentrated at that time on the walo floodplains – clay soils suitable for the cultivation of rice – pushing dieri lands into the background. Cultivating irrigated fresh vegetables on the dieri was not impossible though, as evidenced by the farm developed by SOCAS¹⁸ in the 1980s near its tomato concentrate production plant in Savoigne (Landais, 1992). However, this development involved significant investment – inaccessible to most family farmers – to be able to pump and conduct the water to plots often far from the main channels. Consequently, as long as they had access to walo lands, and benefitted from the support of SAED, the inhabitants of Thilène had no reason to engage themselves with the vast dieri lands of their village.

The context changed from the end of the 1990s onwards. Non-cultivated walo lands started to become scarce while demands by young farmers continued to grow. In addition, the pressure on the dieri lands began to manifest itself in the 2000s with the installation of private operators specialising in large-scale production of fresh vegetables for export, especially west of the RN2 where water was easily accessible from the Senegal and its main tributaries. Under these circumstances, the venture led by the SV of Thilène aimed both to relieve the land scarcity suffered by a large number of villagers, as well as to mitigate the risks of land grabbing. This did not happen without significant technical and financial difficulties.

A farmer-led development underpinned by a concerted access to, and use of, collective lands

In the early 1990s, shortly after the change in status of Thilène's lands to zone de terroir, some families of the village and their corresponding GIEs turned to the rural community of Ross Béthio in order to formalise their rights over large areas of dieri. They claimed that these lands belonged to their ancestors insofar as the latter had cultivated rainfed crops prior to the droughts of the 1970s. As a result, each family GIE obtained between 25 and 50 ha out of a total of nearly 400 ha. Some other inhabitants of the village, especially those belonging to the foyers de jeunes, expressed their discontent with this initiative, which depleted the village's land reserves. By the end of the 1990s, the families holding the rights over these areas decided to transfer them to the SV, provided that it carried out a collective irrigation development project that would benefit all the inhabitants of the village.

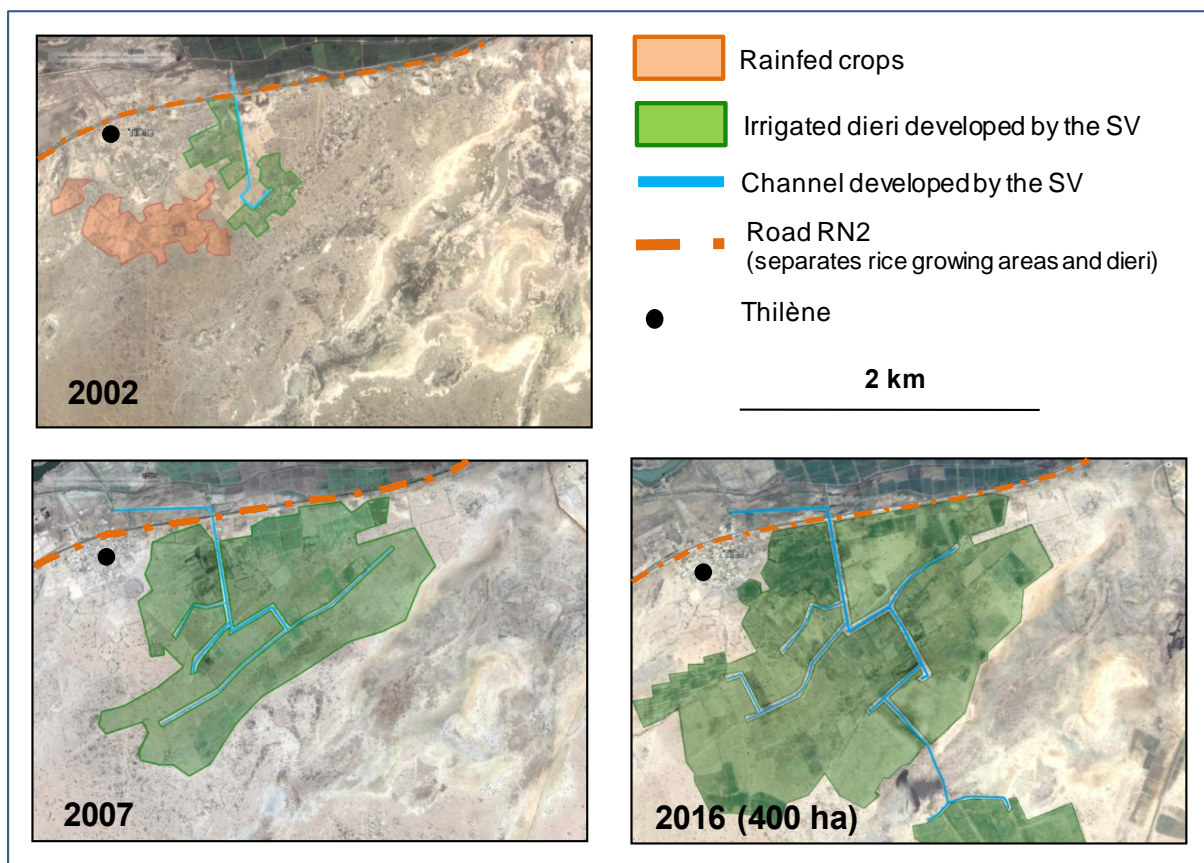
Initially appropriated by some well-off families of Thilène, these lands became the common property of all the inhabitants of the village represented in the SV. Nonetheless, the gesture of these few families must be understood as a 'necessity made virtue'. Indeed, in the absence of irrigation, they would never have been able to cultivate the lands they controlled, despite the existence of remunerative outlets (especially SOCAS) for fresh vegetable production. By transferring these lands to the SV, they counted on the strength of the entire village population to finance the construction of the infrastructure necessary to cultivate dieri lands. In so doing, they also responded to the land needs of other villagers. However, as we shall see later, they kept back some privileges during the distribution of irrigated lands.

A 4.5-kilometre-long channel designed to convey water sourced in the Lampsar River (a tributary of the Senegal) to the dieri of Thilène, was planned. Its construction took place between 2000 and 2009. The estimated cost of the works (including motor pumps) was FCFA 70 million (about €107,000), of which 80 percent was financed by the SV's own funds and by the members, some contributing to the investment with capital or equipment, while others provided their labour. The SV funded the remaining

¹⁸ In 1972, SOCAS opened a tomato concentrate production plant a few kilometres away from Thilène, and began contracting with local producers to supply it with fresh tomatoes. Tomatoes were essentially produced in walo lands during the off season. Nevertheless, in order to increase the processed volumes, in the middle of the 1980s SOCAS implemented its own tomato farm of nearly 500 ha of dieri land, located close to the plant. SOCAS has recently refocused on purchasing and transforming smallholders' production exclusively. Its irrigated domain has been rented to SCL (see footnote 17).

20 percent with a credit granted by the CNCAS after SAED gave a no-objection notice. After 2009, the financing of further extensions of the hydraulic network of Thilène has involved different economic agents such as state subsidies, funds from private operators in exchange for short-term renting lease, and NGO projects. Figure 2 shows the gradual extension (2002-2016) of the hydraulic network and the irrigated area in Thilène’s dieri.

Figure 2. Successive extensions of irrigated area in Thilène’s dieri lands (2002-2016).



Source: Authors, from Google Earth

Both the construction and financing of the hydraulic network of Thilène have been systematically examined and validated by the assembly of the SV. In the same way, the choice of criteria for allocating the new irrigable areas was decided collectively (Table 1). It was agreed that each individual would be granted a plot the size of which would be determined according to his/her then-current walo land endowment, those with less land receiving slightly larger parcels. There were some exceptions to that principle: those families (GIEs) who transferred their rights to dieri lands obtained larger areas, but these were capped at five ha per GIE. Those who participated in the development of the hydraulic network by providing capital or equipment also received slightly more land. Despite these exceptions favourable to the best-endowed families (in lands and capital), all the inhabitants of Thilène were finally able to benefit from this collective action to develop irrigation on the dieri lands. The principle of providing lands to those hitherto most disadvantaged, and the establishment of ceilings on allotment per GIE, have significantly limited the land concentration observed elsewhere in the delta, as we will see later.

Table 1. Irrigable dieri land distribution decisions by the assembly of Thilène's SV.

	Hectares	Irrigable dieri land distribution in Thilène (2000-2016)
Individual land allocation (2000-2009)	40	Farmers who transferred their land rights to the SV. The corresponding households or GIE obtained 5 ha each.
	40	Farmers who contributed with capital, tools, and materials for the construction of the primary channel. The corresponding households obtained 2 to 5 ha each.
	260	Farmers belonging to the UH and having access to a rice-growing parcel of more than 0.60 ha in the flood plains, obtained 0.30 ha/farmer; those with 0.50-0.60 ha obtained 0.40 ha/farmer.
Recent arrangements with non-profits or investors (since 2014)	35	Project funded since 2014 by ADF (see footnote 22). Some areas have been individually attributed. But most of the area was given to groups composed of young farmers and women.
	25	Partnership between the SV and private investor (see footnote 22).
Total	400	

Source: Fert and Radzik (2016)

In addition, the SV ensured that all Thilène farmers had access to both walo (for rice production) and dieri (for fresh vegetables cultivation), so as to enable crop diversification and mitigate income differences resulting from various sources of risk, including fluctuation of agricultural prices. For example, in 2008, SAED, with support of the *Programme national pour l'autosuffisance en riz* (PNAR),¹⁹ rehabilitated a small rice-growing area (about 50 ha) in Thilène, and the decision of the SV was to give plots first to those who were already granted with dieri land but had no access to areas suitable for rice cultivation. As Takahashi (2011) demonstrated, the SV thereby supported the combination of rice and fresh vegetable cultivation over three growing seasons per year on different types of land (walo and dieri), and by all family farms. In doing so, there has been improvement in the performances of the latter in terms of food security, cash income, and solvency vis-à-vis the CNCAS credits (for rice and tomato).

Progressive but accelerated accumulation and reduced land concentration

The development of irrigation by Thilène farmers on dieri lands is a first in the delta in terms of hydraulic infrastructure. Until then, irrigation had been concentrated mainly on the floodplains, close to the Senegal River's main tributaries. The dieri lands east of the RN2 road had never been irrigated. This line, per se, represented a significant physical barrier to any attempt to irrigate, and thereby cultivate, these areas. However, relying on a solid SV and pooling the means and resources of each other, the farmers of Thilène have been able to carry out this venture. This has obviously been done in a progressive way, adapted to the rhythm of accumulation of this family-style agriculture. A decade of hydraulic works later, 400 ha are irrigable and accessible to all the inhabitants of the village. This is certainly a slow average pace of development compared to those achieved by large public and private operators in the same area in recent years. Nevertheless, this rate has accelerated as a result of the increase in farmers' incomes associated with the development of fresh vegetables growing on dieri land, and the success of this collective initiative has made it possible to attract additional financial support. Indeed, the resulting prestige accumulated by Thilène's SV irrigation development

¹⁹ The Senegalese Government implemented the PNAR as a response to the food security crisis of 2007-2008. They included important subsidies for hydraulic infrastructure, as well as for fertiliser supply.

performances has led to additional financing and material outcomes on several occasions, and these have in turn allowed prestige to grow.²⁰ In that respect, Thilène has attracted different means of financial support not only to renovate the hydraulic network,²¹ but also to develop small-scale projects with NGOs or in partnership with farming investors.²²

Access to irrigated dieri land has had a strong impact on the economic performance of Thilène's family farms. The possibility of practising labour-intensive fresh vegetable crops and generating significant value added per hectare has thus far had a positive impact on the income of the most disadvantaged families. To illustrate this, we consider (in Table 2) the economic performance of two of the production systems identified in the lower delta (Fert and Radzik, 2016).

The bulk of Thilène's farmers can be represented by PS-A, a production unit composed of two family workers, and a seasonal worker staying 10 months of the year. These farmers have a plot for rice cultivation of 0.5 to 0.6 ha (located in the area developed by SAED in the 1980s) and a similar area of dieri land where they cultivate irrigated fresh vegetables (located in the area developed collectively by the SV). The latter makes it possible to create a very high gross value added (GVA)²³ per hectare of around FCFA 2.5 million (€3800), almost three times greater than that generated by rice cultivation. The result is a total amount generated at the farm level (total value added, or VA) of FCFA 0.6 to 0.7 million (€915-1070) per worker, and a farm income of FCFA 0.65 to 0.85 million (€990-1220) per family worker.²⁴

PS-B represents a farm located in another village of the lower delta, also composed of two family workers, but having only a parcel of walo for rice cultivation similar in size to that of PS-A, and a very small area of irrigated dieri (0.1 to 0.15 ha). The latter corresponds to plots located near the water supply or drainage channels of the rice-growing areas, and farmers irrigate them with buckets at the cost of considerable work. In order to increase the wealth generated per hectare, these farmers alternate rice and onion cultivation on walo plots following a biennial rotation (onion/rice/rice). Nevertheless, since the dieri area devoted to fresh vegetables is small, the total wealth and the farming income generated at the farm level are lower than those realised by PS-A (by 30 percent and 40 percent, respectively).

²⁰ Drawing on Bourdieu's concept of 'symbolic capital' (Bourdieu, 1980), Batterbury (2005) has developed this idea in the context of resource conservation projects carried out in Burkina Faso in the 1990s: "Symbolic capital leads to material outcomes. And the material outcome (...) also allows symbolic capital to grow". Indeed, some villages particularly favouring participation in natural resources management works, gave a good image of themselves to outside agencies, and so obtained further support (for instance, to build schools or wells).

²¹ Between 2009 and 2012, the primary channel of Thilène was renovated as a part of the Agricultural Markets Development Project (*Programme de Développement des Marchés Agricoles du Sénégal*, PDMAS), carried out by SAED with World Bank and French Development Agency support.

²² For example, the ongoing project financed by The United States African Development Foundation (USADF) to develop sprinkler irrigation on 35 ha of the dieri lands, which includes an extension of the main channel, motor pumps, and access to credit for tomato cultivation. More recently, the SV made an agreement with a farming investor who financed the extension of Thilène's hydraulic network in exchange for the use of 25 ha to make one trial of sweet potatoes. According to the village chairman, this irrigable area will soon be distributed among villagers.

²³ Gross value added (GVA) is an indicator of the annual wealth created during the whole production process. It is calculated as follows: $GVA = GP - IC$ where GP (gross product) corresponds to the value of the production, and IC (input consumption) corresponds to the addition of all the values consumed during the production process (fertilisers, seeds, herbicides, fuel, etc.). The family's farm income is the GVA minus the wages of the seasonal employee and of the daily labourers employed during peak labour periods.

²⁴ The opportunity cost of labour in the region, given the employment alternatives such as those offered by large farms or agro-industries such as SOCAS, has been estimated at FCFA 500,000 per family worker (Fert and Radzik, 2016).

Table 2. Main features of two production systems of the lower delta of the Senegal River.

Production system (PS)	Rice fields (ha)	Irrigated dieri (ha)	GVA fresh vegetables FCFA million/ha (€/ha)	Total VA FCFA millions /worker (€/worker)	Total farm income FCFA millions /family worker (€/family worker)
PS-A					
1-1.2 ha	0.5-0.6	0.5-0.6	2.5	0.6-0.7	0.65-0.85
2 family workers			(3800)	(915-1070)	(990-1220)
1 seasonal worker					
PS-B					
0.6-0.75 ha	0.5-0.6	0.1-	2.8	0.4-0.6	0.4-0.6
2 family workers		0.15	(4300)	(610-915)	(610-915)

Source: Fert and Radzik (2016)

Thus, the farmer-led collective irrigation development on Thilène's dieri land has significantly contributed to increasing the wealth generated per hectare and farmers' income. In the second village, dieri land is equally abundant. However, either because of the absence of irrigation or the fact that they have been grabbed by large private operators (see next section), these lands do not contribute to improving the incomes of most of the inhabitants of the village. In Thilène, all lands are managed concertedly by the villagers represented within the SV, the latter ensuring that the development of irrigation benefits the entirety of the inhabitants. It should be noted that significant differences exist between the bulk of Thilène farmers (who may be represented by the PS-A system) and those who have benefitted from larger irrigated dieri land allocations given the reasons mentioned previously. Differences in area between family farmers, with ratios in the order of 1 to 3, generate similar differences in terms of incomes. These remain moderate, however, compared to those observed elsewhere in the region. This limited differentiation consolidates the cohesion of the SV, which has been indispensable when implementing the successive extension of irrigated farming to the dieri lands.

Nevertheless, the dynamics observed in other villages of the delta – very different from those of Thilène – make it necessary to mention the highly contingent nature of this collective action and, subsequently, the low likelihood of its reproducibility. In the next section, an analysis of the recent transformations of agriculture in Ndelle (a village located 15 km southwest of Thilène) in favour of a large agricultural investor (see box) will allow us to explore the sources of this contingency. Until the end of the 1990s, both in Ndelle and Thilène, irrigation development followed the same assemblage as elsewhere in the delta region. From the 2000s onwards, even though it involved the same parties (farmers, UHs, rural communities, foyers de jeunes, SAED, CNCAS, farming investors, NGOs, international development agencies, and donors), there were significant differences across the two villages in the relative positions of these groups, their practices, and the resultant effects.

BOX: THE CASE OF NDELLE, AN INSTANCE OF THE DOMINANT ASSEMBLAGE

Until the end of the 1990s, the village of Ndelle shared an agrarian history similar to that of other villages in the lower delta, including Thilène. In the early 1980s, SAED built a large rice-growing area of 240 ha, equitably distributed among all villagers according to the size of the household. However, during the 1990s, this irrigated area became insufficient to generate satisfactory agricultural income. At that time, SAED was no longer prepared to implement new hydraulic developments, and the reserves in walo land had decreased with the development of PIPs. Ndelle farmers then turned to the dieri lands, as did the Thilène farmers. But, in Ndelle, the irrigation of the dieri land was not based on a collective approach. Instead, each villager individually established irrigated parcels to grow fresh vegetables on the dieri lands located along the existing main drainage channel of the rice-growing scheme, and irrigation water was extracted from this channel. These parcels are today very variable in size, which means there has been increasing socio-economic differentiation among Ndelle's farmers. Those who can invest in motor pumps are able to cultivate substantial areas (on the order of 0.5 ha) while others are limited to the areas they can irrigate with buckets (about 0.1 ha).

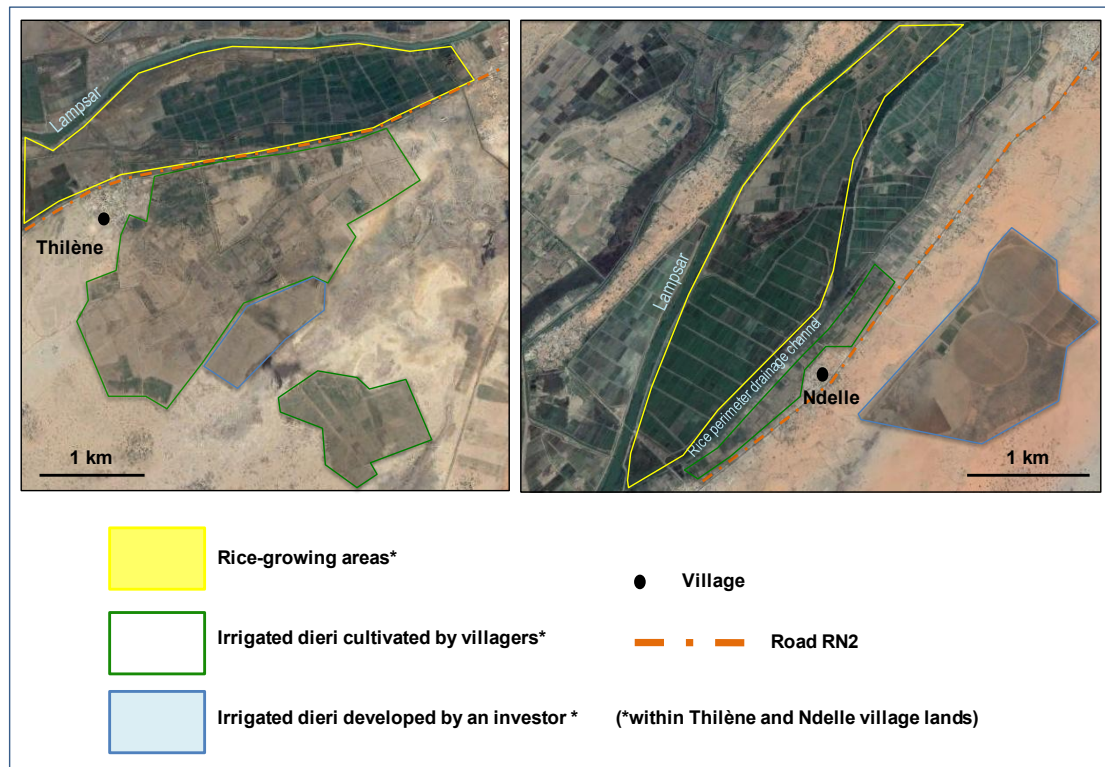
Most of the villages of the lower delta located along the RN2 have been involved in such an individual farmer-led irrigation expansion in the dieri. However, in the case of Thilène, irrigation from the drainage waters of rice-growing schemes was either not technically feasible or was confined to very small areas. Indeed, in this village, the RN2 road runs along the drainage channel and represents an important physical barrier to the use of its waters. Therefore, in Thilène, irrigating dieri lands necessarily entailed the implementation of important hydraulic works (including the canalisation of a large flow of water under the RN2) which would not have been possible in the absence of the collective action. The situation in Ndelle was different. At that time, the inhabitants showed no interest in the large sandy land reserves located to the east of the road, as they had easy access to dieri lands that they were able to irrigate individually (if in a rather unequal way) (see Figure 3).

In 2014, 160 ha of that eastern sandy land were allocated by the rural community to a large investor, with the agreement of Ndelle's elected representatives on the rural council. The rural community justified its decision by referring to the lack of resources – and thus inability – of the inhabitants of Ndelle to develop irrigated agriculture on this eastern land, and the local benefits (employment) that would accompany this transfer. Today the investor irrigates the area with pivots, and grows maize which is used on the farm for intensive production of broilers. Water is pumped from the Lampsar and piped underground over several hundred meters. Compensations for villagers have never been formally established, but according to surveys, they are apparently paltry.²⁵ Given the industrial nature of broiler production, the automated irrigation methods and the mechanisation of farming operations, it should be noted that the benefits in terms of employment generated per hectare are much lower than those obtained in Thilène from labour-intensive crops (fresh vegetables).²⁶ Additionally, the establishment of this large farm has led to the depletion of almost all the land reserves of the village that could potentially contribute to improving the very precarious incomes of many of Ndelle's farmers (those we had represented by PS-B), and which could enable the installation of young farmers.

²⁵ A relative of the village chairman mentioned the benefits as being the financing of the construction of a fence around the mosque, some jobs in the establishment phase, as well as "tea and sugar for the elderly".

²⁶ In the context of the mentioned study (Fert and Radzik, 2016), an evaluation of the economic performance of this farming development was scheduled. Unfortunately, we could not get access to this data. An ongoing study focuses on comparing the economic performance of the different production systems present in the delta of the Senegal River. It should shed more light on the (socio-economic) effects of the different models and assemblages that characterise irrigation development in the region.

Figure 3. Distribution of rice-growing areas and diéri lands in Ndelle and Thilène.



Source: Authors (2018) from Google Earth

DISCUSSION: RESISTANCE AND CONTINGENCY OF DEVELOPMENT PATHWAYS

One could suggest that it is the relative absence of easily accessible diéri land in Thilène that boosted the emergence of the collective action to develop irrigation. However, the rise of Thilène's farmers' action seems far from being reducible to a mechanical reaction to a specific physical environment, and should better be described as a form of resistance. Here resistance corresponds to a disruptive 'right manner' of developing irrigated agriculture, ensuring that respect is shown for the 'moral economy' shared by Thilène's farmers. This resistance takes the shape of an alternative pathway to the dominant assemblage (illustrated by what has happened in Ndelle) which reveals the contradictions (increasing socio-economic differentiation) and the drifts (rapid land exhaustion) of the latter, while showing that these are not inevitable.

One of the key features of resistance is that it arises from the very inside of the dominant assemblage. Indeed, the parties involved in Thilène's alternative pathway are similar to those observed in the more conventional trajectory illustrated by Ndelle's development. However, the nature of the relationships between these parties, their practices, and the related effects are rather antagonistic. In terms of institutions, the activity of the farmers of the SV of Ndelle remained limited to the operation and maintenance of the rice schemes developed in the early 1980s, while the SV of Thilène also undertook to develop irrigation in the diéri lands. In other words, Ndelle's SV has just kept the role that dominant agents have assigned to it, while Thilène's SV has redefined its role as well as the (power) position occupied by the different parties of the irrigation development assemblage. How Thilène's SV has recently interacted with an outside farming investor (see footnote 22) is quite illustrative of such a redefinition.

In the same vein, it is worth noting that the very same land rights formalisation processes and institutions (rural communities) that allowed Thilène's SV to implement a long-term collective effort to develop the dieri lands were mobilised in Ndelle in favour of the installation of a large investor, which jeopardises the enhancement of local living conditions. In the case of Thilène, the way in which new irrigated land have been allocated (with special attention to land-poor families and young farmers' needs) results partly from the robustness of the foyers de jeunes. These youth organisations influenced the SV decisions at the end of the 1990s, responding to the moral economy shared at the village level. This egalitarian mindset has been clearly inspired (or enriched) by former land allocation procedures undertaken by SAED in the large rice schemes developed in the 1970-1980s, which were based on allotting land equitably. Although these criteria became formally obsolete in most parts of the delta upon SAED's withdrawal in the 1990s, youth organisations pushed to preserve what had been the hallmark of land distribution in the region for more than 30 years. Given growing land scarcity among villagers, youth organisation demands to holders of dieri land rights were admitted all the more since the latter have no means to develop irrigation in those lands by themselves. In the process, Thilène's villagers sanctioned a moral economy that has been in use and preserved ever since.

Irrigated land distribution mechanisms in Thilène have evolved from the former 'SAED-inspired' mechanisms to be even more concordant with this moral economy, given a continually changing context. Current mechanisms enable all villagers to have access both to irrigated walo and dieri lands, so as to favour diversification and thereby to mitigate the effects of agricultural market fluctuations. The result has been a limited socio-economic differentiation which in turn has played in favour of the stability of this alternative irrigation development. As described in the previous section, given the success of this collective action both in terms of irrigation extension and increasing incomes, Thilène's SV has gained more respect and support from the other parties of the assemblage – SAED, CNCAS, investors, NGOs, and so forth – to whose practices farmers usually have to conform.

In Ndelle no moral economy was transgressed, since individual farmer-led irrigation development of easily accessible dieri enabled most villagers to overcome, to some extent, land scarcity and the deterioration of farming conditions in the 1990s, and some of them were able to improve their incomes. However, such a development has gone together with progressive socio-economic differentiation and a certain inhibition of the local youth organisation and SV, which in turn did not play in favour of a collectively run initiative to develop irrigation in the less accessible dieri (located in the eastern side of the RN2). More recently, the weakening of these villagers' organisations likely contributed to the ineffectiveness or invisibility of attempts to oppose the land transfer to the farming investor at the rural council and rural community levels.

Lastly, the cross-analysis of the evolutions observed in Ndelle and Thilène shows that, as in other current contexts, secured access to land today goes hand in hand with the ability to cultivate the land in a way that is 'economically efficient'.²⁷ The investor installed in Ndelle very efficiently expanded the irrigated area (160 ha in two years), whereas the pace of Thilène's farmers has been slower, even though remarkable (360 ha in nine years). However, we have demonstrated the effects of their collective action, both in generalising land uses that result in increasing value added and farmers' income, and in mitigating the trend towards resource concentration observed elsewhere in the delta. This raises the problem of how 'economic efficiency' is assessed, which parties of the assemblage prevail when deciding the 'right manner' of defining it, and what are the consequences in terms of resource allocation (of irrigable land) and, thus, in the evolution of irrigation development and the underlying public policies.

²⁷ See also the cases described by Veldwisch et al. (2013), in the Mozambican context.

CONCLUSION

Irrigation development in the delta of the Senegal River was analysed as a provisional assemblage (Li, 2007b; 2014) of heterogeneous elements (technologies, practices, discourses, etc), and pulled together by a range of parties with uneven capacities to influence their final shape. In the context of the delta, where state agencies, donors, and investors have set the tone of irrigation development over the last decades – similarly to what has been taking place in other main Sahelian valleys – the concerted irrigation development led by Thilène's farmers has disrupted the predominant assemblage and can thus be considered as a form of resistance. By drawing on comparative agriculture methods, we were able to better situate the conditions (ecological, social, economic) of the emergence of this collective action, to understand more precisely who has governed it and by what means or practices, and, finally, to know to what extent this alternative pathway for irrigation development has enabled relatively equitable land redistribution and an increase in farmers' incomes.

A harsh physical and socio-economic environment – the absence of easily accessible *dieri* (specific to Thilène), and the deterioration of farming conditions, especially in the 1990s – pushed farmers to design a plan to counter the decline of their incomes. They did so in accordance with a shared system of requirements, or moral economy, i.e. in a way benefitting all villagers and with the next generations in mind. The strength of the local youth organisation, as well as the mark left by SAED's former equitable land distribution procedures, were essential to transferring *dieri* land rights held by a few well-off farmers in favour of Thilène's SV. From the 2000s onwards, Thilène's farmers have developed irrigation on *dieri* lands on the basis of a collective compromise. This has made it possible to improve farmers' incomes without either the marked differentiation or the accelerated depletion of land that has been observed in many parts of the delta, including the neighbouring village of Ndelle presented in this article. Gradually, other parties of the assemblage (SAED, credit services, donors, farming investors, NGOs) have also contributed to the development of irrigation in Thilène, but taking a subsidiary rather than leading role.

While Thilène's farmers' action has thus transformed the conventional 'right manner' of developing irrigation and has subverted the positions of the different parties involved, its contingent nature raises the question of whether such dynamics can be scaled up in the region. Being rather unique, would Thilène's farmers' action prove to be just the exception to the rule, the 'other side' of the dominant assemblage prevailing in neighbouring villages such as Ndelle? Or is it possible to implement adapted public policies to favour the emergence of similar collective farmer-led irrigation initiatives? The incorporation of such initiatives into policymaking calls for caution. In this vein, Li's analysis of development interventions points out that one of the central practices that the dominant agents – i.e. policymakers – deploy to ensure the coherence of the corresponding assemblage is 'rendering technical' or 'operational'. This consists of "extracting from the messiness of the social world with all the processes that run through it, a set of relations that can be formulated as a diagram in which problem (a) plus intervention (b) will produce (c)" (Li, 2007b). In that respect it is worth noting that 'rendering technical' contrasts with the singular, situated, and long-term nature of collective farmer-led irrigation developments such as Thilène's, and seems to better correspond to the prevailing development models based on so-called 'natural synergies' between purportedly homogeneous smallholders and agribusiness. Consequently, ensuring that collective farmer-led irrigation initiatives are not shut down or distorted by 'operational' or 'technical' turnkey solutions, will entail further rapprochement between the parties involved in the assemblage and, particularly, will require the balancing of social and power structures in policymaking.

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