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Vegetable Gardening in Burkina Faso: Drip Irrigation, Agroecological Farming and the Diversity of Smallholders

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ABSTRACT: Small-scale irrigated vegetable production has expanded dramatically in Burkina Faso. Its development can be divided into four periods: the colonial period with the construction of small dams; the boom in reservoir development as a response to drought and famine; the period during which private irrigation was supported; and the current period of new irrigation technologies such as drip irrigation and, to a lesser extent, agroecological vegetable gardening. Since the 1990s, vegetable gardening projects have had a limited impact and irrigation development has been led and financed mainly by farmers. This situation still prevails with current projects, which throws into question their capacity to respond to the needs of family farms. This issue is addressed in the Réo area, where an in-depth survey of family farms revealed a large diversity of situations and livelihood strategies. It became evident from the study that drip irrigation or agroecological gardening can only be adopted by a very small number of family farms. In addressing the problems of smallholders in this regard, development organisations and public policies need to consider their diversity, and adapt accordingly to farming families' needs and capacities.

KEYWORDS: Vegetable market gardening, irrigation, development project, agroecology, smallholder, family farming, Burkina Faso, Réo

INTRODUCTION: IRRIGATED VEGETABLE PRODUCTION IN BURKINA FASO

Smallholder irrigated vegetable production expanded in Burkina Faso following the construction of small dams, initiated during the colonial period and pursued after Independence. Water mobilisation has been a key challenge in the Sahel, and small reservoir developments have played a central role in mitigating the effects of food and water shortages. Since the 1990s, irrigated vegetable production has significantly expanded – a movement largely led by farmers investing in irrigation with no financial or technical support. This movement was backed by the national irrigation policy (MAHRH, 2003, 2004), including the establishment of a specific department of the Ministry of Agriculture devoted to small-scale irrigation (DADI¹), and information on irrigated production (BCRGA, 2011). Yet projects promoting small-scale irrigation, such as those funded by the World Bank (DIPAC² and PAFASP³), contributed only to a limited extent to this movement.

¹ DADI: *Direction des aménagements et développement de l'irrigation* (Department of Irrigation, Infrastructure, and Development).

² DIPAC: *Programme de Développement de l'irrigation privée et des activités connexes* (Private Irrigation and Related Activities Development Programme).

Small-scale irrigation is one of the main topics of the current agricultural policy drafted in 2017 (Burkina Faso, 2017). Since the late 2000s, small-scale irrigation development projects have been focused primarily on the promotion of low-cost drip irrigation. Fewer and smaller projects are directed at irrigated vegetable production, aiming at the promotion of agroecological farming. Two groups of projects have put forward objectives referring to sustainability, livelihoods enhancement, and poverty reduction. They both promote technical changes, which are quite different in nature. One type of project promotes low-cost drip irrigation kits as part of a package which includes improved seeds, fertilisers, and phytosanitary products; the other – which avoids the use of agrochemicals – is based on organic farming principles such as composting, natural pest management, and crop rotation and combination. Both orientations are directed at smallholder family farms.

Drip irrigation systems are reported to have contributed to an improvement in smallholders' livelihoods in South Asia (Polak et al., 1997), and to have the potential to alleviate poverty by facilitating year-round production of irrigated fruits and vegetables (Pasternak and Bustan, 2003), and achieve an African Green Revolution (Postel et al., 2001). These success stories are an important component of the foundation and justification of the strategy to promote drip irrigation in sub-Saharan Africa (Venot et al., 2017). In Burkina Faso, the African Market Garden project, initiated by ICRISAT⁴ in 2004, was followed by several projects aimed at distributing drip irrigation kits. There is evidence, however, that they have so far yielded rather disappointing results regarding farmers' adoption of drip irrigation technology (Wanvoeke, 2015; Troy and Picaud, 2013), which provokes the question: do agroecological farming projects do any better in promoting technical changes and addressing the needs of vegetable producers than do projects aimed specifically at promoting drip irrigation? Beyond this question, the issue at stake is the capacity of vegetable gardening support projects to respond to the needs of diverse types of family farms.

This issue is addressed in the Réo area (located in the central-western ('*Centre-Ouest*') region of Burkina Faso), using results of an in-depth survey of family farms and vegetable gardening conducted in 2014 and 2015.⁵ The study area is conducive to small-scale vegetable gardening, and both low-cost drip irrigation and agroecological farming projects are implemented there. The survey takes a broad perspective centred on livelihood economics and their agroecological context. Vegetable cropping is indeed one of the many activities of the family farms, taking place in (and bounded by) a natural environment. Putting the family farm, rather than the irrigation system (ARID, 2004; Barbier et al., 2011), at the heart of the study gives new insights into the role of irrigation, its development, and the function of vegetable production in family economies. The perspective draws on the *terroir* approach developed by ORSTOM,⁶ in order to study the human and territorial organisation in postcolonial sub-Saharan Africa (Couty, 1992; Basset et al., 2007). It also builds on field-grounded, evidence-based research, peasant studies, and agroecology as a science – i.e. the study of sustainability issues in agri-food systems (Altieri, 1995; Gliessman, 2015).

This type of systemic approach is needed to tackle farmer-led irrigation development. Contrary to the reductionist conception of family farms on which is based many development interventions, recognition of the diversity of smallholders helps understand global and local transformations and identify their needs regarding irrigation and vegetable production. The failure of development projects and public policies to acknowledge this diversity contributes to explaining their lack of impact. The case

³ PAFASP: *Programme d'appui aux filières agro-silvo-pastorales* (Agro-Sylvo-Pastoral Support Programme).

⁴ ICRISAT: International Crops Research Institute for the Semi-Arid Tropics.

⁵ The objective of the research that the survey was part of was to analyse the links between socio-economic transformations and land-use evolution in relation to the development of vegetable gardening (Gross, 2018).

⁶ ORSTOM: *Office de la recherche scientifique et technique outre-mer* (French Office of Overseas Scientific and Technical Research).

study thus contributes to the wider debate on the necessity of reframing irrigation policy and investment in Africa (Woodhouse et al., 2017), with a focus on the role of development interventions in relation to the diversity of family farms.

The paper first gives an historical overview of vegetable gardening development in Burkina Faso. It then focuses on the case study in the Réo area to analyse the role of vegetable gardening in family economies and to discuss the adoption of the technical changes proposed by the two types of development projects in relation to the diversity of family farms.

IRRIGATION AND VEGETABLE PRODUCTION DEVELOPMENT: AN HISTORICAL OVERVIEW

Colonial roots

Dry season vegetable production in the West African Sahel area dates back to the precolonial period. This type of production was nevertheless marginal in agri-food systems and mainly served to cover food needs during the dry season. Irrigation water was limited, and lowland intensive home gardens were primarily used for staple food cereal production during the rainy season – they are called 'maize fields' in local languages, as opposed to 'bush fields' which are used for millet and sorghum cultivation (Barral, 1968; Lahuec, 1980).

During the colonial period, irrigation development was central to the strategy implemented by the French colonial authorities to enhance food production in their West African dependencies. This period witnessed the implementation of large projects such as the *Office du Niger* in Mali, and irrigation schemes in the Senegal River Valley. Burkina Faso, with limited surface water resources on its territory, didn't possess sufficient potential for implementing such large-scale irrigation projects. The main interest in the region was the production of cotton and groundnuts for export (Tourte, 2005).

The first attempts to foster dry season agricultural production, and to develop irrigation, date from the colonial era, with a small-scale, non-governmental, and decentralised approach pursued by missionaries. They brought not only their Bible to Burkina Faso, but also their love for horticulture and gardens. With the help of the local population, they built earth dams near their settlements. They introduced 'new' vegetables like green beans and tomatoes, which were adopted first by local elites and then by the broader population (Zoungrana, 2006; Freidberg, 2003; Ouédraogo, 1993). The *Pères Blancs* (White Fathers) have thus played a key role in introducing small-scale irrigation development in Burkina Faso and, above all, in teaching horticultural techniques to the rural population. The number of dams built during the colonial period, however, was very small (about 100), compared to the number constructed later (Cecchi et al., 2009). Vegetable production and consumption thus remained limited before Independence in 1960.

The development of small reservoirs and peasant organisations

Shortly after Independence, and through the 1970s and 1980s, Burkina Faso faced several critical social and environmental crises. The government recognised the need to enhance water availability and develop food production during the dry season as a means of mitigating the effects of drought and to prevent famines. From that moment on, and following the example of the *Pères Blancs*, development efforts were primarily targeted at the construction of small dams throughout the territory, especially on the Mossi Plateau. At least 500 dams were built between 1974 and 1987 (Cecchi et al., 2009).⁷

⁷ It is likely to be higher than 500, since 2100 reservoirs were recorded in a 1991 governmental report (cited in Zoungrana, 2006: 418). The actual figure is difficult to assess due to the multiple variations and uses that are categorised as 'small reservoirs', and a more recent nationwide estimate has yielded a figure of 1700 dams (Venot and Krishnan, 2011: 317).

Several actors have been engaged in the construction of dams. First, the state saw an opportunity to strengthen its presence at a national level and to improve its legitimacy in the eyes of the rural poor by providing water access and thereby supporting dry season agriculture (Zoungrana, 2006). Most of state investments were targeted at the development of large-scale irrigation schemes, such as those of the Sourou Valley. But the policy also provided a legal and institutional framework favourable to a more decentralised type of development which was based on local peasant organisations. This positive momentum for rural development reached its peak during the Sankara Revolution in the 1980s, which also coincided with the second major drought and food crisis. The debt crisis, and the subsequent structural adjustment programmes and global shift in development strategies, put an end to this era.

Second, peasant organisations emerged as key actors in uniting the local workforce to address common needs, mostly in northern Burkina Faso. These village associations were mainly a modernised version of the customary *Naam*, a mutual aid organisation involving the whole village population, including men and women of all ages (Ouédraogo, 1990). Under the initiative of these associations, many roads and small dams were built, soil and water conservation techniques were disseminated, and trees were planted. The dry season thus became a time of collective action, and lowlands witnessed the development of individual income-generating activities – a form of farmer-led irrigation development.

Finally, non-governmental organisations (NGOs) financed hydro-agricultural infrastructure and supported the associative movement. Catholic aid organisations played a distinctive role in this respect, contributing to the spread of the Pères Blancs model both in terms of agricultural development and proselytism. Another programme, Six-S,⁸ played a central role in financing the first *Naam* organisations. Its aim was not only to develop dry season agriculture, as its name indicates, but also to provide a new source of income to women and young people from activities that were not under the direct control of the family head, which were thus a means to their progressive emancipation (Lecomte, 2018). Moreover, at a time when bilateral aid was directed to the state to finance clearly defined programmes or projects, Six-S practised an alternative way of financing development by making funds freely available to its partner peasant organisations. The flexibility of this arrangement thus falls outside the usual rigid project framework and makes local development agents more accountable for their actions (Gueneau and Lecomte, 1998), thanks to the openness of the funder and the mutual trust of all partners.⁹

Villagers, with the financial support of foreign donors, were therefore the main driving force behind the small reservoir boom that took place in the 1970s and 1980s.

Small-scale private irrigation

The following decades were characterised by deep changes related to the neoliberal agenda imposed by international organisations which led, among other things, to withdrawal by the state and, paradoxically, to the collapse of the peasant organisation system. In the 1990s and 2000s, a new form of intervention emerged under the small-scale private irrigation model that was being promoted by the World Bank (Sally and Abernethy, 2002). It caused a shift from hydro-infrastructure development to the improvement of irrigation technologies and the modernisation of farming.

This new era is marked by the debt crisis, the structural adjustment programme, and the global liberalisation process. This turning point had a clear impact on rural development in Burkina Faso, and on the irrigated agriculture sector in particular. From then on, policies have favoured private actors to the detriment of the associative movement and, to a large extent, of family farming. By prioritising the

⁸ Six-S: *Se servir de la saison sèche en savanne et au Sahel* (Making Use of the Dry Season in the Savanna and the Sahel).

⁹ Six-S was also known to stand for *Se servir sans souci des sous suisses* (Making use of Swiss funds without worry) (Lecomte, 2018).

professionalisation of farmers, support and investment were de facto targeted at an elite group of business farmers, and at non-farmers. It did not benefit the vast majority of small family farms, not to mention the food-insecure or low-income sector of the population. Moreover, by focusing on a segmented sectoral approach, and by supporting the specialisation of production, rural development strategies opposed the basics of peasant family farming, which rely on the convergence of various activities and on family labour. The ambivalence of the rhetoric – which evinced a desire to assist both agribusiness and small family farms – was thus, in effect, conducive to the former. It fostered large-scale developments such as the Bagré Dam project (Kaboré and Sédogo, 2014).

Peasant organisations were deeply affected during this period for several reasons. First, funding aiming at agricultural development substantially decreased and was no longer targeted at village associations, even though collaborations with producer organisations continued to be favoured. Second, the efforts to federate local organisations at different levels (provincial, national, regional) often led to the creation of empty-shell organisations with no legitimacy (Onate, 2012; Coronel and Keita, 2010). Third, the changes in the legal framework that were designed to promote cooperatives came at the expense of local associations, prohibiting them from performing commercial activities. As a result, paradoxically, local peasant organisations declined even as they were being federated, and even as they continued to be the preferred partners of development projects as *producer* organisations or cooperatives (Ouédraogo and Ouédraogo, 2011; Mercoiret, 2006).

In this context, a new approach to irrigation development appeared in Burkina Faso, originating from the *Fadama* (lowlands) development programmes in northern Nigeria that had been supported by the World Bank since the early 1980s (Hima et al., 2016). This new approach consisted of disseminating modern irrigation technologies – treadle pumps, motor pumps, low-cost drills – associated with the Green Revolution package of improved seeds, pesticides, and fertilisers. In the late 1990s, the World Bank wished to expand its programme to the broader Western Sahel region and to spread this model of small-scale private irrigation to Niger, Mali, Burkina Faso, and some other countries (Sonou and Abric, 2010).

In Burkina Faso, the World Bank approach was implemented through the DIPAC programme between 1999 and 2004, with a budget of US\$5.2 million, and was followed by the PAFASP programme between 2007 and 2017 (ibid). However, the World Bank did not invest as much in Burkina Faso as in other West African countries, and favoured the use of treadle pumps even after motor pumps became available and affordable for family farms. The impact of the World Bank-supported programmes on irrigation development was thus limited.

Nonetheless, irrigated gardening expanded in the country as the availability of agricultural inputs and irrigation equipment increased. During the 1990s and 2000s, irrigation development continued to be characterised by duality (small vs large, peasant vs agribusiness) and adopted a neoliberal orientation. Projects and programmes were not key drivers of the expansion of small-scale irrigation. It was led by farmers with their own, if limited, investment capacities, in response to a growing demand for vegetables. The state irrigation development strategy was overtaken by farmers' adaptation and innovation abilities, in the context of rapid market globalisation which was characterised by a necessity for farmers to engage in income-generating activities like market gardening.

Current directions of small-scale irrigation development: Drip irrigation and agroecological gardening

From the mid-2000s, the small-scale private irrigation model evolved towards the low-cost drip irrigation promoted by the ICRISAT programme, *The African Market Garden, Advanced Horticulture for the Poor* (Woltering et al., 2011). The new model was promoted through huge marketing and communication efforts (Venot, 2016; Wanvoeke et al., 2017).

Under the African Market Garden initiative, two kinds of drip kits were proposed in Burkina Faso, with two different approaches employed for their dissemination. Under a classical developmentalist approach, the Netafim drip kit (fed from a cement water tank) was subsidised through programmes such as the World Bank's PAFASP, the Swiss Cooperation's PDMIG,¹⁰ and IFAD's PIGEPE.¹¹ The other approach, developed by iDE,¹² is based on social entrepreneurship. Its drip irrigation kit, with a low-cost plastic water tank or barrel, was promoted through market incentives and demonstration sites. Though their approach was market-based, 85 percent of their kits were actually bought by development organisations and offered to farmers, hence were indirectly subsidised (Wanvoeke, 2015: 99).

This approach had a limited success in Burkina Faso. The adoption of low-cost drip irrigation kits is indeed very low, and they are barely used in concrete production situations (Wanvoeke et al., 2015). One iDE agent declared that it would take time for farmers to acknowledge the need for water-saving drip irrigation, in the same way that it took time for them to adopt animal-drawn cultivation in past decades. As of 2018, despite growing evidence that the adoption of drip irrigation remains marginal, it is persistently praised in development narratives and national policies – for instance in the *Programme National du Secteur Rural II* (Burkina Faso, 2017)¹³ – and continues to be promoted through development programmes. The situation reveals a profound gap between population needs and development policies.

Agroecological gardening has recently emerged as an alternative model based on a radically different conception of agricultural development. The agroecological alternative is rooted in the revolutionary Sankara period. President Sankara was indeed strongly concerned about environmental issues linked to agricultural development, such as desertification, deforestation, and land degradation. Moreover, he was willing to base the national development strategy on endogenous development principles. In this respect, he delivered a famous speech at the African Union on the reasons for indebtedness, defending the local production of clothes and food (Sankara and Ziegler, 2014). He was also prepared to set up pro-peasant and pro-poor policies. At some point, he was introduced to Pierre Rabhi, a now very well-known peasant-philosopher who was then experimenting with agroecological practices in Gorom Gorom, in the Sahel Region, and was training Burkinabè peasants to adopt natural farming principles inspired by Steiner and Pfeiffer's biodynamic agriculture.¹⁴ Impressed by his abilities, Sankara offered him the post of Minister of Agriculture. Sankara was assassinated before the appointment was made, and the agroecological programme was shelved. Occasional agroecology-related initiatives were however conducted through the works of Rabhi's students and some others.¹⁵ The agroecological movement was reactivated in Burkina Faso in around 2010, notably in the form of small projects supported by Terre et Humanisme, a French association founded on Rabhi's legacy.

The re-emergence of the agroecological alternative in the 2010s was fuelled by the renewed worldwide interest in agricultural development in the late 2000s (World Bank, 2007; McIntyre et al.,

¹⁰ PDMIG: *Programme de développement du maraichage par l'irrigation goutte-à-goutte* (Market Gardening Development Through Drip Irrigation Programme).

¹¹ IFAD: International Fund for Agricultural Development. PIGEPE: *Projet d'irrigation et de gestion de l'eau à petite échelle* (Small-Scale Irrigation and Water Management Project).

¹² iDE: International Development Enterprises.

¹³ PNSR II = *Programme National du Secteur Rural II* (Second Rural Sector National Programme).

¹⁴ Biodynamic agriculture, pioneered by Steiner and Pfeiffer, can be considered to be one of the cornerstones of organic agriculture (Besson, 2011). Rabhi explained his inspiration and unique relationship with Burkina Faso at a conference in Ouagadougou in 2015.

¹⁵ For example, and without any direct connection to the international agroecology movement: Yacouba Sawadogo, Laureate of the 2018 Right Livelihood Award, and known as the man who conquered the desert; René Girard, whose land use design called *Wégoubri* interestingly involves not only agroecological farming but also land redistribution (Girard, 2008).

2009). Alternative approaches like agroecology were being brought forward, challenging the mainstream model of agricultural development. Agroecology is linked to the global peasant movement led by *La Via Campesina* in its fight against further agricultural product trade liberalisation promoted by the World Trade Organisation. Sustainable peasant agriculture and family farming are presented as the sole way to meet global food needs in the near future, while at the same time improving resilience to climate change (La Via Campesina, 2010). Agroecology is thus as much a science as a set of agricultural practices and a social movement (Wezel et al., 2009), and these three dimensions are inseparable (Sevilla Guzmán and Woodgate, 2013).¹⁶

Meanwhile, soil and water conservation techniques based on farmers' knowledge have been promoted in Burkina Faso since the 1980s in order to mitigate environmental degradation and halt the decline in rainfed-crop yields (Ackermann et al., 2012; CILSS, 2012). However, these techniques are not as radical in transforming agricultural practices as the systemic approach of agroecology. Improving water infiltration and saving soils from run-off is one thing, but it is another thing entirely to shape the whole farm and regional ecosystem to optimise resource use under natural agriculture principles, and to increase vegetation and soil biomass that can be used to meet human needs (Agrisud, 2010; Berton et al., 2012). Moreover, far from the agroecological ideal, vegetable production has intensified and agriculture as a whole relies increasingly on agrochemical inputs. As a result, water pollution, pest resistance, misuse of chemicals, and food contamination have become issues of concern.

VEGETABLE PRODUCTION AND THE DIVERSITY OF SMALLHOLDERS IN RÉO

Study area

As indicated in the introduction, our study takes a holistic perspective centred on livelihood economics and agroecology, addressing irrigated vegetable production as just one of the family's activities. The survey was conducted on a sample of 66 smallholders spread over 27 production sites in Réo. The latter share similarities – as, for example, the proximity of a reservoir – but are different in many respects, particularly regarding irrigation practices, but also in terms of market access factors such as transportation opportunities and distance to the city. The sample covers a wide range of socio-economic realities, including a range of poor to rich smallholders, and men and women of all ages. The aim was to highlight the diversity of smallholders and to understand their trajectories.

The study area is located in Réo, a municipality near the city of Koudougou in the central-western region of Burkina Faso, 100 km west of the capital city, Ouagadougou (Figure 1). The city of Réo, with a population of about 30,000 in 2006,¹⁷ gives its name to the municipality. The neighbouring villages of Zoula and Goundi form the second area of settlement in the municipality, with a total population of about 15,000. The population is composed mainly of Gourounsi people, with Mossi people as the next-largest group.

The area is conducive to vegetable gardening. The topography is characterised by lowlands channelling run-off in multiple ways that are favourable to small reservoir development (Figure 1). Though subject to strong climate constraints, and with a short rainy season, this setting makes water available during the dry season for small-scale irrigated vegetable production. Furthermore, Réo is one

¹⁶ In this study, agroecology is mobilised as a scientific method for analysing the current living situations of smallholders producing vegetables, as much as being an object of study (the agroecological farming projects and the practices they promote).

¹⁷ The most recent figures date back to the last General Census of Human Population (2006). With an average annual growth rate of three percent, population has dramatically increased since that census.

of the historical zones of vegetable gardening development due to the long-lasting presence of the Pères Blancs, and to the high density of small reservoirs.

Water availability for irrigation is one of the most critical issues for dry season vegetable production. At the national level, water consumption in 2013 amounted to 6.5 percent of the estimated renewable water resources, with about 50 percent of the withdrawal being devoted to agriculture (FAO-AQUASTAT). Overall, national water resources are underused, but the availability of water throughout the year depends on the hydrological infrastructure. Hundreds of dams have been constructed, and it is not clear whether the actual slower pace of dam construction is related to the decline in funding or to fewer appropriate locations. In the medium term, water availability also strongly depends on rainfall, and thus is potentially significantly affected by climate change. Regional trends in total rainfall look favourable, although future climate models show that rainfall episodes might become more intense and erratic (Descroix et al., 2015).

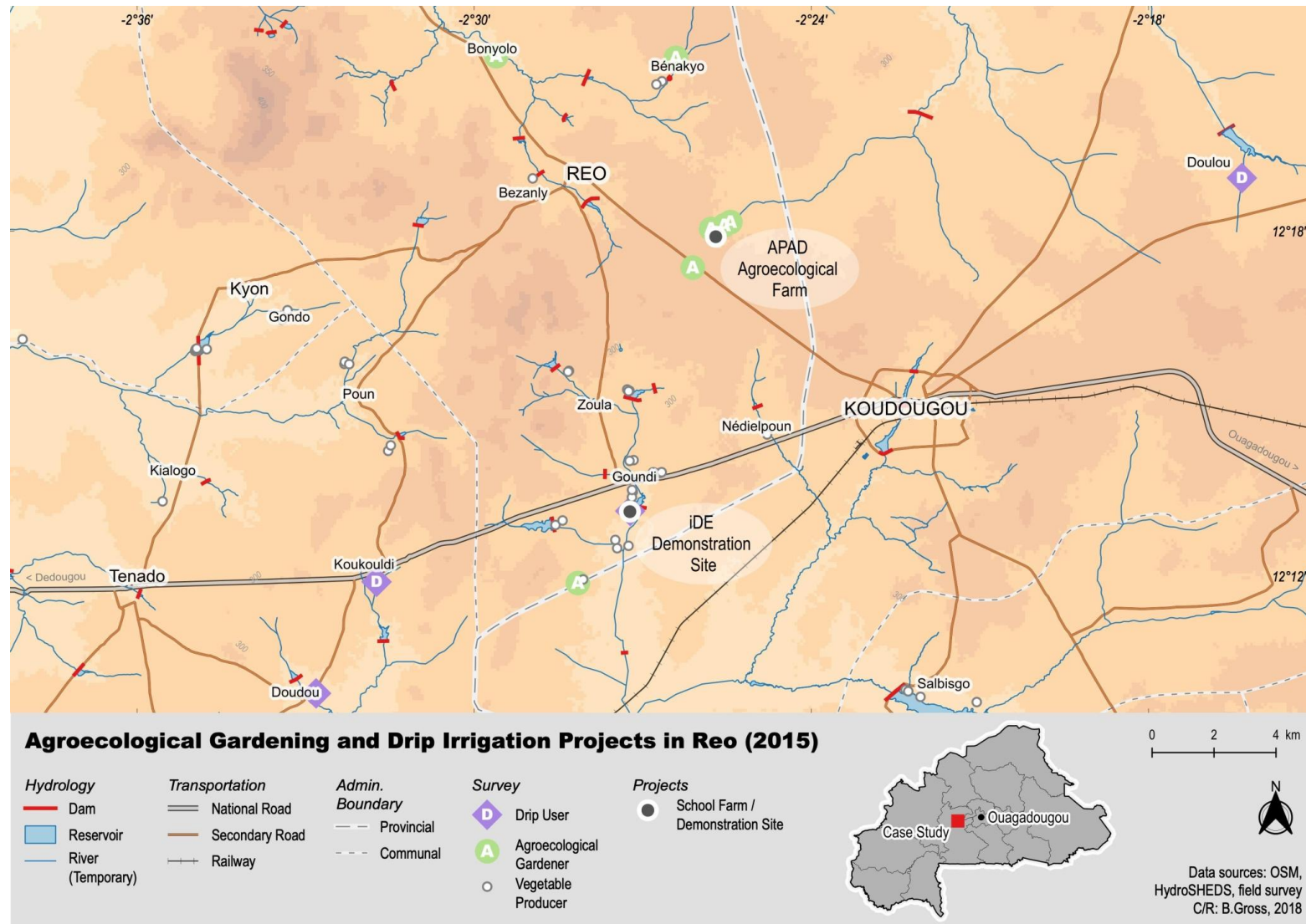
There are no signs of water over-exploitation in the study area, but neither the spatial extent of irrigated land nor the amount of water consumption is precisely known, and the exact number of reservoirs is also unknown since not all are registered. A regional census (DRA-CO, 2006) provides a low estimate: the municipality of Réo holds the largest number of reservoirs in the central-western region – 15 of the 138 that are spread over 29 municipalities. They were mostly built between 1974 and 1988, and were financed by different funders, mainly the Catholic aid organisations (37 percent), but also the state (13 percent), local village associations (11 percent), as well as NGOs, development agencies, and private donors. According to the census, in 2006 only 16 percent of the reservoirs were in good condition, while most of them were in an average or even bad condition (30 percent). Indeed, vegetable producers witness the shrinkage of water storage capacities because of silting and/or the degradation of hydro-agricultural infrastructure. The state of reservoirs is thus an issue today, threatening water availability for irrigation, but little is done for their maintenance. Water-saving techniques can ease the situation but do not address the core problem. With its water use optimisation strategy, the systemic agroecological approach offers a solution to silting of reservoirs but it needs to be applied at a large scale.

The next two most important issues regarding vegetable production development are sustainability and health hazards for producers and consumers, illustrated by several examples in the Réo area. The whole region specialises in onion production. Cultivation is very intensive, and farmers produce up to three crops per year on the same plot. As a result, farmers experience a growing resistance by pests to chemical treatments. In Koukouldi (Figure 1), for instance, 2015 was by far the worst year in memory, with a mysterious disease that caused seedlings to rot. Almost all farmers were affected, and their income was drastically reduced.¹⁸ Vegetable producers' intensive practices also impact water and food quality, and thus human health. The use of chemicals leads to potential water contamination in a context where areas of residence and cultivation are in close proximity, and where drinking and irrigation water sources are not differentiated. Farmers also reported that pesticides are often sprayed on fruits and leaves just before their consumption, causing stomach pains or other health problems.

Regarding vegetable gardening challenges in Réo, drip irrigation is presented as a response to water scarcity, and agroecology as a global approach that addresses both water availability and health hazards. Agroecology proponents promote a solution that is designed to help poor farmers manage natural resources in marginal environments (Altieri, 2002), recognising however that this strategy needs to be part of a global approach to the multiple challenges of agricultural sustainability. In the following sections we analyse the actual impact of both approaches in relation to vegetable gardening and with respect to the concrete socio-economic situation of smallholders.

¹⁸ For example, the net income of a surveyed farmer fell from US\$3574 to US\$476.

Figure 1. Location of the study area and development projects sites.



The vegetable production economy

Vegetable production mainly takes place during the dry season, between December and April. Few farmers cultivate vegetables on smaller upland gardens during the rainy season, from June to September, while rice or tuber cultivation takes place in lowland areas, and mango trees grow at the edges of lowlands. Most pasture land is used for free grazing of goats, sheep, and cattle during the dry season, giving gardening its regional uniqueness: fences made of stacked sorghum stalks, constructed in order to prevent small livestock from entering gardens.

Vegetable producers of the Réo area generally do not utilise modern irrigation techniques (information on vegetable gardening characteristics can be found in Table 1). Manual irrigation is prevalent, from water drawing to plant watering. In 90 percent of cases, the main water source is wells by which shallow groundwater is accessed. Though a few farmers cultivating land near the reservoir use surface water for irrigation, reservoirs are primarily used to foster infiltration and groundwater recharge. Motor pumps are also used by 19 percent of vegetable producers (Table 1), either for drawing up groundwater or for pumping surface water from reservoirs, depending on the garden's location – a figure which is far lower than in other regions of the country. Moreover, farmers in possession of a motor pump do not use it systematically, in order to save on fuel or to avoid temporary water shortfalls due to groundwater drawdown. In some rare instances, more sophisticated forms of irrigation such as gravity-fed networks or drip kits are used (one and four cases out of 66 respectively).

Access to land is mainly governed by customary rules, either in the form of inherited ownership or lending. The study showed no evidence of formal land tenure rights that were based on a property title in the central ('*Centre*') and central-western ('*Centre-Ouest*') regions of Burkina Faso.¹⁹ Some modern forms of tenancy agreements involving monetary compensations can however be noticed, especially near the capital city of Ouagadougou. In the Réo area, 69 percent of vegetable producers inherited their land, and the size of garden plots ranged from 400 m² to 1.5 hectares (ha), with an average size of 0.61 ha (Table 1).

Onions are the main vegetable crop cultivated in the area, followed by cabbage, though there are local variations on this. Some villages cultivate garlic instead of onions, some farmers produce tomatoes, pepper, or local eggplant. But, by far, the main income-generating crop is onions, accounting for 50 percent of the total earnings from vegetable production in the survey sample. Vegetable production is very profitable: it generates an average profit per household of FCFA 534,000 (US\$929) per year (Table 1). As an input-intensive activity, vegetable gardening requires high expenditures. Chemical fertilisers are the biggest expense, followed by seeds and pesticides. Labour, when hired, is a significant expenditure. Only 14 percent of farmers spend more on labour than on inputs, a figure which can also be influenced by a relatively low level of input use. Family farms have limited investment capacities. Meeting operating costs constitutes 85 percent of their garden-related spending while benefits are used for meeting the family's basic needs, leaving little financial capacity for technical improvements even in the form of a small motor pump.

¹⁹ Formal property (i.e. registered with a certificate or a title) may exist in specific locations such as small- or medium-scale irrigation schemes. Our study mostly focused on informal irrigated land dominated by informal property (i.e. inherited ownership) and lent land (which includes a broad range of informal arrangements to access un-inherited irrigated lands, and is to be distinguished from rented land) (Table 1).

Table 1. Main characteristics of the sampled smallholders in Réo.

	Survey sample			Smallholder types ^a			
	Min.	Mean	Max.	Wealthy	Market-oriented	Traditional	Poor
N (sample size)		66		6	9	10	18
Vegetable gardening							
Members of peasant organisations		32%		67%	56%	30%	6%
Development support beneficiaries ^b		20%		83%	22%	20%	0
Trained vegetable producers ^c		39%		83%	33%	50%	22%
Veg. producers trained in agroecological farming		11%		0	0	20%	11%
Vegetable garden area (ha)	0.04	0.61	1.50	0.76	1.06	0.60	0.50
Land tenure: ownership		69%		83%	50%	80%	72%
lent or rented land ^d		31%		17%	50%	20%	28%
Irrigation by motor pump		19%		50%	33%	20%	6%
Number of permanent workers	1	3.4	19	4.7	6.4	2.5	2.8
Total garden operation charges (US\$) ^e	73	637	4669	1418	880	412	436
Labour costs/garden op. charges		25%		29%	31%	24%	21%
Inputs/garden op. charges		57%		51%	51%	54%	61%
Family economy							
Household size	3	11.4	30	15.2	13.4	10.4	9.3
Food self-sufficiency (months/year)	2	6.6	12	10.6	4.2	10.1	4.1
Indebted households	34%			20%	22%	10%	44%
Total household annual income (US\$)	39	1429	5766	3304	2459	692	550
Vegetable production net annual income (US\$)	-61	929	3605	2288	1832	481	294
(percent of total income)		(73%)		(68%)	(76%)	(73%)	(62%)
Off-farm annual income (US\$)	0	164	2104	639	155	5	108
(percent of total income)		(10%)		(18%)	(5%)	(1%)	(17%)
Total household expenditure (US\$) ^f	224	1256	4002	2021	2309	629	770
Food expenditure (US\$)	0	222	626	182	342	146	224
(percent of total expenditure)		(24%)		(9%)	(16%)	(27%)	(33%)
Income-expenditure balance (US\$)	-1133	173	3135	1284	149	63	-220

^a The four categories are built on two key indicators: food self-sufficiency and monetary income. Sub-samples exclude data extremes

^b Any kind of support ever received by a farmer from a development organisation. ^c Any kind of formation, including agroecological farming

^d Rented land is marginal and mostly used by market-oriented smallholders. ^e Includes labour, inputs, amortisation of investments, and some other fixed costs

^f Includes the costs of food, health, education, housing, transportation, and customary celebrations. US\$1 = FCFA 575

Crop choices are driven by market preferences and sales opportunities. Some vegetables are produced for the local market (mainly green leaves like sorrel), where small quantities of leftovers or secondary crops can also be sold, however most of the production is intended for urban markets. Intermediaries, often women, may buy directly from the field, or the producers will transport produce to the closest city themselves in order to get a better price from a city wholesaler or, in the case of a glut and therefore no demand from intermediaries, to sell their produce at a slashed price before it rots. Vegetables are either marketed to the main cities where they are sold to middlemen and retailers, or they are exported to foreign countries such as Ivory Coast or Ghana.

For instance, a significant part of the tomatoes produced in Burkina Faso are exported to Ghana. According to the chairman of the Ghana National Tomato Traders and Transporters Association, this trade is approximately worth US\$100 million per year, and Ghana imports 90 percent of all the tomatoes produced in Burkina Faso (Ghana Business News, 2018). They are then processed and partly re-imported by Burkina Faso in the form of tomato paste. All the tomato producers interviewed in the Réo area reported their dependence on Ghanaian trucks to sell their produce, and some testified to wasting their time and losing all their money as they waited in vain for a truck that failed to arrive. Vegetable market gardening is generally profitable but is not without risk, and stories of this sort are common among producers.

Onion trade chains are more complex. Two of the largest suppliers of onions in Western Africa are Burkina Faso and Niger, but part of the national export stocks may be found on the other country's markets as they follow local price variations and particular arrangements of sellers' networks. Onion stocks also circulate within each country, as they have become part of both the rural and urban diet. Onion producers of the Réo area usually target more than one of these different trade circuits, depending on their production capacities but also for the purpose of risk mitigation. The more direct the link between a producer and a (foreign) wholesaler – for instance after a migrant working experience in Ivory Coast – the better the possibility of making money. The aggregate vegetable market value is thus considerable, and contributes significantly to the cash income of family farms in Réo, as well in Burkina Faso as a whole and in other Sahelian countries.

In light of the above, some major issues regarding vegetable production in Réo can be put forth. First, reservoirs have to be functional to ensure water availability for vegetable gardening during the dry season. Irrigation techniques as simple as motor pumps are not widely spread and appear to be the first necessary step towards modernisation. Second, irrigable land is not equally shared among community members, and the conditions for its access differ in terms of surface area and security. If no land acquisition can be witnessed, the trend is towards new types of arrangements involving a rental payment. Third, the low diversity of vegetable crops leads to market saturation and plant disease persistence, in both cases causing income losses for many family farms. This situation calls for better organisation of smallholders and production planification in order to reduce price volatility and stabilise income, and the implementation of safety nets or other risk alleviation measures – for example a fairer sharing of risks and benefits between producers and traders. Fourth, investment capacities are constrained by high operating costs. As vegetable production is very profitable, improving access to credit or other forms of financing would help farmers develop their operations. Finally, some challenges fall beyond the scope of local development and must be addressed nationally or regionally, as shown by the example of the tomato producers who would benefit greatly from processing facilities located in Burkina Faso.

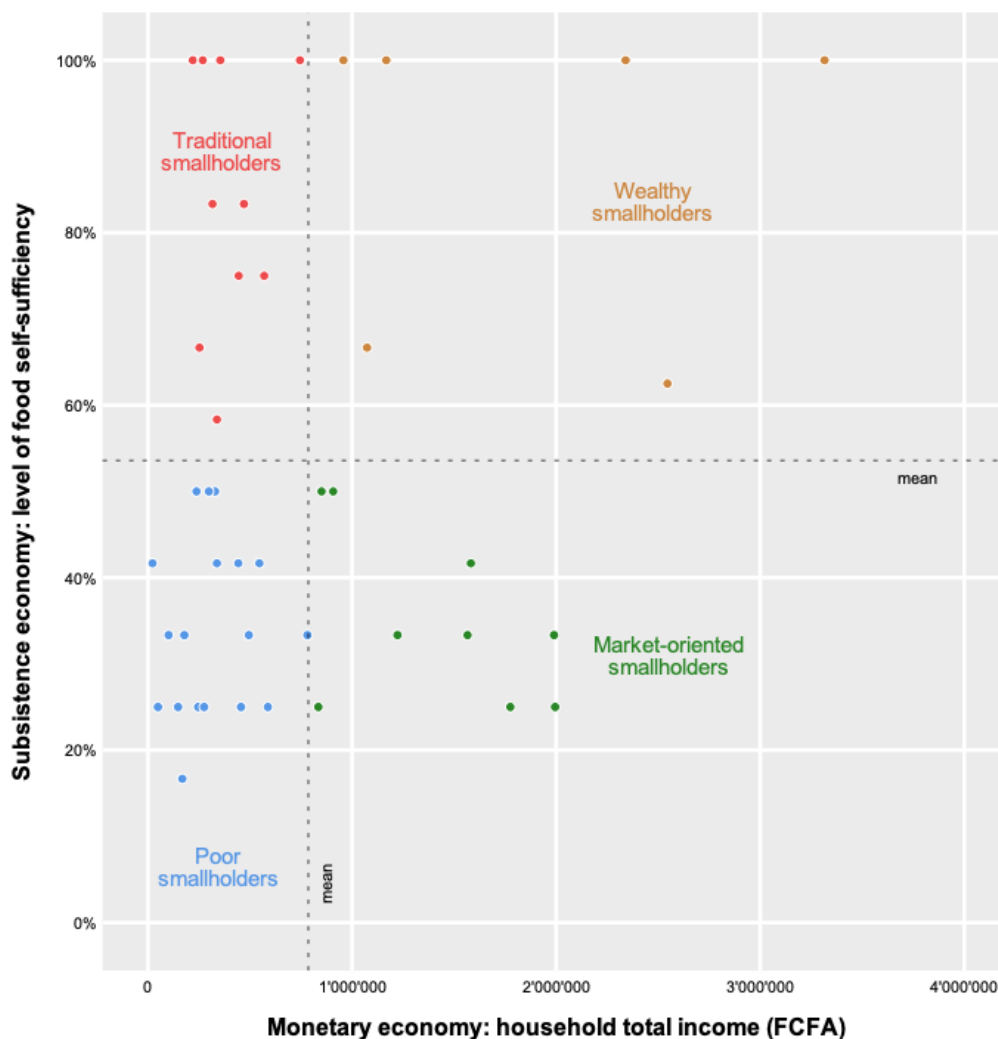
The smallholders' family economies

The survey highlights the large diversity among smallholders undertaking vegetable market gardening in the region of Réo, whose main characteristics are presented in Table 1. The average family's annual income amounts to FCFA 822,000 (US\$1429), with a great disparity among households (ranging from

US\$39 to US\$5766, see Table 1). Vegetable production is the main source of income from family farms, accounting for 73 percent of their total income. In per capita terms, however, average income is below the standard poverty line, at less than US\$0.50 per capita per day. The subsistence non-monetised economy also plays a crucial role in meeting smallholders' needs, as on average half of the food they consume is self-produced.

All family farms combine rainfed and irrigated crops, livestock breeding, and off-farm activities such as small businesses or working as mechanics, in an attempt to meet their livelihood needs through various strategies which balance self-sufficient and market-based economies. Food self-sufficiency and monetary income are key indicators of these two types of economy. They are used to define four types of smallholders (Figure 2), a categorisation that helps understand the diverse situations of rural family farms (Table 1). Two categories of 'well-off' and two of 'insecure' family farms can be differentiated: 'wealthy' smallholders, benefitting from monetary income and close to food self-sufficiency; 'market-oriented' smallholders, specialised in income-generating activities (including market gardening) as their main source of income, and dependent on purchased food to cover family needs; 'traditional' smallholders, who are food secure but lack money to access basic services such as education and health; and 'poor' smallholders, who struggle to meet their food and non-food needs.

Figure 2. Categorisation of smallholders in Réo.



Households which have many years of experience in market gardening, and also have available family labour and investment capacity from other income-generating activities, are generally in a profit-making position. These well-off vegetable producers are often self-sufficient in grain, which earns them a prominent social status. Some have relinquished this traditional position, however, as they prefer to produce vegetables during the rainy season and purchase the staple foods they need (Table 1). In other words, signs of wealth are gently moving from barn and herd to motorcycle and home solar power systems. If the incomes of wealthy and market-oriented smallholders are very high in comparison with the two other groups, only the former end up with a largely positive balance, thanks to off-farm incomes and a higher level of food self-sufficiency (Table 1).

For some family farms, vegetable production is a secondary activity. Typically, they have only one small garden and produce one onion crop during the cold season, from December to February. Their expertise at gardening is not always well developed, and they may face problems in crop production or sales. Market saturation at harvest time, and the consequent drop in prices, is the factor with the most impact on their income since they cannot store onions. These households are relatively insecure, especially as their farm production does not cover their annual food needs – marking the differentiation between traditional and poor smallholders. Nevertheless, their small income helps them meet basic expenditures like their children's education or their food supply, which represents a higher share of the poor household's budget (Table 1). But the balance between income and expenditure is on average negative, causing 44 percent of poor smallholders to be in debt (Table 1). That said, the poor smallholders in our sample are not part of the most deprived family farms found in the area. They can face the relatively high costs of vegetable production, and their members provide the required labour. The most vulnerable households are those who lack workers and access to land and/or cash income opportunities such as market gardening. These very poor smallholders fall beyond the scope of our study.

The four categories we identify are used to explain the main trajectories of vegetable gardening development. They are not homogenous, and they encompass different situations. Some family farms rely on livestock, others on rice cultivation or arboriculture, giving vegetable market gardening more or less importance in their multifaceted strategies to meet family needs. Vegetable producers may at the same time be vegetable traders, organisation leaders, or development brokers. Women also play a distinctive role in vegetable production, either within the family helping their husband, or cultivating vegetables independently. A couple of the well-off farmers mentioned above have shifted from a family-based farming model to agribusiness. They employ hired labour, and the heads of farms concentrate their activity on the technical and financial management of the farm. They use inputs intensively, and have a large investment capacity. Those fitting this emerging entrepreneurial profile are the primary target of the current rural development policy. Another distinctive profile encountered in the Réo area is the young migrant vegetable producer. His activity is financed by a member of his family and takes place near a reservoir, typically in the informal 'colonised' areas outside of irrigation perimeters (de Fraiture et al., 2014), always far from their home. This new form of internal economic migration replaces traditional external migration routes to the plantations of Ivory Coast and Ghana, suggesting how profitable and promising the national vegetable production potential is.

Who among the farmers have benefitted from irrigation development projects? Our study confirms the limited impact of development interventions other than the construction of dams – which are in most cases older than the surveyed farmers. In Réo, while 40 percent of the surveyed farmers benefitted from training in gardening techniques provided by projects or an agricultural school, only 20 percent of the smallholders have received support, mainly in the form of equipment provision (Table 1). Approximately half of the support was intended for rice production and used for gardening in the dry season. Rice production projects provided cement wells and, in a few cases, small collective irrigation schemes. But what is most striking is that beneficiaries are mostly part of the wealthy smallholders, and 83 percent of these wealthy smallholders gained support from projects, a situation linked to their

belonging to a peasant organisation (Table 1). On the contrary, poor smallholders are rarely members of peasant organisations and therefore do not receive support (Table 1). Development projects not only have limited impact, they also fail at addressing the insecure smallholders, not to say those who cannot afford to engage in irrigated vegetable production. Since development interventions had limited impact, the recent expansion of gardens and intensification of vegetable production were thus primarily led and financed by farmers.

DRIP IRRIGATION AND AGROECOLOGICAL FARMING PROMOTION IN RÉO

Two vegetable gardening development projects have been implemented in the study area, one by iDE and the other by APAD²⁰ promoting, respectively, low-cost drip irrigation kits and agroecological farming. iDE established a demonstration site in Goundi in 2014 (Figure 1). An irrigation kit was offered to a farmer identified as a community leader – a 'market-oriented' smallholder, according to our categorisation. He was asked to use the drip irrigation system in his garden and act as a product demonstrator for potential buyers from the area. The demonstration went on for three years. iDE's irrigation kits were made available in the city of Koudougou, at stores where farmers usually purchase seeds, pesticides, and gardening equipment. The marketing strategy was based on a strong confidence that the benefits of the innovation would be self-evident to farmers – iDE's slogan is "show, don't tell" (iDE, 2016). Several sizes of drip kits were made available to cover a broad range of possible uses, from the small family garden (50 m² at a cost of about US\$350) to the bigger market garden (over 500 m² at a cost of about US\$2500). iDE also put farm business advisors at the drip users' disposal to ensure that kits were correctly installed and maintained.

APAD is part of the Terre et Humanisme network in Burkina Faso, and follows its model for the promotion of sustainable agriculture through agroecological school farms. The new generation of interventions favoured by Terre et Humanisme to promote agroecology is twofold, and originates from the Gorom Gorom experience. The main activity is centred on a school farm and consists of training courses for agroecological leaders from the region who will then disseminate their knowledge. The second type of intervention is more local and diffuse. It aims at raising neighbouring farmers' awareness on sustainable agriculture and healthy food issues in a context of growing problems related to the use of agrochemicals. Farmers are sensitised to the limits of intensive agriculture and introduced to natural pest management, composting, combine cropping, and water-saving gardening techniques (Terre et Humanisme, 2015).

APAD established a school farm in Réo in 2013. The farm centres its activities on seed production to assure its economic autonomy, besides hosting agroecological training sessions. The sensitisation and training programme targeting local vegetable producers began the following year and introduced smallholders to several techniques. Agroecological gardening mainly rests on aerobic composting – as opposed to the anaerobic degradation of common manure. Composting requires dung, vegetal biomass, ashes, and a few other inputs. These are stacked and need to be flipped and watered from time to time. After a few weeks, a highly fertilising humus is obtained and can be used on gardens. The technique is thus time-consuming, and during the dry season necessitates the use of scarce inputs such as water and vegetal materials. Moreover, free grazing makes manure harvesting difficult. Intensive livestock breeding could produce a solution but is barely found in the study area. Another crucial set of techniques and principles relates to natural pest management. The key aspect of the approach is to avoid the occurrence of plant diseases or pest attacks, notably by implementing crop rotation. Farmers are taught how to use natural pesticides that are self-produced using neem leaves or pepper to control diseases and pest attacks. These techniques are not always successful, especially when agroecological

²⁰ APAD: Association pour la promotion d'une agriculture durable (Association for the Promotion of Sustainable Agriculture).

gardens are surrounded by intensive production sites. Vegetable producers were also introduced to water-saving techniques and crop associations. Finally, agroecological farming techniques specific to rainfed agriculture such as *zai*,²¹ and soil preparation favouring water infiltration, are also demonstrated at the school farm. Neighbouring farmers have a traditional knowledge of similar techniques but showed interest in the techniques promoted by the school farm. Many visited the demonstration site, where they gained advice for their farming practices.

The impact of the iDE approach to promoting drip irrigation in Réo is at best limited. Apart from the demonstration sites, not a single iDE irrigation kit was installed in the study area in the three years of the onsite demonstration. The owner of the demonstration site did not install the irrigation kit on other gardens he cultivates. The new technology is expensive with regard to smallholders' incomes: the cost of the smallest kit (US\$350 for 50 m²) represents one-third of the average annual net income from market gardening, and exceeds it in the case of poor smallholders (Table 1). Moreover, drip irrigation is not adapted to local gardening practices: gardens are divided into plots of about two square metres, and are planted with a high density of onions to maximise land and water use. Drip irrigation does not allow such high cropping density. Land, more than water, is a limiting factor for most of the farmers. Smallholders don't invest in a costly technique which results in a reduction of their potential income per unit of land. Another reason why they don't adopt iDE drip kits is that the micro-tubes are clogged by silt that is present in water, and the maintenance of the system is thus very time-consuming.

Nonetheless, three farmers in Koukouldi, Doudou, and Doulou (Figure 1) have invested in the competing and more expensive Netafim drip irrigation system. The investment of about FCFA 4 million for the whole system (US\$7000) was borne by two farmers, while a third farmer benefitted from a grant by the PAFASP and paid only a fraction of the cost. The investment, which is about five times the average annual household income in the area of Réo (Table 1), is out of reach for the majority of farmers. Those who invested in the Netafim system are among the most well-off smallholders. A significant part of their income is generated by activities other than market gardening (livestock farming, off-farm activities, etc) and they have enough land at their disposal to test drip irrigation (Table 2). Their interest is in saving hired labour rather than water, though another hypothesis is that they did not invest expecting any return other than prestige. One farmer using drip irrigation in 2014 was not using it in 2015 because poor storage conditions during the rainy season made the kit inoperable. He did not resume the use of the kit, and explained that drip irrigation was not worth further investment.

The success of the Terre et Humanisme training programme among vegetable producers in Réo is not evident either. If APAD's project does target insecure smallholders from both the traditional and poor categories (Table 1), five smallholders out of the six beneficiaries surveyed were not receptive and didn't adopt any of the agroecological techniques they learned. Only one farmer applied agroecological practices, including composting, natural pest management, own seed production, and water-saving plots. This traditional smallholder however continues to use chemical fertilisers or pesticides when needed, and did not adopt the overall agroecological approach to sustainable farming.

By contrast, another farmer from the survey applies agroecological principles and has, on his own initiative, abandoned the use of agrochemicals. His activities are complementary, not only in order to satisfy family food and cash needs but also to optimise resource use from a biophysical perspective. Livestock manure is systematically used as fertiliser for vegetable gardening and grain crops. One benefit of these practices is to improve the storage of onions and thus obtain a higher sale price, while livestock breeding is another important source of income. He also plants trees to restore the long-term

²¹ *Zai* is a farming technique to dig pits (20-30 cm long and deep and 90 cm apart) in the soil during the pre-season to catch water and concentrate compost. The technique is traditionally used in western Sahel to restore degraded drylands and increase soil fertility.

production potential of the land. His capacity for innovation draws on traditional knowledge and simple techniques. According to his sources of income, this smallholder belongs in the market-oriented category.

Table 2. Main characteristics of agroecological farmers and drip users in Réo.

	Smallholder types		
	Trained in agro-ecology ^a	Applying agro-ecological practices ^a	Using drip irrigation
N (sample size)	6	2	4
Vegetable gardening			
Members of peasant organisations	40%	0	100%
Development support beneficiaries ^b	33%	0	100%
Trained vegetable producers ^c	100%	50%	100%
Veg. producers trained in agroecological farming	100%	50%	0
Vegetable garden area (ha)	0.40	0.75	1.19
Land tenure: ownership	67%	50%	100%
lent land)	33%	50%	
Irrigation by motor pump	17%	0	100%
Number of permanent workers	2.7	4.5	3.5
Total garden operation charges (US\$) ^d	382	348	1,018
Labour costs/garden op. charges	28%	69%	17%
Inputs/garden op. charges	56%	25%	57%
Family economy			
Household size	11.3	10.5	16.0
Food self-sufficiency (months/year)	7.6	6.5	8.0
Indebted households	50%	0	33%
Total household annual income (US\$)	503	2144	3468
Vegetable production net annual income (US\$)	208	1,428	2,301
(percent of total income)	(59%)	(69%)	(62%)
Off-farm annual income (US\$)	28	0	678
(percent of total income)	(10%)		(15%)
Total household expenditure (US\$) ^e	585	1434	2784
Food expenditure (US\$)	237	214	298
(percent of total expenditure)	(47%)	(36%)	(11%)
Income-expenditure balance (US\$)	-81	710	684

^a Trained agroecological farmers benefitted from APAD's project but have not necessarily adopted the techniques they learned, contrary to farmers applying agroecological practices (one of them was trained by APAD, the other is self-taught)

^b Any kind of support ever received by a farmer from a development organisation

^c Any kind of formation, including agroecological farming

^d Includes labour, inputs, amortisation of investments, and some other fixed costs

^e Includes the costs of food, health, education, housing, transportation, and customary celebrations

US\$1 = FCFA 575

When comparing the economic situation of the two smallholders who apply agroecological practices with the group who benefitted from APAD's training, it appears they are not in the same league in terms of market gardening income and household total income (Table 2). Furthermore, garden operating costs are very low in relation to the garden area (US\$348/0.75 ha, Table 2), unmatched in any other category (Tables 1 and 2). If inputs represent the higher share (50-60 percent) in every category while labour comes second (20-30 percent), the situation is reversed for the two smallholders (25 percent for inputs, 69 percent for labour, Table 2). The application of agroecological practices reduces input costs and increases the labour requirement. In areas such as Réo, in which unemployment and economic migration are high, labour intensive activities are of interest. Paradoxically this argument is not put forward in agroecological farming narratives in Burkina Faso. However, only a small number of farming families can, or are willing to, allocate more family labour to vegetable production or resort to hired labour.

The global understanding of complex interactions related to agriculture and the natural environment is key in implementing agroecology, and small projects promoting particular techniques cannot address this broad issue. The main limitation of the strategy of Terre et Humanisme and APAD is precisely at this level. If it has succeeded in training agroecological leaders who are able to master this complex approach to farming, the wider dissemination of agroecological knowledge among smallholders – even solely for the purpose of vegetable production – poses a challenge. The situation points to the heart of agroecological transition issues, which go far beyond the farm level and involve consumers and policy makers. Agroecological projects contribute to the spread of a positive image of agriculture, promoting the pride of peasant families and enhancing traditional agricultural practices at a time when agricultural entrepreneurship and commercial farming are at the core of agricultural policies. However, the current project approach is not appropriate for a global transformation of the farming system.

CONCLUSION

The development of vegetable gardening in Burkina Faso has been largely led by farmers who have made use of opportunities following from the increased availability of water and the growing demand for vegetables. Past development projects have indeed had a limited impact, and current projects promoting either low-cost drip irrigation or agroecological farming have not had better success.

The two approaches to vegetable gardening development – drip irrigation and agroecological farming – are technically opposed in several respects. They represent, on the one hand, the mainstream agricultural development model and, on the other, the alternative agroecological model. Beyond the ongoing debate on the pros and cons of these respective models, the two approaches share similarities. They are both based on strong narratives referring to global issues: the world water crisis with regard to drip irrigation, and the unsustainability of the global agri-food system with regard to agroecological farming. They are also presented as promising options in terms of poverty alleviation and food security.

Smallholders are central to both narratives but, as shown by the survey, the term smallholder encompasses a wide range of profoundly different situations, and the diversity of family farms is a key issue in addressing vegetable gardening. By contrast, the two approaches are based on a preconceived perception of smallholders as, respectively, agricultural entrepreneurs (for the mainstream drip irrigation model), and peasants aiming at living in harmony with their natural environment (for the agroecological model). Grouping smallholders in this way is convenient, but is misleading in that it overshadows their large diversity with regard to constraints, capacities, and strategies.

In the current circumstances, drip irrigation and agroecological farming are accessible only to a very small number of farms, however different in nature. Drip irrigation users are among the wealthiest farmers in the study area, which confirms the results of previous studies on the adoption of this technology in Burkina Faso. Farmers who have adopted agroecological practices are not among the largest in the sample. The farms in question are of medium size and are labour intensive, since

agroecological practices reduce the cost of inputs but increase labour requirements. There are several impediments to the adoption of agroecological practices for irrigated vegetable production: the majority of farming families cannot, or are not willing to, allocate more labour either from the family or hired; agroecological farming relies on natural resources such as water, manure, and vegetal biomass that are scarce during the dry season; and the systemic agroecological approach is complex to master.

Opposing the two orientations is a vain debate at the farm level, since both the mainstream drip irrigation and the alternative agroecological approach fail at improving the livelihoods of family farms significantly. The focus, instead, needs to be on developing supports and services that respond to smallholders' actual needs and capacities. To this end, it is essential to take the large diversity of family farms into consideration, and to see irrigated vegetable production as just one part of their livelihood strategies. Information is generally lacking as to who are smallholders, and what are their needs and constraints, yet development organisations devote little attention to answering these questions in their areas of intervention. Addressing smallholders' needs requires a paradigm shift which places those needs and the capacities of family farms and local farmer organisations at the heart of development strategies.

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