LOW COST DRIP IRRIGATION IN BURKINA FASO

Unravelling Actors, Networks and Practices

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Minakpon Jonas Virgile Wanvoeke

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To Hermine, Herginas, Mirabel, and Fannette,
my lovely parents Simplice Wanvoeke
and Beatrice Houevoessa

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Abbreviations and Acronyms

ADECCOL	Action pour le Développement des Communautés et des Collectivités Locales
AEDE	Association Eau Développement et Environnement
AIDEM	Approche Intégrée pour le Développement de la Maraîcherculture
AMG	Africa Market Garden
AMIFOB	Amicale des Femmes Forestières du Burkina
APEFE-WBI	Association pour la Promotion de l'Education et de la Formation à l'Etranger de Wallonie Bruxelles international
APIPAC	Association des Professionnels de l'Irrigation Privée et des Activités Connexes
ASPMY	Association Professionnelle des Maraichers du Yatenga
AVDRC	The World Vegetables Center
BuCo	Bureau de Coopération Suisse
CSRS	Centre Suisse de Recherche Scientifique
DMP	Desert Margins Program
EHFP	Enhanced Homestead Food Production
FBA	Farm Business advisors
GAG	Goutte à Goutte
GEDES	General Des Services
HYV	High Yield Variety
ICRISAT	International Crops Research Institute for the Semi-Arid-Tropics
iDE	International Development Enterprise
IFPRI	International Food Policy Research Institute
IFDC	International Fertiliser Development Centre
INERA	Institut de l'Environnement et de Recherches Agricoles
IFAD	International Fund for Agricultural Development
Kali Service	Drip Kits Provider
OFDA	Office of US Foreign Disaster Assistance
OFID	OPEC Fund for International Development
OPEC	Organization of the Petroleum Exporting Countries
OCS	Optima Conseils et Services
MAHRH	Ministère de l'Agriculture, de l'Hydraulique et des Recherches Halieutiques

PDMIG	Programme de Développement du Maraichage par l'Irrigation Goutte à goutte
PIGEPE	Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle
PMU	Project Management Unit
SDC	Swiss Agency for Development and Cooperation
SHA	Self Help Africa
SUMIT	Scaling Up Micro Irrigation Technologies Project
WUSMK-BF	Water use and sustainability in market gardening in Burkina Faso

Chapter 1

General Introduction

This chapter provides the background of the research and outlines its theoretical and conceptual sources of inspiration. The overall study design is presented and the chapter ends with an outline of the thesis.

Chapter 1

General Introduction

1.1 A personal journey towards drip irrigation

I encountered drip irrigation for the first time in 2006 during a training visit to Israel. As a project officer with a local NGO in Benin, I went to Israel for special program training on 'community development and project management'. During this training, I visited a site in the Negev Desert with tomatoes under high pressure drip irrigation. I was really impressed, but I never thought, at the time, that I would later embark on a study on drip irrigation.

My real journey with drip irrigation, however, started in 2011 when I joined the NWO funded Drip Irrigation in Perspective (DRiP) project as a PhD fellow at Wageningen University in the Netherlands. My research was to focus on drip irrigation in Burkina Faso. When starting, I thought my work would consist of assessing the adoption patterns and impact of the technology. With a background in agricultural economics complemented with a rural development diploma, I considered drip irrigation as yet another agricultural technology comparable to high yielding varieties, improved seeds, fertilisers and post-harvest technologies. I pictured myself studying adoption patterns and triggers for innovation, something that would involve going to the field, selecting farmers, administer questionnaires, and analysing my data using statistical software. As I later discovered, these ideas were guided by a common linear model of innovation. Through a guided review of the literature, I soon learned about different ways of understanding technical innovation. I for instance read about the context-dependent nature of irrigation technology (Mollinga, 2003; E. Shah, 2003), and became acquainted with theories of innovation that conceptualized it as a partly contingent social process of interaction and negotiation. I also learned more about low-cost drip irrigation, getting to know it as a technology that was gaining in popularity in West-Africa after having been disseminated (apparently with success) in Asia.

Before coming to Wageningen in August 2011, I decided to embark on a short fact-finding visit to Burkina Faso to gather background information, with the blessing of my promoters. As a Beninese, I travelled by road from Cotonou (Benin) to Ouagadougou (Burkina Faso). During the 24 hours long trip I was hoping to see some drip irrigation systems along the road. Unfortunately, this did not happen. Even if there had been some, it would not have been possible to have a close look at them, given the mode of transport I used.

By chance, my neighbour in the bus was a staff member from an international Non Governmental Organisation (Action Aid). He was surprised to learn that I was going to Burkina Faso to meet actors promoting drip irrigation and to visit some drip irrigation sites. He replied: "what is drip irrigation? Are you sure farmers are using that in Burkina Faso?" His question was the first indication that drip irrigation was not as well-known in the country as I thought.

After having spent these few weeks in the field, I had mixed feelings:

- On the one hand, I was happy to see various development agencies involved in the promotion of drip irrigation and the impressive size of the development assistance that went along with the promotion of such innovation in terms of funding and numbers of drip irrigation kits
- On the other hand, I was disappointed that I had not been able to come across and talk to farmers using drip irrigation in their fields. My dream to select farmers and study the adoption dynamics of drip irrigation was fading. Indeed my brief mission suggested that although drip was promoted, there were few local farmers displaying an interest in the technology.

There was an apparent contradiction between these two observations that needed an explanation. As an African development practitioner, I found the sheer number of development interventions promoting drip irrigation surprising in view of the lack of evidence of farmers actually using it in their fields.

After this two months exploratory visit to Burkina, I travelled to Wageningen in August 2011. Through discussions with my promoters and peers at the university, I decided to reorient my research ideas. Instead of analysing the adoption of drip irrigation, my challenge became to understand and explain the discrepancy I had observed in Burkina. My objective became to better understand the gap between donors' sustained enthusiasm and the lack of evidence of uptake in farmers' fields. To explain this gap I had to study how and by whom development interventions are conceived, implemented and evaluated, taking the drip irrigation technology as a case study.

1.2 Smallholder drip irrigation: principles and features

Drip irrigation is an irrigation method whereby small quantities of water drip directly to the root zone of crops through a network of plastic pipes, valves, emitters or drippers, and

ancillary devices (Venot et al., 2014). Drip irrigation technology is said to improve yields and irrigation efficiency (Goldberg et al., 1976; Keller & Bliesner, 1990; Postel, 1999), notably by maximizing irrigation uniformity and minimizing water deliveries (Keller & Roberts, 2004).

Research and development efforts on drip irrigation have long been driven by a search to optimize and better adjust irrigation delivery to crop water demands and the notion of efficiency (van der Kooij et al., 2013; Venot et al., 2014). Irrigation scholars, professionals but also the wider public generally consider drip irrigation to be a more sophisticated form of irrigation as compared to surface irrigation for instance. Its use is associated with modernization and progress, and with large and wealthy farmers. Since the 1960s when the first modern drip irrigation systems started to appear in Israel and the United States, efforts have also started to focus on refining drip irrigation to make it useful and affordable to smallholders' farmers.

The first model of drip irrigation systems specifically designed for smallholders in the developing world was developed in the 1970s by a US based irrigation equipment company called Chapin Watermatics Inc. (Postel et al., 2001), following a request of the NGO Catholic Relief Service who wanted to use them in Senegal (Keller, 2000) Over the last 20 years, several other organizations, such as the Non-Governmental Organization International Development Enterprises (iDE) as well as the two major manufacturers of drip irrigation equipment, NETAFIM and Jain irrigation Systems Ltd, also engaged in efforts to design and disseminate drip irrigation systems for smallholders. Industrial manufacturers have "scaled down" and simplified large commercial drip irrigation systems (Huang, 2012). On the other hand, NGOs, such as iDE, claim to have designed a new spectrum of drip irrigation systems for the "poorest of the poor" in South Asia and sub-Saharan Africa (Polak, 2008; Postel et al., 2001). Both systems promoted by NGOs and large irrigation equipment companies have come to be known under the generic name of "drip irrigation kits" as they are compatible with small plots (from a few to one thousand square meters). These kits are also called 'low cost' or 'low pressure' drip irrigation systems. They are mostly used to grow vegetables and, in some instances, fruit trees on small plots.

A typical drip irrigation kit comprises of a screen filter, a main valve, several thin flexible plastic pipes (often called drip lines) of different lengths, and water emitters (which can be in-line emitters built in the plastic pipes or micro-tubes that are punctured in the plastic pipes). A water reservoir (in the form of a plastic bucket, a drum barrel, a plastic tank, or a

cemented reservoir) with a capacity varying from 10 litres to 3 cubic meters completes the system. Water is manually supplied to the reservoir or by using treadle or motorised pumps. A defining difference between conventional high-tech drip irrigation and the low-cost version is the pressure in the drip lines. The pressure in the pipes of drip kits is delivered by gravity, typically 1 to 2 meters of head, as opposed to the 'high-tech' version where pressure is typically around 20 to 40 meters of head, provided by a motorized pump. The lower head provided by gravity reduces the costs of the material (pipes and drippers) and fuel to run the pump. The drip lines operate under low gravity as the water reservoir, which supplies water to them, is elevated by one or two meters. The size of the water reservoir depends on the area the drip kit covers; three types of systems are generally identified (see figure 1.1). Depending on the authors, different names are given to the drip kits: the 'bucket kits' or 'family nutrition kits' (for areas of less than 50 m^2), the 'drum kits' or 'vegetable garden kits' (for areas of less than 500 m2) and the 'family drip kits', the 'shiftable drip kit' or the 'Ideal drip kit' (for areas of more than 500 m2) (see for instance iDE, n.d; NETAFIM, 2008; Postel et al., 2001).

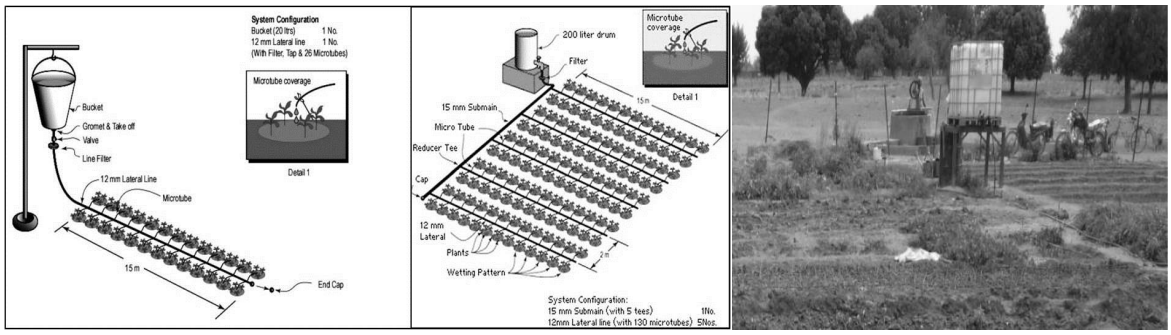

Figure 1.1. Schematic diagrams of smallholder drip irrigations systems
Source: Left (Postel et al., 2001); Right (Polak & Yoder, 2006)]

Drip irrigation kits are promoted on the ground that they can contribute to poverty and food security while making efficient use of scarce water resources (Oumarou, 2008; Pasternak & Bustan, 2003; Woltering et al., 2011b). For instance, both Pasternak et al. (2006) and Woltering et al. (2011a) claim that low cost drip irrigation is suitable for the arid environment of the Sahel and is profitable for farmers, allowing them to grow vegetables. Other studies likewise suggest that drip irrigation is a technology that can potentially help reducing poverty and food insecurity in Africa and Asia (Burney & Naylor, 2012; Polak et al., 1997c; Postel et al., 2001). These studies are technical in nature, identifying the changes that occur while using the technology in terms of yield, water, labour, time and crop productivity (Keller & Roberts, 2004; Mahamadou, 2005; Woltering et al., 2011a).

Other studies are more critical about smallholder drip irrigation (Belder et al., 2007; Dittoh et al., 2010; Friedlander et al., 2013; Garb & Friedlander, 2014; Kulecho & Weatherhead, 2005). Dittoh et al (2010) for instance conducted a regional study in Burkina Faso, Mali, Niger and Senegal to assess the impacts of drip irrigation and the factors affecting its adoption. The study concluded that the costs of establishing a viable, effective, and sustainable smallholder drip irrigation system exceed the capabilities of most small farmer groups in the Sahel. Kulecho and Weatherhead (2005) similarly suggest that low-cost drip kits are not suitable for many African smallholders. They show how farmers in Zimbabwe and Kenya tried the drip irrigation kits for at least one cropping season, with support from staff of the project promoting the technology, but quickly abandoned the drip kits and reverted back to traditional methods of irrigation after this first trial period. Farmers, who were grouped in associations, used the technology during the time of the project and stopped using it when the project ended (Belder et al., 2007). This was partly because of maintenance problems and because of an unreliable water supply.

There are several studies that focus on identifying the factors facilitating or impeding drip irrigation adoption, with the explicit objective of lifting adoption barriers. They identify blockages, wear, problems with drip lines and problems with filters as major factors of non-adoption or disadoption (Friedlander et al., 2013; Kulecho & Weatherhead, 2006; Ngigi, 2008). In a recent study, which shares some of the theoretical underpinning of my own research (see below for an overview), Garb and Friedlander (2014) attribute the failed uptake of drip irrigation in many sub-Saharan African countries to a tendency to frame technology as a series of static physical artefacts, which, it is assumed, can be transferred seamlessly into new contexts. They stress the fact that the promoters of drip irrigation see the latter as an object that can be moved from one place (Israel) to another (sub-Saharan Africa). They question this assumption of the mobility of the technology across contexts, and propose instead to conceptualize a technology as a socio-technical construct that needs to be continuously re-invented to be absorbed and evolve into new contexts

1.3 Burkina Faso: The promises of a smooth landing for smallholder drip irrigation

Burkina Faso is a landlocked country of the Sahelian zone of West Africa and one of the poorest countries of the world (it ranked 181 out of 187 countries in the Human Development Report, 2014) (UNDP, 2014) . In Burkina Faso, agriculture is the backbone of the national

economy and provides employment and revenue for 90 percent of the population and contributes to the 33.6% of the country GDP (Index, 2014). Agriculture is mostly rainfed, for subsistence, and takes place during the 3-4 months long rainy season (June-September). The country is generally regarded as vulnerable to famine, with the FAO estimating that about 3,5 millions people face the threat of hunger (FAO et al., 2014), the months preceding the rainy season being the most critical. Thus, the government has set up in the country a Famine Early Warning System (FEWS) to take preventative actions amongst which the intensification of agriculture during the off season is targeted (Simonsson, 2005).

Vegetable gardening, generally in the form of home-garden of small size (not more than a few hundred meters, often less, per household), often managed by women, has long been a component of local farming systems (Merrey & Langan, 2014; van Leeuwen, 2001). The role of home-gardening to enhance food security, household health and incomes has long been recognized (Weinberger, 2013). However, not all farm households grow vegetables. Vegetable gardening indeed depends on labour and water availability, and is conducted only if it does not compete with other agricultural tasks.

Being one of the poorest countries of the world, Burkina Faso is among the largest recipients of development aid in West Africa (Samoff, 2004) with a very large number of international development aid agencies and NGOs having operations in the country, together with national NGOs and civil society organisations (Atampugre, 1997; Harsch, 1998). Enhancing food security, alleviating poverty, and making sound use of vulnerable resources (eroded soil and scarce water) feature high among the objectives of these development actors.

In this conducive environment for development assistance, it is understandable that many development actors and projects are interested in a technology widely described as low cost (hence affordable to farmers), geared at vegetable gardening (hence allowing to target women who ‘traditionally’ grow these crops), leading to higher yields (hence higher incomes and poverty alleviation) than other methods of irrigation, and allowing to save labour and water. It is perhaps not surprising that, from 2004 when the first drip kits were introduced in Burkina Faso through the Africa Market Garden (AMG) project, the technology has created much interest and enthusiasm within the development agencies arena. Multiple projects dealing with the promotion of drip kits were initiated, involving a large number of organisations: Government, funding agencies, multilateral and bilateral organisations, research institutes, international and national NGOs, kits suppliers, etc.

But as stated above, this very large development effort (and the enthusiasm of development actors it reflects) contrasts to the enthusiasm of farmers and field realities. The actual use of drip irrigation remains limited to demonstration plots by a few pilot farmers with active support from development agents. It is the existence of this contrast that my PhD aims to understand and explain.

1.4 Research objective and questions

The general objective of my PhD research is to understand the paradox of drip irrigation in sub-Saharan Africa, that is, the co-existence of continued dissemination efforts by development actors and a low extent of use by farmers. I explain how the disconnect between, on the one hand, the interest of the development community and, on the other hand, the lack of interest of farmers for the drip irrigation technology could continue to exist over a period of time that has stretched almost two decades. To do so, I unravel what low cost drip irrigation represents to different actors, the motivations they have to promote it and the meanings they attribute it. My research is different from most studies on drip irrigation, which focus on the physical and technical dimensions and the adoption dynamics of the technology. I instead look at the social dimensions of drip irrigation, looking at it in terms of the objectives it achieves for different actors rather than considering it as an object with intrinsic properties.

The main research question to be addressed in this study has been formulated as follow.
What are the meanings of low cost drip to different actors, and what are the implications of these for the promotion and use of the technology?
The sub research questions are:

- How has smallholder drip irrigation been framed as a success and which actors were pivotal in such construction? (chapter 2)
- What does smallholder drip irrigation represent for different actors, and why do they engage in projects promoting it? (chapters 3 and 4)
- Why do development interventions persist even though there is little evidence of sustained use of drip by farmers? (chapter 5)

1.5 Theoretical perspectives

Many studies explain the existence of a dichotomy between the enthusiasm and efforts of development actors and the lack of interest of farmers as a failure of adoption. They ascribe this for instance to the lack of knowledge of farmers to appropriately use the technology. In

this reasoning, what drip irrigation is and does is taken for granted, as it is assumed to reside in the technical characteristics that define what it potentially can do. In my study, I do not explain the dichotomy by only looking at failures of adoption or technical factors, but instead propose a wider analysis of the social and political dimensions of low-cost drip irrigation dynamics. Central to my analysis is the idea that a technology means and indeed is different things depending on contexts and actors. A single technology can thus have multiple meanings or manifestations or interpretations. I hypothesise that the simultaneous existence of these different meanings - these different low-cost drip systems - can explain the dichotomy I observed.

Drawing on actor network theory, and contributing to the debate about the social and political nature of technological artefacts and combining this with notions of innovation in development, my research thus aims to critically analyse the meaning of drip for different actors. More specifically, this research deals with the dualism technology-actors in the context of development projects. Towards this aim, it combines insights from Science and Technology Studies (STS), with the socio-anthropology of development. More specifically, the analysis is based on the 'Practice-base theory of innovation' (an application of Actor Network Theory), complemented by other key concepts such as 'Brokerage' and 'translation' associated to development intervention (chapters 3 & 4). I go further in my development axis by using 'interpretation of events' which I draw from the ethnography of development aid to explain why drip is seen as a success and why drip is still being promoted despite the dichotomy observed (chapters 5).

1.5.1 Practice-based theory of innovation

The practice based theory of innovation proposed by Akrich et al. (2002a, 2002b) is an application of Actor Network Theory (ANT). ANT describes a process in which entities form a *network*, whereby each actor aims to benefit from being part of the network; the network helps to advance their goals. ANT is the name given to a framework originally developed by Latour (1987), Callon et al. (1986) and Law (1992) as a powerful approach to understanding success and failure in the construction of scientific and technological facts and artefacts. The endeavour of designing a new theory was to bring together non-humans (objects of science and technology) and humans, making the former socially-compatible too (Latour, 2005). ANT examines social situations in terms of the various types of relationships that emerge in connection to a specific technology (in the case of this thesis, drip irrigation).

With ANT, artefacts are part of a network consisting of actors. ANT therefore emphasizes the importance of understanding technologies (and what they do; their agency) as part of networks of other artefacts and people. It adds a number of useful elements to science and technology studies, including the idea of that non-human actors can have agency after a process of translation and enrolment (Latour, 1996).

Different than 'classical' innovation analyses such as the diffusion of innovation of (Rogers, 2003), the practice-based theory of innovation does not ascribe the success or failure of a technology to its 'intrinsic' properties (the diffusion model) but instead looks at technologies in context to suggest that innovations are only taken up if they manage to interest more and more actors; this is the "model of interessement" (Akrich et al., 2002a). Theoretically, the ability of an innovation (in our case the drip kit) to align actors into a network and to sufficiently interest them so that they start acting in the interests of the network (beyond their own interests), explains its success or durability (see chapter 2 and 3). In this perspective, the model postulate that one actor, known as the "spokesperson" plays a particularly important strategic role of 'enrolling' other (Akrich et al.,2002b). Through careful negotiations, this spokesperson "translates" the technology in many ways so as to capture and hold the interest of other actors. The concept of translation has been introduced by Callon (1986) who outlines it occurs in four stages, problematization, interessement, enrolment and mobilization, a linearity we engage with in chapter 2.

ANT and the practice-based innovation are useful to explain the process through which drip has been translated and enrolled many actors and what it does to them. It also helps in explaining how drip becomes a success. From such stand point, it becomes clear that the drip kits are more than just a tool to irrigate plants; they are part and parcel of broader socio-technical networks they contribute to shape and are also shaped by.

1.5.2 Development interventions as arena of multiple transformations and interpretations

Development projects promoting drip irrigation involve multiple entities: farmers, development practitioners, researchers, policymakers and kits providers. Referring to Long (2001), all these entities are 'social actors' that are guided or tempted by individual interest/profit, sometimes at the expense of other actors or the entire project members. Long (2001) proposed considering development interventions as arenas where social actors, each with specific interests and stakes, coalesce, negotiate with and/or confront each other. In these

development arenas, different negotiations, transformations and interpretations take place or occur to explain the interests of social actors' involved. I postulate that, in the case of Burkina Faso, various transformations, and interpretations take place during the implementation of the different drip projects in Burkina Faso. Long explains that the way people make use of external interventions fundamentally rests on how each agent 'translates' the interventions in accordance with his/her own interest Long (2001, p. 17).

Other scholars in the field of Anthropology of Development have built on the ideas of Long (2001). J. P. Olivier de Sardan (2005) considered development projects as social phenomena that involve a number of social actors on the side of the ‘developers’ (the institutions of development) as well as on the side of those ‘to be developed’ (target users). Developers and Developees enter into a process of bargaining in attempts to make the project fit with their own logics and interests. He explains the transformations occurring during development interventions with the different logics in competition. Both Olivier de Sardan (2005) and Long (2001) liken development projects to *arenas* where various logics and strategies meet and confront each others: the 'developees’ logics versus 'developers’ logics (J. P. Olivier de Sardan, 2005). Their reasons are often different from the technical attributes of efficiency and productivity associated to the drip technology (see chapter 3).

In this thesis, I follow the different categories of actors to better understanding what drip represents and means for them. This enables me to identify actors' motivations, interests and logics in getting involved in drip projects (chapters 3 & 4). I first introduce the concept of 'brokerage' to explain the reasons of the negotiations occurred during development interventions. Later, I highlight the importance of ‘interpretation of events’ to explain how drip projects are transformed and interpreted as success by development actors. In doing this, I answer to my third research sub-question and give more details in the reasons why the technology is still being promoted by development interventions despite the dichotomy (chapter 5).

Brokerage

In the arenas of development interventions, some actors play the role of *'development brokers'* in shaping the reality of projects (Bierschenk et al., 2000; J. P. Olivier de Sardan & Bierschenk, 1993). The concept of brokerage was introduced in the field of development in the nineties by a team of French Anthropologists and it has gained popularity since then (APAD-http://www.association-apad.org). They define development brokers *(in French*

Courtiers en développement) as "social actors implanted in a local arena […] who serve as intermediaries who drain off […] external resources in the form of development aid" (Bierschenk et al., 2000, p. 8). They work with aid donors and international NGOs but actively direct project funding towards the communities with which they have connections. Located at different levels or stages of the project implementation, these brokers can be managers, consultants, field workers, retailers, community leaders, etc. Bierschenk et al. (2002) have presented brokers as unavoidable figures in development projects in Africa. Many examples from Africa serve to illustrate this; brokers are vital and play an important role in making development projects into a success (Blundo, 2000; Lavigne-Delville, 2000; Le Meur, 2000; Mongbo, 2000; Neubert, 2000; Tidjani, 2000). Rottenburg (2009) for instance sheds light on the important brokering role that development experts and consultants have in 'translating' projects activities and outcomes, as they often mediate between funding agencies and national governments. Klerkx et al. (2009), while analysing the emergence of brokers in innovation systems, likewise concluded that brokerage is likely to be relevant in developing countries. Lewis and Mosse (2006) introduce the notion of "translation" to extend the scope of brokerage to also encompass the production and stabilization of knowledge, meanings and interpretation. They argue that mutual enrolment and interlocking of interests within networks of actors (funding and governmental agencies, NGOs, research centres, private companies, pilot farmers, etc.) is what produces project 'realities'. This happens as multiple actors engage in sustaining a coherent vision regarding a specific sphere of intervention.

I invoke notions of brokerage and intermediation to analyse the motivations of development actors to get involved in drip projects, interpreting this involvement not as a stand-alone activity but as part of larger networks and practices of actors, who have an interest in producing a coherent vision on the promises of this technology (chapter 4).

Interpretation of events

The idea developed by Latour (1987) and other STS scholars that the success of a technology is not simply based on an empirically verifiable fact, an argument or a narrative, (Mosse, 2005, p. 8), positively resonates with ideas in the field of Development Studies that the success of a project or intervention 'depends upon the stabilisation of a particular interpretation of events'. For development projects, realities are generated and interpreted through the production of data, results, and outcomes. Development success is not merely a question of measures of performance, it is also about how particular interpretations are made

and sustained socially. It is not just about what a project does, but also how and to whom it speaks, [and] who can be made to believe in it.

The ethnography of development aid and practice (see Lewis & Mosse, 2006; Mosse, 2005; Mosse & Lewis, 2005) therefore offers interesting sources of inspiration to explain how development projects work in practice and how projects' successes or failures are socially produced. It for instance offers an way to analyse why discrepancies between an idealised linear view of development projects (especially among practitioners) and actually observed behaviour emerge and persist (Rap, 2006). For ethnographers, the success or failure of development projects is a matter of interpretation in turning designs into reality. The questions ethnographies of aid answer 'is not whether but *how* development projects work; not whether a project succeeds, but *how* success is produced' (Mosse, 2005, p. 8).

The main argument here is that the reality of a development project is not merely proclaimed or reported, but is a social performance. It is indeed "determined through the interpretive work of experts who discern meaning from events by connecting them to policy ideas, texts, log frames, and project documents''(Mosse, 2005, p. 157). In doing this, the ethnography of aid is compatible with, and reinforces, practice-based theories of innovation in linking any development or innovation outcome to the intrinsic features of the disseminated technology. In my study, these insights have prompted me to trace and explain the success of drip projects as something that is actively performed through the production of data, results, and outcomes.

1.6 Research design and methodology

1.6.1 Study phasing

This research was conducted from June 2011 to February 2015 in four regions (south west, East, Centre and the North) of Burkina Faso (see figure 1.2) and was conducted in four main phases:

The first phase from June 2011 to August 2011 was exploratory and consisted of a diagnostic study of drip dissemination efforts in Burkina Faso. During this phase, I met with some key actors of drip irrigation in Burkina Faso and listed the different development projects that have been promoting the technology over the last 15 years. I also conducted selected field trips to appreciate the diversity of drip irrigation systems that were disseminated in the country. 87 experimental drip sites were inventoried with the help of development

actors. This phase aimed at getting acquainted with drip irrigation and at developing first contacts with farmers and development actors in connection with drip irrigation.

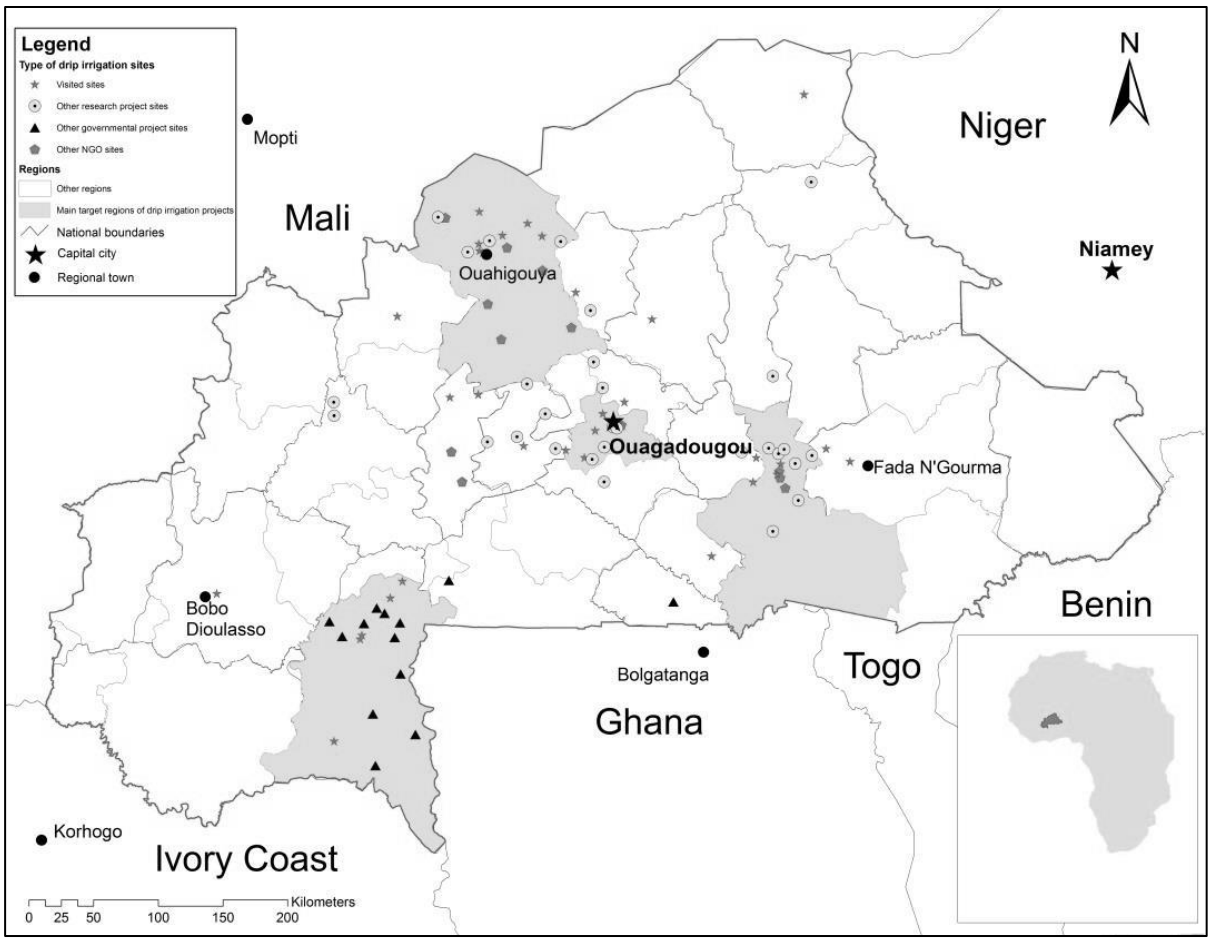

Figure 1.2 Location of the four regions in Burkina

Second, from November 2012 to November 2013, I identified actors having a stake in the promotion of drip irrigation in the country, and organized joint field trips with some of them. I interviewed 44 agents from international and national development agencies, government officials, Non-Governmental Organizations, and private companies involved in the promotion of smallholder drip irrigation in Burkina Faso. Out of the 87 drip irrigation sites identified, I visited 28 drip 'operational' sites for a better understanding of the interface between farmers and projects and to see drip kits in use. In addition, I visited six sites of the AMG ended project. Data were concomitantly collected at village level with farmers, provincial level with extension agents and national level with development agencies. 30 farmers were interviewed during this phase and 44 interviews were conducted with development agents.

Third, and during the same period (November 2012 to November 2013), I selected three projects (PIGEPE, SUMIT, and AIDEM-PDMIG) as more detailed case studies. I also used this period for additional interviews with staff and partners, visits to projects sites and for participatory observations during project events (promotional campaigns).

Fourth, in February 2015, and after some of our initial conclusions had raised questions among the organisations promoting drip irrigation in Burkina Faso, I conducted a short visit to assess how the situation had evolved in some of the sites we had previously visited and documented.

1.6.2 Methods for data collection and analyses

This study is based on qualitative data and follows an interpretive approach, which considers the meanings and interpretations given by social actors to drip irrigation and actions as constituting their social reality (Mason, 2002). This includes the way I also interpret my own observations, interviews, experiences and data.

I used a combination of data collection methods, explained in each chapter. These included literature search, interviews, informal discussion, focus group discussion, life story, direct and participant observation. I recorded, translated and transcribed most of my interviews when the interviewees accepted. The data collected were double checked with other interviewees to collect reliable information and to support the findings and to test their validity as required in qualitative research (Lincoln & Guba, 1985).

One of the methods I used to identify the interviewees was snowball sampling. It has helped me in identifying individuals and organizations involved in drip, and its multiple offshoots. Snowball sampling is a technique allowing to gather data, starting from the identification of a limited set of individuals who are knowledgeable on the topic of interest and in a position to identify others who could bring additional information on the same subject (Faugier & Sargeant, 1997).

Throughout this thesis, different approaches are used to analyse the data. They are specific to each chapter and depended on the specific issues tackled. Detailed explanations are provided about the different approach used to analyse the data in each of the chapters. The different theoretical insights described above have supported the data analysis in this thesis.

1.7 Outline of the thesis

This thesis comprises six chapters (see figure 1.2). Four of them deal with specific aspects of the research question and together form this dissertation. The chapters address the following:

- Chapter 1 (this chapter) presents the basic technical component of low-cost drip irrigation, also discussing how low cost drip irrigation is discussed in the existing literature. In addition, this chapter describes my personal research journey and trajectory. It explains the research questions, gives some background to the main theoretical sources of inspiration and the methods used.
- Chapter 2 explains how the reputation of drip has been shaped. It gives an overview on how and by whom drip was constructed as a success by tracing how different actors were enrolled in the promotion of the technology. Based on the case of the AMG project, this chapter presents the substantial efforts of drip promoters to align the technology with the interests of a variety of other actors.
- Chapter 3 explores the reasons why farmers agreed to become engaged with drip projects, and explains what drip represents to them.
- Chapter 4 focuses on the role of development actors - mainly NGOs and Projects - in the promotion of drip in Burkina Faso. This chapter tackles what drip represents to development actors and the role of brokers in aligning interests, shaping activities and interpreting project outcomes.
- Chapter 5 synthesizes the results from chapters 2, 3 and 4 to explain the seeming contradiction between the enthusiasm of donors and development agents, on the one hand, and farmers who accept the project hand-outs but do not intend to use the technology, on the other. This chapter identifies the reasons why drip is being promoted and finds that the success of smallholder drip irrigation is not related to what the technology does in the field.
- Chapter 6 is the conclusion of the thesis. It summarizes the major findings of the study and provides answers to the research questions laid out in the introduction. It stresses the contribution of the thesis in theoretical terms, notably regarding the notion of "translation" applied in a development context and that of brokerage applied to a technical object, the drip-kit. This chapter also stresses the operational contribution of the thesis with regard to irrigation policy making in sub-Saharan African countries.

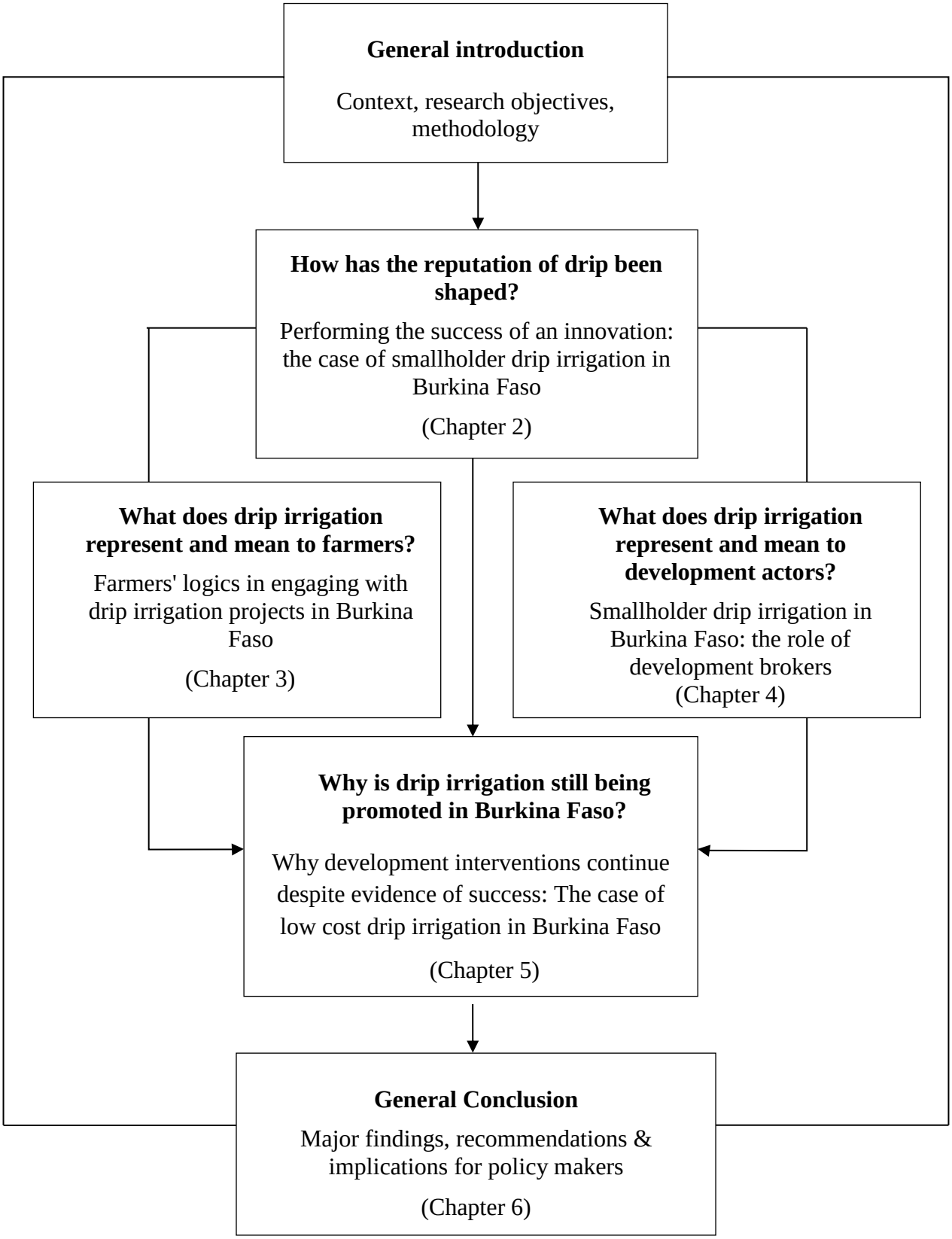

Figure 1.3 Thesis outline

Chapter 2

Performing the success of an innovation: Case of smallholder drip irrigation in Burkina Faso

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Performing the success of an innovation:
Case of smallholder drip irrigation in Burkina Faso

Abstract

Over the last 15 years, smallholder drip irrigation has gained almost unanimous popularity as an effective tool to achieve the combined goals of sustainable water use, food security and poverty alleviation in the developing world. Based on a study in Sub-Saharan Africa, this article shows that this popularity does not stem from what the technology does in farmers' fields, but is the result of the concerted efforts of a number of key spokespersons to align it with the projects and interests of a variety of actors, including development agents, researchers, NGO staff and pilot farmers.

Keywords: actor-network theory, development, innovation, smallholder, Sub-Saharan Africa.

2.1 Introduction

About 15 years ago, *Water International* published an article entitled 'Drip irrigation for small farmers: A New Initiative to Alleviate Hunger and Poverty' (Postel et al., 2001). The article applauded the emergence of a new range of drip irrigation systems specifically targeting smallholder farmers. It articulated the expectation that these new systems 'could form the backbone of a second green revolution, this one aimed specifically at poor farmers in Sub-Saharan Africa, Asia, and Latin America' (p. 3). The article's optimism was importantly fed by first experiences of non-governmental organizations (such as International Development Enterprises (iDE) with the promotion of these small, low cost irrigation technologies in South Asia (Bangladesh, India and Nepal).

Since then, initiatives aimed at promoting smallholder drip irrigation have indeed "travelled" to sub-Saharan Africa (Andersson, 2005; van Leeuwen, 2001; Woltering et al., 2011a; Woltering et al., 2011b). Almost all studies published to date that document these travels share Postel et al.'s optimism regarding the potential promises that smallholder drip irrigation holds. Although acknowledging the multiple obstacles and constraints that (may) impede widespread adoption and use by smallholder farmers, most reports and articles agree, in principle, that the dissemination of smallholder drip systems is a promising idea. This

agreement is anchored in the belief that the technology – the smallholder drip system - is itself intrinsically good, a goodness that is attributed to its technical design characteristics: affordability, small size and infinite expandability (Polak, 2008), coupled to notions of efficiency and productivity that are associated with drip irrigation systems in general (Venot et al., 2014).

The widespread positive interest in the technology in development cooperation circles stands in stark contrast with what happens in Sub-Saharan farmers' fields. To give just the example of the main project discussed in this article, the African Market Garden (AMG) Project distributed 500 drip kits in Burkina Faso (Dittoh et al., 2010), reaching at least as many farmers.[1] In 2012, only one of these farmers was still using a drip irrigation kit.[2] Since the first experiences of AMG in Burkina Faso in 2003 and for all the successive projects that have been promoting drip afterwards (Tables 2.1 and 2.4), we observed that drip kits had only been used on experimental or demonstration sites established by promoters (NGOs, projects, etc.) and that farmers involved are generally considered pilot farmers. As Kulecho and Weatherhead (2005) described in a study on smallholder drip irrigation in Kenya, pilot farmers stopped using the technology when external support from projects ended. These observations, however, have done little to dampen the enthusiasm of the various development actors. Projects involving the technology abound, including in Burkina Faso (Table 2.4). Rather than prompting scepticism regarding the promise and the success of the technology, disappointing results tend to be interpreted as indicating weaknesses in dissemination, a lack of support services or farmer's inability to properly operate and use the technology.

This article proposes a different analysis of the fate of smallholder drip systems in West Africa, explaining how it has been positioned as a promising and successful technology

[1] AMG Project data is not publicly available and different sources contradict each others. For instance, Dittoh et al. (2010) report 500 drip kits to have been distributed in Burkina Faso while interviews and the notes of former AMG technicians in charge of the distribution of drip kits in Burkina Faso tend to indicate that only half this number would actually have been distributed. In 2012, field visits in the villages that had been indicated to us as "AMG target villages" by former project's technicians, allowed us to assess the absence of sustained drip irrigation use in nearly all sites.

[2] The farmer is named Hadj Lansane Sawadogo from Ouahigouya. He said he was still using the drip kit AMG provided him. The kit he is using may not be the one from AMG. Since then, this farmer indeed received support and other drip kits from different programs and organisations promoting smallholder drip irrigation.

regardless of what happens in farmers' fields and users' perspectives on this technology. Drawing on actor-network theory (Akrich et al., 1988; Latour, 1987), it argues that the resonance that smallholder drip irrigation has acquired among a broad range of development actors does not so much stem from what it does in farmers' fields. Instead, it is the result of a carefully designed and staged promotional campaign by people (key spokespersons) believing in the (potential of the) technology. The active efforts of these key spokespersons have generated widespread interest in (and support and funding for) the technology from a broad coalition of actors by aligning it with a diversity of interests, projects and discourses. We provide a detailed historical analysis of this campaign on the basis of the trajectory of the AMG program (and of its offshoots). The AMG was the first large-scale initiative aimed at promoting smallholder drip irrigation systems in the West African context.

After some theoretical background in the next section, the third section provides some information on smallholder drip irrigation in general, and more specifically on the AMG. The fourth section identifies the actors (individuals and organizations) who have actively worked to generate enthusiasm (funds and support) for smallholder drip irrigation systems and the AMG – and describes the multiple strategies they used to do so.

2.2 Shaping the success of technologies: Some theoretical insights

Our explanation for the continued 'success' of smallholder drip irrigation is theoretically anchored in the practice-based theory of innovation proposed by (Akrich et al., 2002a, 2002b). In contrast to 'classical' innovation analyses, their innovation theory does not ascribe the success or failure of a technology to its 'intrinsic' properties (the diffusion model), but instead looks at technologies in context to suggest that innovations are only taken up if they manage to interest more and more actors; this is what they call the "model of interessement" (Akrich et al., 2002a, p. 203).

This model postulates that for different actors to become interested in a technology, the technology needs to be *translated* to fit different contexts, interests and discourses. Callon and Latour (1981) defined translation as "the negotiations, intrigues, calculations, acts of persuasion and violence, thanks to which an actor or force takes, or causes to be conferred on itself, authority to speak or act on behalf of another actor or force". Translation theory was originally developed as a framework to reveal that 'scientific facts' are built through networks, hence shedding light on the underpinnings of controversies that surround these

'facts'. Latour (1987) broadened the scope of translation theory to the analysis and socialisation of tools and machines. Since then, scholars have applied this theoretical framework to study the creation, acceptance and success of various devices (Dreveton & Rocher, 2009; Johansson, 2012).

Callon (1986) outlines four stages in the process of translation of a technology: problematisation, interessement, enrolment and mobilisation. *Problematisation* refers to the articulation of a problem on the basis of observations or experiences drawn from the 'real world'. A main actor (spokesperson) articulates a problem (s)he is interested in addressing and that 'talks' to a broader network, and establishes her or himself as an indispensable resource to solving the very problem (s)he formulated. *Interessement* refers to a series of actions and strategies through which the actor who formulated the 'problem to be solved' aims to stabilize the identity, and identify and trace the potential role, of other actors. Here, the main actor (the spokesperson) aims to make her or his immediate interest (in solving the problem (s)he articulated) a 'shared concern'. Akrich et al. (1988) suggest that the success of the process of interessement (which they call "the art of interessement") in building a support network, strongly depends on the choices made regarding the recruitment of representatives and intermediaries who interact and negotiate to shape and transform the innovation until it finds its 'market'. In her view, the fate of innovation, but also its content and chances of success, importantly rest on the choice of these individuals or organisations, as these have a key role in 'translating' the innovation so that it is adapted and adopted by other actors, who will then become allies. In this paper, we show that the spokesperson has not just created interessement; he has played a central role throughout the four stages of the translation model. *Enrolment,* or the establishment of a wider supporting coalition, follows, through a process of coercion, seduction, or consent. The spokesperson seeks to engage a series of stakeholders so as to form a stable network of alliances. Callon (1986) highlighted that this phase is characterized by multilateral negotiations, power grabs or ruses; it enables the art of interessement to come to fruition. *Mobilisation* finally occurs as the proposed solution gains wider acceptance in an ever larger network.

We make use of this analytical framework to explain the trajectory of smallholder drip irrigation in Sub-Saharan Africa. Based on empirical evidence, mostly drawn from Burkina Faso, we show that the four phases of the innovation translation model do not take place one after the other; rather, they occur concomitantly and reinforce each other. Our contribution to

the translation model notably lies in the identification of the strategies used by the spokesperson to co-opt and enrol other individuals or organisations that will contribute to building the legitimacy of his or her own project.

2.3 Smallholder drip irrigation and the African Market Garden (AMG)

Drip irrigation is a method whereby small quantities of water drip directly onto the root zone of crops through a network of plastic pipes, valves, emitters or drippers, and ancillary devices. Research and development efforts on drip irrigation have long been inspired by expectations that the technology would allow more precisely adjusting irrigation to crop water demands, improving water use and application efficiencies (van der Kooij et al., 2013; Venot et al., 2014). Irrigation scholars and professionals generally consider drip irrigation a more sophisticated form of irrigation as compared to, for instance, surface irrigation. Its use is commonly associated with modernization and progress, and with larger and wealthier farmers.

Drip systems for smallholder farmers in the developing world were first developed in the 1970s by a US-based company, Chapin Watermatics (Postel et al., 2001). Over the last 20 years, several other organizations, such as iDE, as well as the two major manufacturers of drip irrigation equipment, NETAFIM and Jain Irrigation Systems, have also engaged in efforts to design and disseminate smallholder drip irrigation systems meant to irrigate relatively small gardens in the developing world. Such initiatives are said to have had beneficial impacts at scale on smallholders' livelihoods in South Asia in the early-to-mid 2000s (see e.g. Polak et al., 1997c; Postel et al., 2001), which in turn has generated much enthusiasm regarding the prospect of drip irrigation in Sub-Saharan Africa. In the literature, various names are given to these smallholder drip irrigation systems: 'low-cost drip system', 'low-pressure drip system', 'low-tech gravity system'. For the sake of clarity, we will use the term smallholder[3] drip irrigation in this paper. Depending on the size of the plot they can irrigate and the type of water storage, Postel et al. (2001) distinguished between three different types of smallholder drip systems, all referred to by the generic term 'kit': bucket kits, drum kits and family drip

[3] The term 'smallholder' requires clarification as it means different things to different people. For this paper, smallholder is synonymous with 'small-scale' or 'small farms' (often less than 2 ha), privately owned and under the complete control of the farmer with little or no input from external government resources.

kits. Depending on the designer and manufacturer, smallholder drip systems have drip laterals of 8-16 mm in diameter and are made of thick-tube, rigid polyethylene with in-line drip emitters, PVC, or flexible tape. Regardless of the system and the manufacturer, the principle is the same: the 'drip kit' operates under low pressure to irrigate a small plot, from a few square meters to a few hundred square meters.

The African Market Garden, described by its designers and promoters as an integrated horticultural production system, had the objective to improve the profitability of small farmers' horticultural production in the Sudano-Sahelian region of Africa by means of drip irrigation, high-quality crop varieties and an adapted operation and management package (Woltering et al., 2011b). The drip system used was the Family Drip System (FDS) designed by NETAFIM. It is a pre-packaged kit using rigid polyethylene pipes that are pre-fitted with advanced drippers and can be adapted to variable plot sizes (Huang, 2012). The typical system size ranges from 500 to1000 m² and a complete FDS kit consists of four components: a water tank; a simple control head (valve); a filter; and the drip lines (Figure 2.1). Apart from the water tank, all the components of the kit are supplied in one box (Phocaides, 2007). The FDS is commonly seen as the most hi-tech, high-quality and expensive option among all available smallholder drip irrigation systems on the market (Kay, 2001).

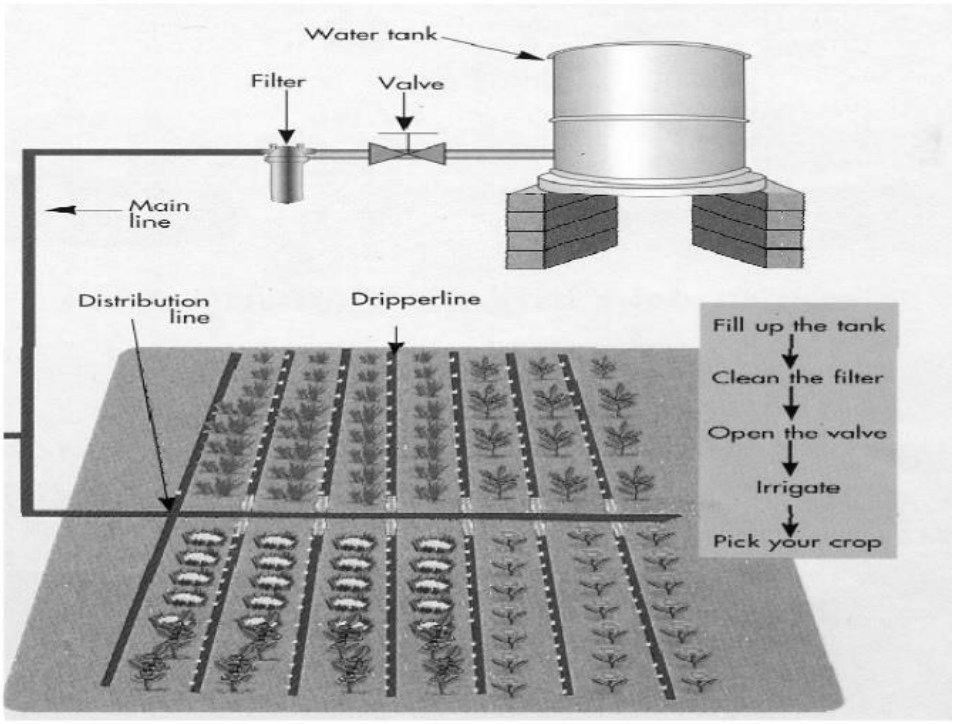

Figure 2.1. Family Drip System (FDS) Source: NETAFIM (2008); (Phocaides, 2007)

2.4 Deciphering success: The case of smallholder drip irrigation

2.4.1 Methodology

The analysis of the trajectory of the AMG that follows is based on an intensive literature review that included scientific articles, news clippings, blog posts, and websites. The literature review was complemented with interviews with people involved in the development, promotion and dissemination of smallholder drip irrigation systems in sub-Saharan Africa. Snowball sampling was used to identify individuals and organisations involved in the AMG and its multiple offshoots. Snowball sampling is a technique that enables gathering data starting from the identification of a limited set of individuals who are knowledgeable on the topic of interest and in a position to identify others who could bring additional information on the same subject (Faugier & Sargeant, 1997). The first person we identified and interviewed was the former agricultural technician of the AMG project in Burkina Faso. From that interview, we built a web of contacts of individuals and organisations which had played a role in the AMG project and its multiple offshoots. We conducted a total of 15 interviews with people who contributed to the design and implementation of the AMG, either as core-team members or associated partners. Interviews were performed in a semi-structured way, with a general interview guide and thematic questions.

2.4.2 Problematisation: Drip irrigation for poverty alleviation

Smallholder drip irrigation in Sub-Saharan Africa, and globally, is seen as an answer to a double problem statement. First, smallholders in the developing world are poor and highly vulnerable; they have not yet benefitted from technological advances in the field of irrigation (Postel et al., 2001). Second, water resources are scarce and increasingly unreliable; they need to be secured and used more efficiently (Rosegrant, 1997). Smallholder drip irrigation is presented as a solution to these two problems, in that (1) there is a wide scientific and development consensus that drip irrigation is a ‘proven technology’ that allows for efficient water use (of secured water supplies) and higher yields of vegetable and fruit crops that can be sold for a profit and generate income and (2) small, low cost drip irrigation systems that fit smallholder farm sizes and investment capacities exist and have been used in South Asia.

In addition to this high-level problematisation in terms of poverty and environmental sustainability, smallholder drip irrigation is also presented as a way to reach yet another important development objective: the empowerment of women. Small drip systems would

allow women to grow their own crops, on their own small plot of land, and decide what to do with the money earned out of the vegetables produced (T. Shah & Keller, 2002)

2.4.3 The art of interessement: A core network

The year 2002 saw the first attempts of international development and agricultural research actors to promote smallholder drip irrigation systems in the West African region, and the beginning of a period when such initiatives started attracting much attention. (Until then, efforts of charitable organisations such as Chapin Living Waters and other NGOs aiming at supporting the use of such systems remained limited in scope and had not been 'brought to scale'). This was linked to a convergence of interests of four major actors: NETAFIM (an Israeli company and the biggest manufacturer of drip irrigation equipment worldwide); the World Bank; IPALAC (the International Program for Arid Land Crops of the Ben-Gurion University of Negev); and ICRISAT (the International Crops Research Institute for the Semi-Arid-Tropics). NETAFIM had long engaged in developing small-scale drip irrigation systems (targeting small Chinese greenhouses) and was looking for support from the Development Marketplace initiative of the World Bank[4] to extend similar activities to the African continent, where smallholders traditionally irrigate vegetables with watering cans. IPALAC was set up in 1994 by an Israeli researcher named Dov Pasternak with the objective of transferring new crops to semi-arid regions, notably in Sub-Saharan Africa (interview with Dov Pasternak on June 27, 2013). ICRISAT engaged in promoting crop diversification in the region from the late 1990s onwards (http://www.icrisat.org/what-we-do/wit/wit_3/wit_3.htm). This convergence of interests created favourable conditions for Dov Pasternak to join ICRISAT in 2001. The institute would, in turn, host the IPALAC program from its office in Niger and use it as a conduit to pursue its objective of agricultural diversification.

As an Israeli scientist involved in the field of irrigation, Dov Pasternak had close relationships with NETAFIM, and he convinced them that ICRISAT would be an interesting partner from the perspective of submitting a collaborative project to the Development Marketplace initiative of the World Bank. The project was funded in 2002 ($250,000; Huang, 2012) and aimed at promoting date palm cultivation through means of low-pressure irrigation

[4] The Development Marketplace initiative of the World Bank was set up in 1998 to provide start-up funds to (social) entrepreneurs for them to develop, and bring to scale, their innovative ideas (https://wbi.worldbank.org/developmentmarketplace/; accessed March 5, 2014

(interview with Dov Pasternak on 27June 2013). A hundred FDS kits would be installed in Niger during the project. Unfortunately, no information is available on the results of this project and what happened to the kits since then.

At an organizational level, the involvement of ICRISAT, a research centre of CGIAR, provided scientific legitimacy to projects promoting smallholder drip irrigation and enabled for harnessing support from international and bilateral funding agencies. At an individual level, the first intermediation of Dov Pasternak (between NETAFIM and ICRISAT) would soon be followed by others that would establish him as the 'public figure' and scientific guarantor of smallholder drip irrigation experiments in the Sudano-Sahel region of Africa.[55] He, indeed, can be identified as a key spokesperson who played a very active role in the innovation translation process. He engaged in constant negotiations aiming at enrolling new actors in an ever-extending network of supporters.

2.4.4 Enrolment: shaping a coalition and strategies to enlist allies

Building alliances

Scaling up the activities conducted between 2002 and 2004 in Niger in the framework of the first AMG project funded by the World Bank required identifying other individuals and agencies that would support the idea of crop diversification through the means of smallholder irrigation. After a talk given at the World Summit on Sustainable Development held in South Africa in 2002, Dov Pasternak managed to create such interessement among Israeli diplomats operating in Sub-Saharan Africa and staff of MASHAV (the organization responsible for the implementation of international collaboration at the foreign ministry of Israel). MASHAV would eventually fund several projects based on the AMG principles, implemented through ICRISAT, but also through other local NGOs (table 2.1). In the same vein, the support of USAID for AMG principles and projects was triggered by a talk given by Dov Pasternak in their regional office in Mali (interview with Dov Pasternak, 17 June, 2013). USAID found in smallholder drip irrigation a (potential) means to achieve its food-security and poverty-reduction goals. As more funding agencies came into play, various projects emerged in many countries of sub-Saharan Africa (table 2.1). These projects, however, shared the principles of

[5] Dov Pasternak was not the only public face of smallholder drip irrigation. Paul Polak, founder of iDE, played a similar role in Asia.

the AMG and had been triggered by the same individual. The multiplication of initiatives and funding agencies and the wide geographical scope of these projects were instrumental in establishing smallholder drip irrigation as a 'success'. After all, if so many organizations promoted it, it had to be good.

Table 2.1 Smallholder drip irrigation projects based on the AMG principles in the Sahel region of sub-Saharan Africa

Dates	Project Name	Funding agencies	Main implementers	Countries
2002-2004	African Market Garden (AMG)	World Bank (Development marketplace initiative)	ICRISAT	Niger
2003-2004	Desert Margin Program (DMP): Market Garden in the Sahel	UNEP	ICRISAT	Burkina Faso, Ghana, Mali, Niger, and Senegal
2003-2008	Techno-Agriculture Innovation for Poverty Alleviation (TIPA)	MASHAV	NGO Ikamva Labantu	South Africa
2004-2007	African Market Garden (AMG)	USAID/ Africa Care/ Swiss Agency for Development and Cooperation	ICRISAT	Ghana and Burkina Faso
2005-2008	AMG Project	MASHAV/John Paul II foundation	ICRISAT	Cape Verde, Mauritania, Senegal, Gambia, Guinea Bissau, Mali, Burkina Faso, Niger and Chad
2006-2013	Techno-Agriculture Innovation for Poverty Alleviation (TIPA)	MASHAV Government of Italy and Government of Senegal	NGO Green Senegal	Senegal
2007-2010	Solar Market Garden (SMG)	USAID and SELF	SELF and ADESCO	Benin

Source: Authors interviews and literature review

Using development discourses and recruiting pilot farmers

The AMG was presented as a holistic crop management package allowing crop diversification through the means of drip irrigation (Woltering et al., 2011b). By presenting drip irrigation technology as a tool to achieve a broader goal and as one important element of an integrated agricultural development project, the promoters of the AMG harnessed the support of development agencies, for which 'integration' had been a key word since the 1970s. Further, by adapting the initial FDS system of 500 m^2 and offering multiple options (80 m^2, 500 m^2, clusters and collective systems of more than 500 m^2; Woltering et al., 2011b), the promoters of the AMG demonstrated the adaptability of smallholder drip irrigation to local conditions and to different types of farmers. This also contributed to making it attractive to development agencies and enabled recruiting 'pilot farmers' who, in turn, played a key role in harnessing support from international and bilateral agencies. Pilot farmers tested the AMG system on demonstration sites and were showcased as successful examples of drip irrigation in use during the many 'field visits' that were organized to these demonstration sites.

About 1200 pilot farmers, extension agents, and NGOs personnel were trained on the use of drip irrigation systems in growing vegetables and fruits (ICRISAT, 2005). This was presented as evidence of success and proved central to enrolling new actors in similar activities.

Experimental results and distribution numbers as "proof of success"

Several scientific publications reported the success of smallholder drip irrigation in terms of water, time, and labour savings as well as increases in yields. These results were obtained on the experimental sites where the AMG was implemented (Mahamadou, 2005; Oumarou, 2008; Woltering et al., 2011a). Such results, corroborated during many field visits organized for development agents but also farmers, were widely circulated as evidence for the potential contribution of drip irrigation to improving food security and land use, increasing household income, and reducing poverty (ICRISAT, 2005). But field visits and experimental results were also used by the AMG promoters and technicians to convince other organizations and individual farmers to stock up on drip irrigation kits. The number of drip kits distributed, in itself, quickly became an objective, even a measure of success, of the AMG project (regardless of whether the kits would actually be used by farmers). As put by a former technician of the AMG in Burkina Faso: 'We were just distributing the drip kits, for free, to anyone, either to individuals or to organisations who requested it. 'We were not interested in

where the kits would end up and whether they would be used' (INERA technician, personal communication, 2012). ICRISAT (2006), for instance, presented the distribution of 2,000 drip kits in nine Sahelian countries as a "Sahelian success". Remarkably little has been reported on the actual use of these smallholder drip irrigation kits (Kay, 2001). Of the 2000 kits, 500 kits were said to have been successfully distributed in Burkina Faso, but little effort was made to see whether they were actually used (Dittoh et al., 2010).

Scientific publication as legitimation on the international stage

Publication in academic journals served as another effective way to build the scientific legitimacy of the AMG and its multiple offshoots and played an integral part in harnessing the support of multiple actors. We were in a position to identify five peer-reviewed articles listed in the Web of Knowledge database that directly deal with the AMG or one of its offshoots (see table 2.2).

Table 2.2: Peer reviewed articles published on the African Market Garden (AMG) and associated initiatives

Article title	Journal, date of publication	Authors	Authors affiliation with AMG
The African Market Garden: The development of a low-pressure drip irrigation system for smallholders in the Sudano Sahel	*Irrigation and Drainage*, 2011	L. Woltering, D. Pasternak, & J. Ndjeunga	AMG project leader and implementing staff
The Economics Of Low Pressure Drip Irrigation and Hand Watering for Vegetable Production in the Sahel	*Agricultural Water Management*, 2011	L. Woltering, A. Ibrahim, D. Pasternak, & J. Ndjeunga	AMG project leader and implementing staff
African Market Garden	*Encyclopedia of Water Science*, 2003	D. Pasternak & A. Bustan	AMG project leader and implementing staff
Smallholder Irrigation as a Poverty Alleviation Tool in Sub-Saharan Africa	*World Development*, 2012	J. A. Burney & R. L. Naylor	AMG project research associates
Intensification and improvement of market gardening in the Sudano-Sahel Region of Africa	*Chronica Horticulturae*, 2006	D. Pasternak, A.Nikiema, D. Senbeto, F. Dougbedji, & L. Woltering.	Project leader and project implementers

What is striking from table 2.2 is that four of these five peer-reviewed articles (and the large majority of the grey literature, not shown) documenting the AMG and similar initiatives have, among their authors, at least one person who was directly involved in the implementation of these projects. Most of the articles conclude that smallholder drip irrigation has the potential to increase the profitability of vegetables gardening, enhance livelihoods and reduce poverty, on the basis of results obtained from experimental or demonstration sites, where farmers had access to much more support and advice than usual

All these peer-reviewed articles are the results of research sponsored or implemented by drip kit producers or disseminators - people, that is, who were keen to make drip work. The publication of AMG articles in scientific journals has significantly contributed to the perceived legitimacy of smallholder drip irrigation and reinforced its recognition as a successful technology, creating further interessement and enrolling additional development and funding agencies in the innovation and dissemination process. Each of these actors found in the technology a means to achieve their own objectives.

Intensive use of mass media

Scientific publications were not the only communication tool used to create interessement and enrol donors and development agencies. The AMG promoters also made intensive use of mass media to advertise the agronomic and economic performance of smallholder drip irrigation. The same pilot sites that served as a basis for collecting data for scientific publications also served for public shows where journalists from newspapers, radio, and public or private television companies reported on the AMG. We identified not less than 15 news cuttings or blog posts on the AMG wherein the major source of information was Dov Pasternak. All these reports focused on drip irrigation (rather than on the integrated horticultural management package of the AMG) and its potential to alleviate hunger and poverty and improve food security. In the same way, the large majority of videos available on the web were staged during the implementation phase of the AMG project and its offshoots, featuring people (researchers and farmers) who had been directly involved in project activities and demonstration sites. They provide testimony of the potential of drip irrigation to increase yields.

2.4.5 Mobilization: the network extends...

We turn here to the last phase of the innovation translation model, that of mobilization: the wide extension of the network of individuals and organizations revolving around a particular innovation. To do so, we focus on Burkina Faso, for which we have more information, but the same processes have probably been at play in other countries of Sub-Saharan Africa.

Table 2.3. Smallholder drip irrigation: supporting coalition and rationales

Actors	Terms of the problem	Terms of interessement	Measure of success
Drip irrigation manufacturers	Entering the African market	Selling equipment	Number of drip kits sold
Research organizations	Contributing to poverty alleviation via science and technology for crop diversification	Demonstrating effectiveness in experimental plots Scientific publications	Publications in scientific literature. Media coverage. Number of farmers trained.
Donors and funding agencies (World Bank, USAID, etc)	Alleviating poverty in a sustainable and gender friendly way Developing a market and business oriented agricultural sector	Demonstrating how World Bank funding (and ideology) contributes to poverty alleviation	Number of drip kits distributed and number of farmers reached
NGOs and other implementers	Alleviating poverty through in a sustainable and gender friendly way	Demonstrating how activities (often measured by number of kits distributed) contribute to lifting farmers out of poverty	Number of drip kits distributed and number of farmers reached
Governments	Modernizing smallholder farming and alleviating poverty	Demonstrating how activities lead to rural development	Number of funded projects. Number of drip kits distributed, number of farmers trained
Farmers	Reducing poverty and vulnerability to external shocks	Free inputs and extension, International exposure, status as pilot farmer.	Training received, free hand-outs (seeds, fertilisers, pipes) and advices

Source: Field data and literature review

In the mid-to-late 2000s, ICRISAT coordinated smallholder drip irrigation initiatives in Sub-Saharan Africa by partnering with other international research centres (such as the World Vegetable Center or AVRDC) and, perhaps more significantly, with national agricultural research organizations. In Burkina Faso, this was the Institut de l'environnement et recherches agricoles (INERA). Since 2010, other actors have taken the centre stage, with smallholder drip irrigation moving from the 'research' to the 'development' field. This is largely because the national government saw initiatives involving smallholder drip irrigation as offering a potential contribution to its food-security agenda, while NGOs and drip irrigation manufacturers saw in smallholder drip irrigation a conduit to pursue their own goals (see table 2.3).

There are important overlaps between the research and development networks that help explain the speed of the mobilization process. For instance, the 'micro-irrigation' officer of the IFAD-funded governmental project PIGEPE was a former INERA technician trained by Dov Pasternak. Also, iDE, which had a long experience of promoting smallholder drip irrigation in the Asian context (Polak et al., 1997c; Postel et al., 2001) has now become a central player in Burkina Faso. iDE activities were largely funded by agencies which earlier supported the AMG initiatives, such as USAID and Swiss Agency for Development and Cooperation (Tables 2.1 and 2.4).

2.5 Conclusion

This paper has described the processes through which a widely shared consensus was created about the validity and legitimacy of promoting smallholder drip irrigation systems as a means to meet a wide number of development goals. Telling the story of smallholder drip irrigation through the theoretical innovation model of interessement, this article has shown that the enthusiasm for this technology can be largely traced back to the relentless efforts of one particular person, an Israeli scientist. With a missionary zeal, he engaged in strategic efforts to convince funders, researchers and many others of the many benefits of the technology, creating a network of support for its dissemination.

A systematic and independent review of the use and impact of drip irrigation kits in Sub-Saharan Africa is lacking. Drip irrigation is widely regarded as a success despite a lack of data on its (un)sustained use in farmers' field. Our field work provides evidence that in Burkina Faso AMG drip kits are no longer in use. In the 10 years that separate our study from

the moment they first 'hit the field', these drip kits *might* have been in use with positive impact on farmers, but this is difficult to assess, because tracing the beneficiaries (villages and farmers) of these kits itself is a challenge. In-depth analysis of current projects implemented in Burkina Faso reveals that kits are seldom used by rural farmers for food, poverty, or water savings. Instead, farmers' engagement with the technology is short-lived, and their interest in it mainly stems from the side benefits that come with the project of which drip irrigation is one element (Wanvoeke et al., 2015c). Such observations make it doubtful that AMG drip kits were used with significant positive impacts even at the height of the project – something that was hinted at by several people we interviewed who had been involved in the AMG project in Burkina Faso. Hence, rather than from what it actually does in the field, the technology obtained its status as a 'success' through a professional and carefully crafted promotional campaign, legitimized by scientific results obtained in experimental or pilot fields. Through this campaign, smallholder drip irrigation has come to be seen as a technology that is potentially instrumental in simultaneously meeting a large number of objectives. It is associated with poverty alleviation and improvements in nutrition, food security and agricultural productivity; with economic growth and women's empowerment; with water conservation, environmental protection and adaptation to climate change. Through these associations, smallholder drip irrigation thus acquired properties that allowed it to attach itself to a wide coalition of actors, including development agents, researchers, NGO staff and some pilot farmers. These actors find in smallholder drip irrigation a way to meet their own goals: social entrepreneurs looking for good causes to support; drip irrigation manufacturers looking for new markets; development organisations looking for 'best practices' they can use to convince funders; etc (table 2.4).

In comparison to the innovations described by Akrich et al. (2002a, 2000b), what is remarkable in the case of smallholder drip irrigation is that the success of the technology appears largely unrelated to whether and how end-users appreciate it. The act of translation in this particular case is one between the technology and the 'development sector', rather than between the technology and end-users. As most actors agree on the potential and promises of the technology, studies that report dissemination, adoption and use challenges are taken as calls to reiterate (and adjust) past efforts. Actual practices (or the lack thereof) by farmers have thus become secondary to the imagery of success that surrounds the technology.

Table 2.4. Recent smallholder drip irrigation projects in Burkina Faso

Dates	Project Name	Funding agencies	Main implementers
2005-2010	Drip irrigation for vegetable crops in Northern region	Swiss Agency for Development & Cooperation (SDC)	Optima Conseils Services (OCS), GEDES, Kali Service
2008-2014	Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	IFAD & Government of Burkina Faso	Ministry of Agriculture (MAHRH)
2009- 2012	Enhanced Homestead Food Production (EHFP)	USAID	Helen Keller International, IFPRI, iDE
2010-2014	Programme de Développement du Maraichage par l'Irrigation Goutte à goutte (PDMIG)	SDC	GEDES, OCS, CSRS, Kali Service
2011-2014	Poly Tank Recycling and Drip Irrigation	IAMGOLD Corporation	iDE
2011-2015	Scaling Up Micro irrigation Technology (SUMMIT)	SDC	iDE
2012-2013	Water use and sustainability in market gardening in Burkina Faso	SHA	Self Help, ADECCOL NGO, and iDE

Source: Field data (2011-2015)

This study holds important lessons for policy makers. First, there is a need for in-depth independent evaluation of drip irrigation projects that reflect the perspectives of smallholders and not only of the promoters of the technology. Second, there is a need to acquire a deeper understanding of how different actors understand and measure what makes the success of a technology before investing in or supporting any technological package. Public campaigns, websites, news stories, and experimental results indeed do not necessarily reflect smallholders' perspectives, which should remain the guiding principles of any development intervention.

Chapter 3

Farmers' logics in engaging with projects promoting drip irrigation kits in Burkina Faso

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Farmers' logics in engaging with projects promoting drip irrigation kits in Burkina Faso

Abstract

Development agencies enthusiastically promote micro-drip irrigation as an affordable water and labour saving device, yet most farmers stop using it as soon as development projects end. This paper analyses why farmers engage in projects promoting micro-drip irrigation, even though it is clear they are not interested in its water and labour saving attributes. We combine practice-based theories of innovation with insights from the anthropology of development to explain that in development arenas, micro-drip kits have different meanings for farmers than for the actors promoting and disseminating the technology. Accepting the technology is just one element of more encompassing strategic efforts by farmers to obtain benefits from development projects. Hence, in the *arena* of the development project and for farmers, micro-drip kits are defined by the side benefits that accompany their introduction such as motorized pumps or free inputs, the promise of credit, or the prospect of acquiring social prestige and forging new alliances.

Keywords: Innovation, Development, Irrigation technology, farmers' logics, sub-Saharan Africa.

3.1 Introduction

Micro drip irrigation was first introduced in Burkina Faso in 2002 by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) through the Desert Margins Project, which aimed at promoting the production of date palms. Two years after, ICRISAT introduced this new form of drip irrigation through the African Market Garden (AMG) project (2004-2007). Funded by the United States Agency for International Development (USAID), this project aimed at combining water management with improved crop production practices (Pasternak et al., 2006; Woltering, et al., 2011b). The AMG promoters tested the so-called pre-packaged Family Drip System (FDS) kits designed by NETAFIM, the main manufacturer of drip irrigation equipment worldwide. The FDS is one among many different micro-drip kits, which consist of a network of plastic pipes, water emitters (or drippers) and a set of valves and filters, and that have been designed to cater to areas ranging from 25m² to 1000m². By communicating that 2,000 micro-drip kits had been distributed in nine Sahelian countries, ICRISAT framed the AMG project as a 'Sahelian success' (ICRISAT, 2006). Its promoters

argued this success was linked to the suitability of the micro-drip technology for the specific arid environment of the Sahel and its affordability for smallholder farmers (Pasternak et al., 2006; Woltering et al., 2011b). In several other countries of sub-Sahara Africa (Kenya, Zimbabwe and South Africa), micro-drip kits were likewise said to have been successfully introduced for small-scale vegetable gardening (Kabutha et al., 2000; Karlberg et al., 2007).

This form of drip irrigation appealed to the Burkina Faso government and various development agencies as a technology holding the promises of efficient water and labour management, improved nutrition and food security, poverty alleviation and women's empowerment (see Venot et al., 2014 for a description of the rationale to promote micro-drip kits in sub-Saharan Africa). This enthusiasm underpinned a multiplication of projects centred on the promotion of micro-drip kits, involving numerous development actors.

The traction this form of irrigation has among development practitioners is remarkable given the little evidence of farmers actually using the technology beyond pilot projects. Wanvoeke et al. (2015c) for example highlight that only one out of the 245 micro-drip kits distributed by the AMG project in Burkina Faso was still in use in 2012, echoing findings from other studies done in Kenya (Belder et al., 2007) and Zimbabwe (Kulecho and Weatherhead 2005, 2006) where farmers discontinued using micro-drip kits once the projects promoting them ended. Many scholars have explained why this happens. They notably highlight: that costs of initial investments are still high (Dittoh et al., 2010); the technical problems (with emitters and filters clogging and deterioration of material) due to unreliable and low quality water supply and harsh environmental conditions (Friedlander et al., 2013); the lack of spare parts, supply chains and support mechanisms; the difficulties to access markets (Kulecho and Weatherhead 2005, 2006); a lack of capacity and knowledge on the part of smallholders; and maybe more fundamentally a misfit between the technology and the cultural setting and agricultural practices of smallholders (Garb & Friedlander, 2014) as many deterrents to widespread adoption. Even though all these studies have critised micro-drip kits, their starting assumption is that using small scale irrigation technologies is potentially beneficial for smallholders'. The studies thus focus on how to make these technologies work (better) in farmers' fields (for instance by teaching farmers about how to use them), or on how to best disseminate them (for instance by improving support services).

Our study builds on these studies, but has a different starting point. Rather than implicitly identifying with designers and promoters in their appraisal of the technology as something potentially positive, we empathize with farmers in an attempt to understand the technology

from their perspective. We do not aim to explain why farmers stop using micro drip kits after projects that promote them have ended (a question already answered by many, see for instance Belder et al. 2007; Kulecho & Weatherhead 2005). Rather, anchored in practice-based theories of innovation and drawing on theoretical insights from the anthropology of development, the paper consists of a systematic analysis of how and why farmers engage with development projects that promote micro-drip kits. The origins of our desire to explore this topic lie with the realisation referred to above that most farmers accept micro-drip kits while projects are running, but appear little interested in water and labour savings attributes that are put forth by their promoters.

In the section that follows, we provide the analytical framework guiding this study. In section three, we describe the methodology used. Through three case studies, we then further analyse the multiple logics farmers have to get involved in development projects that promote micro drip kits (section four). A short conclusion comes back to our main finding, which is that farmers accept engaging with projects promoting this form of irrigation not for the technology per se (or because of its promises in terms of yields and water savings) but for the anticipated side benefits they can gain from it.

3.2 Research framework

A wide variety of disciplines is concerned with the way innovations are created, and with understanding why and how they spread. Rogers' theory of the diffusion of innovation (Rogers, 2003) is perhaps best known and most often used and referred to. Most attempts to explain the success or failure of micro-drip kits indeed make use (sometimes implicitly) of Rogers' classical approach, in identifying the factors facilitating or impeding adoption (see for instance Friedlander et al., 2013; Kulecho & Weatherhead, 2005; Kulecho & Weatherhead, 2006; Malik et al., 2014; Namara et al., 2014).

Although popular and widely used, Roger's approach has also been criticized for its over-simplistic positing of linear causal linkages between design (or dissemination) intentions and outcomes. This has the effect of attributing too much steering power to engineers and innovation planners, to the neglect of end-users or other involved stakeholders. Moreover, Rogers' theory makes it seem as if innovation happens in relative isolation from wider societal processes and structures. Prominent among alternative ways to make theoretical sense of, and help improve, innovation processes are knowledge systems thinking (Röling, 1992), which proposes a much less linear and predictable view of innovation and dissemination, and

participatory approaches to technology development inspired by the seminal work of Chambers (Chambers, 1994; Jiggins, 1989).

The practice-based innovation theory of Akrich et al. (2002a, 2002b) shares with these latter approaches the idea that innovation is open-ended and contingent. Perhaps different than most other theories, which continue adhering to some kind of diffusion model; Akrich et al. do not ascribe the success or failure of a technology to its 'intrinsic' properties. They instead look at technologies-in-context to suggest that innovations are only taken up if an ever increasing number of actors get interested in it. This is the *model of interessement* that postulates that for actors to become interested in a technology, the latter needs to be *translated* to fit different contexts, interests and discourses. In this light, while the discontinued use of micro-drip kits diagnosed by many may mark a "failure" in conventional diffusion terms, in our framework, the fact that farmers do accept the kits reveals that there is something to the technology that does appeal to them. The *model of interessement* directs the attention to why this is so, acknowledging that (the meaning of) an artefact may change depending on the actor-network of which it comes to form a part.

In this paper, we are particularly interested in the influence of development projects in influencing the meaning(s) that micro-drip kits have for farmers. To do this, we make use of insights offered by scholars in the socio-anthropology of development who propose conceptualizing development project contexts as *arenas*, that is, as bounded sites of interaction, contestation and cooperation (Long, 2001; J. P. Olivier de Sardan, 2005). Within these arenas, actors (re)interpret and (re)negotiate things and ideas that come 'from outside'. Olivier de Sardan (2005) proposed the term 'logics' to avoid explaining 'developees' behaviour only from the normative interpretative frames of 'developers' and their projects. When 'developees' behave differently than 'developers' expected, in other words, this is because their logics do not coincide. 'Logics' is akin to strategy and refers to the reasons and motivations actors have for their behaviors. Speaking of 'logics' also stems from recognition that while actors may display an infinite variety of actions and responses, the number of behavioral patterns is limited. This allows inductively explaining similarities in behaviour (Olivier de Sardan 2005: 138). Where Long (2001) and Olivier de Sardan (2005) focused on the negotiated and contingent nature of interpretations and meanings of development interventions, we suggest (inspired by practice-based theories of innovation) that (the meanings of) technologies too are re-negotiated and re-contextualized.

We show through three case studies that, beyond their technical and material properties, and within development project arenas, micro-drip kits have different meanings to farmers than to other development actors. This 'other reality', resulting from a process of interessement in specific actor-networks, is what explains that the reasons for which farmers engage in projects promoting micro-drip kits are often different than the ones assumed and intended by the project and its promoters.

3.3 Methodology and research setting

We used a three-tier methodology. First, from June 2011 to December 2012, we interviewed 44 agents from international and national development agencies, government officials and Non-Governmental Organizations involved in the promotion of micro-drip kits in Burkina Faso. This allowed developing a comprehensive inventory of all development projects and actors promoting this form of irrigation in Burkina Faso (Table 3.1) and yielded a list of 87 sites in which these had been introduced over the last ten years (Figure 3.1).

Second, we made exploratory visits to 28 sites to gain a better understanding of the interface between farmers and projects and to observe micro-drip kits in-use, in a diversity of sites targeted by the different projects that were active at the time of this field work (November 2012 to November 2013). The majority of the 28 sites we visited were considered by promoters and development workers as experimental or demonstration fields, with some of them being referred to as farmers' field schools (Champs Ecole Paysans in French).

Depending on the project and sites, micro-drip kits either used by individual farmers or farmers' groups. In each site, we interviewed one individual farmer using drip irrigation (either in his/her own name or in the name of a group);[6] We also conducted seven focus group discussions in five of the sites where groups of farmers collectively used the micro-drip kits that had been provided to them. The interviews focused on (1) farmers' experiences and expectations in using micro-drip kits, (2) farmers' motivations to be involved in development

[6] Most development agencies and NGOs consider the existence of farmers' groups as a prerequisite for successful development interventions. They see such groups as a guarantee for the sustainability and equity of the intervention; while also hoping that channelling development assistance through groups will increase the number of ultimate beneficiaries. In several of the sites we visited where micro-drip systems were meant for groups, they were actually used by an individual farmer. In two sites we interviewed two persons, bringing up the number of interviews to 30.

projects promoting this irrigation equipment. The interviews were supplemented by direct observation of farmers' using the micro-drip kits in their fields.

Finally, we selected three out of these 28 sites in which farmers were using micro-drip kits, so as to also gain a deeper understanding of their logic. National and international development agents directed us to these sites, which they considered as "exemplary" of drip irrigation promotional efforts. Our sites were selected in contrasting regions of Burkina Faso (Figure 3.1) and funded by different organisations to illustrate different modalities of interaction between farmers and development projects

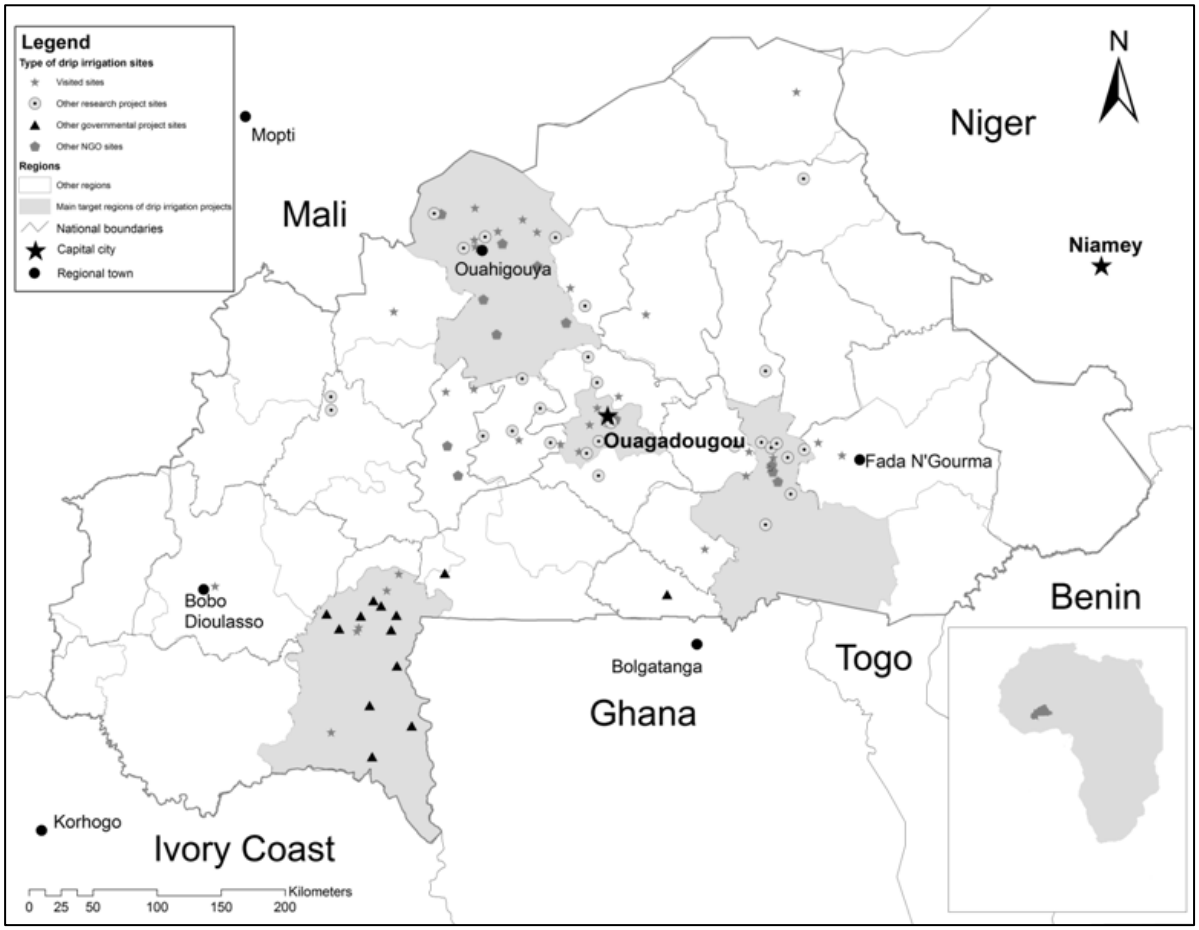

Figure 3.1. Geographical distribution of the drip irrigation sites identified in Burkina Faso
Note: Target villages of the Enhanced Homestead Food Production and Scaling Up Micro Irrigation projects have not been identified They are not represented on the map.

Table 3.1 Overview of drip irrigation projects in Burkina Faso (2004 -2014) Source: this study

Dates	Project Name	Funding agencies	Main implementers
2004-2007	African Market Garden (AMG)	USAID/ Africa Care/ Swiss Agency for Development and Cooperation	ICRISAT, INERA
2007-2010	Approche Intégrée pour le Développement de la Maraîcherieculture (AIDEM)	Swiss Development Cooperation (SDC), Burkina Faso Office (BuCo)	Optima Conseils Services (OCS), GEDES,
2008-2012	Drip irrigation promotion	IFAD Grant (820 & 1174)	IFDC
2008-2014	Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	IFAD, OPEC/OFID & Government of Burkina Faso	Ministry of Agriculture (MAHRH)
2009-2012	Enhanced Homestead Food Production (EHFP)	USAID	Helen Keller International (HKI)
2010-2014	Programme de Développement du Maraichage par l'Irrigation Goutte à goutte (PDMIG)	BuCo/SDC	GEDES, OCS, CSRS, Kali Service
2012-2013	Water use and sustainability in market gardening in Burkina Faso	Self Help Africa (SHA)	SHA, ADECCOL NGO, and iDE
2011-2015	Scaling Up Micro Irrigation (SUMIT)	SDC	iDE

Source: Field data (2011-2015)

3.4 Farmers' logics to get involved in project promoting micro-drip kits projects

3.4.1 An overview

Before elaborating on how and why farmers engage with projects promoting micro drip kits, it is important to give some background information about agriculture and rural livelihoods in Burkina Faso. In Burkina Faso, most agriculture is rainfed and takes place during the three to four months-long rainy season (June-September). This rainfed agriculture is exclusively devoted to the production of cereals, mostly for self consumption. Vegetable gardening, the type of cultivation that micro-drip kit projects are targeting, is normally done on relatively small plots (less than 1 ha) and mostly is a supplementary activity. Whether farm households decide to engage in vegetable farming depends on the availability of water and labour; they

only choose to do it to supplement their food and incomes if it does not compete with other agricultural chores. Not all farm households therefore grow vegetables. Development agencies have nevertheless long promoted vegetable gardens as a way to improve diets and combat poverty, often especially targeting women.

Our exploratory visits to 28 sites allowed getting a first idea of the diversity of reasons why farmers engaged with projects promoting micro-drip kits. These are summarized and categorized in Table 3.2. About 50% of our respondents said they were interested in micro-drip kits because they believed it could improve their health through better nutrition and food security (five answers) and enhance their income through the production of off-season vegetables (eight answers). These answers clearly reflect what is said about drip irrigation among development practitioners. Two farmers explained that they agreed to try the micro-drip kits because they hoped it would allow them to save water and labour when growing vegetables, while another five farmers said they wanted to 'experiment' with a new cultivation technique without articulating any clear expectation. One quarter of all farmers (eight answers) hoped micro-drip kits would come with other benefits such as fertilizers, seeds, micro-credits or expected that accepting the technology would help them to reinforce their social network through the partnership with a development project. Finally one fifth of all respondents answered they 'accepted' micro-drip kits systems because this is what development agents had on offer at the time; they wanted to benefit from the project (and would have accepted any other technology in the same way), reflecting a supply-driven intervention approach.

Table 3.2 Motivations to use drip irrigation as expressed by farmers (N=30)

Main motivations	"Experiment"	Gateway to other benefits (inputs/ pumps/credit), prestige and network	Health, Nutrition, food security	Increase income (food production)	Water and labour saving	Being part of a project
Number of answers[7]	5	8	5	8	2	6

Source: Field data, 2011-2014

[7] The total number of answers is higher than the total number of interviews as some respondents expressed they had multiple reasons to use drip irrigation systems

3.4.2 Case 1: The Wenden Kondo farmers group

The development project

Self Help Africa (SHA), a UK-based charity organisation promoting agricultural development and active in the Sahel region for a long time, initiated a project entitled "Water Use and Sustainability in Market Gardening" in 2012. SHA funded this project for two main reasons. First, SHA staff was aware of the literature praising the technical performance of micro-drip kits and their potential to increase smallholders' incomes whilst reducing the water and labour demands of market gardening (SHA, 2012). Second, international Development Enterprises (iDE, a NGO promoting micro-drip irrigation) convinced them of the appropriateness and affordability of their micro-drip kits, based on stories of success obtained in Asia (SHA West Africa Head of Program, pers comm, July 2012).

SHA saw the project as a development research project, intended to measure the effectiveness of micro-drip kits as compared to traditional irrigation methods such as watering cans. iDE would contribute to the project by providing its expertise in disseminating micro-drip kits. SHA wanted to implement this new initiative in seven villages of the Kouritenga Province in the eastern region of Burkina Faso, a province in which they had already supported vegetables growers that had been organized in groups for this purpose. The idea was for farmers to witness and experiment, first hand, the differences between drip and traditional irrigation methods. First, seven market garden sites (one per village) whose size varied between 0.75 and 1 hectare were identified. Second, four micro-drip kits were to be installed in each village (one of 100 m^2 and three of 500 m^2) and four demonstration plots (one of 100 m^2 and three of 500 m^2; meant to be irrigated by watering cans) were delineated in each of the villages. In each village, SHA provided one motorized pump with accessories (fuel, toolkit and support) to help fill the four reservoirs that would supply water to the micro-drip kits. Third, in each village, four farmers were selected. Each of them was entrusted with the management of two demonstration plots (one with drip irrigation, the other without) and responsible to select (pilot) farmers that would conduct cultivation. Finally, there were transversal activities such as training and capacity building (in relation to installing the kits and using them) and data collection and monitoring.

A local NGO (Action pour le Développement des Communes et des Collectivités Locales; ADECCOL) was put in charge of implementing the activities of the project, thus

acting as an extension service provider (provision of agricultural inputs, link to micro-finance institutions, capacity building). iDE provided the micro-drip kits and related technical support for their installation; it also had the responsibility for monitoring drip irrigation in use and was made responsible for collecting the data that would allow comparing micro drip kits with traditional irrigation methods. When talking to SHA staff, they expressed their disappointment about iDE in this regard, because this research activity had not taken place.

The Wenden Kondo farmers' group

Wenden Kondo is the name given to the vegetable growers' group of the Dassui village. Meaning 'God will provide', the name of the group gives an indication of the way its member perceive development projects, that is, as an assistance provided by God. The group had received various types of support from SHA in the past. At the time of our field work (August 2012), it was the only group among the seven targeted groups initially planned by the project to have received the four micro-drip kits.

Created in 2009 by ADECCOL with the objective of producing and marketing vegetables on one hectare of land, the group counted 42 members (21 women & 21 men). Since its creation, it had received regular training courses regarding horticultural production and group management and also benefited from diverse farming equipments and tools. In addition, in 2010, ADECCOL organized a field visit for the group to another village so that the Dassui farmers could learn about different water lifting (treadle, motorised pumps) and application (watering cans, micro-drip irrigation kit) devices. In 2012, the group visited the iDE experimental field located in Yamtenga, province of Kadiogo. Following these visits and on the insistence of ADECCOL, the group accepted to experiment with micro-drip kits in their garden.

The four micro-drip kits were installed on the collective plot of the group, together with a new diesel pump and four water reservoirs. The group was also provided with fuel and maintenance tools. The executive committee of the group together with the members identified 4 persons who were to manage the micro-drip kits. These became the de facto 'representatives' of the project in the village. A work plan was established by the executive committee of the group to enable all members to contribute to cultivation, which they did under the supervision of the four designated 'representatives' As expressed by the president of the group, *"it was our first experience with drip irrigation; we decided to work together on*

the collective plots to avoid that failures would be attributed to just one person. We decided to share the harvest or sell it and put the money in the group's bank account".

Drip irrigation as part of a development assistance package

In Dassui, we organized two focus group discussions; one with the women members of the group, the other with the men members of the group. During the discussions, it was clear that farmers were sceptical about the (potential) benefits of the micro-drip kits, which they derogatorily called 'plastic agriculture'. Yet, they did want to benefit from SHA activities in the village. We asked every individual independently to identify the main reasons why they participated in the drip experiment conducted by SHA. Results are summarized in Table 3.3.

Farmers appeared to be mostly interested in the prospect of being provided with diesel pumps (and related equipment: fuel, a maintenance toolbox) as these allow for significant time and labour savings compared to drawing water from wells by hand. The readiness of farmers to accept (and potentially use) micro-drip kits largely hinged on the fact that these kits were being supplied together with other goods such as pumps.

Table 3.3. Interests to participate in the SHA funded drip project (farmers in the 'Wenden Kondo' group)

Responses (number)	Free motorised pumps	Free drip kit + pumps	Free inputs	No articulated interest	Free drip kits	Total (N=35)
Women (16)	5	5	3	2	1	16
Men (19)	7	6	2	2	2	19
Total (35)	12	11	5	4	3	35

Source: Field data (2011-2015).

Women farmers also mentioned that their interest in experimenting with the kits was linked to the fact it facilitated access to micro-credit. Instead of using the pumps to supply the micro-drip kits of water, farmers used them to fill up the collective water reservoirs and used these to fill up their watering cans to irrigate their individual fields. Farmers indicated some hesitance in using the micro drip kits as this would necessitate a change in cultivation methods: from direct seeding to transplantation of young carrot seedlings (the preferred crops of farmers in the village), which they were not aware at the start of the project and led them to discontinue using the kits quickly after they were installed.

3.4.3 Case 2: The Yelkpieripouo farmers' group

The development project

The Small-Scale Irrigation and Water Management Project (Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle - PIGEPE) is a project funded by the International Fund for Agricultural Development (IFAD) and the Organization of the Petroleum Exporting Countries Fund for International Development (OPEC/OFID). With a total budget of $19 million over six years (2008-2014), the project was implemented by the Ministry of Agriculture, Hydraulic and Fisheries (MAHRH), through a Project Management Unit (PMU) specifically set up for this purpose, operating from Gaoua, the regional capital of the South-Western region of Burkina Faso. The project targeted six provinces, located in three regions of Burkina Faso (South West, Central West, Central South), and aimed "at improving the living conditions of 19,500 rural families by increasing their agricultural productivity through better access and control over water resources" (IFAD, 2007).

According to project documents, the PIGEPE's approach was demand-driven whereby, after an awareness campaign on the scope and objectives of the project, potential 'beneficiaries' were to express and submit their demands (in the form of micro-projects) to the project team, following a template designed by the PMU. By 2013, the project had financed 150 micro-projects. Agricultural and water management in the form of the promotion of small scale irrigation technologies was central to the project. The choice to provide smallholders with micro-drip kits was based on the belief that this responded to farmers' needs to save water while boosting yields, thus offering the scope to address the rampant rural poverty in the region. The project envisioned the dissemination of 15,000 kits over 600 sites during the lifetime of the project (IFAD, 2007). By 2012, PIGEPE declared having installed 488 kits (PIGEPE, 2012). The PIGEPE project subsidized micro-drip kits and related accessories up to 85 %, with the beneficiaries of the kits paying the remaining 15%. In 2013, and following difficulties in ensuring a steady supply of good quality micro-drip kits from local entrepreneurs, PIGEPE entered into an agreement with iDE for the supply of 2700 micro-drip kits. At the time of writing this article (December 2014), iDE had supplied the kits to the PMU of PIGEPE but we did not know if they had been installed or were used by farmers.

PIGEPE specifically targeted women, as it considered them to be the most vulnerable farmers. Based on the diagnosis that women lacked investment capacity, had difficulties

accessing land, and that very profitable ventures risk being appropriated by men, smaller kits of 20 m² and 30m² were thought to be best suited to women, while men were expected to use 100 m² or 500m² kits

The Yelpieripouo group

The Yelpieripouo ('move out of misery') group is a mixed group of 25 farmers (11 women and 14 men) in Bapla Birifor in the Bougouriba province in the South Western region of Burkina Faso. Like many other groups, it was specifically created in 2011 to partner with the PIGEPE project and benefit from its activities. With the help of the extension agent of the decentralized office of the MAHRH, the Yelpieripouo group elaborated and submitted a micro project for the creation and development of a market garden of one hectare, which was accepted by the PMU. One hectare of community land was thus identified to be used as a gardening site. The land was given to the group by the chief of the village; it had only been used for the production of rainfed cereals until then. Though owned by the group, the site was divided in individual plots of land. PIGEPE built two wells to enable farmers to access water, provided four treadle pumps to draw water from the wells, and fenced the garden to protect it from domestic animals and predators. In addition, the group received tomato and pepper seeds from the decentralized office of the MAHRH.

Two types of irrigation methods were practiced within the garden site: manual irrigation with watering cans and calabashes, and drip irrigation. Farmers who wished to use micro-drip kits had to submit an individual request to the project. Yet, it is important to highlight that the development of the gardening site (wells, treadle pumps, fence) had been made conditional to women agreeing to test micro-drip kits. Consequently all women (11) of the group and three men agreed to test the kits; men were supplied with 100 m^2 kits and women with 20 m^2 kits (as agreed, both contributed 15% of the drip kit cost that is, about $23 and $4, respectively). PIGEPE trained farmers in the use and maintenance of the kits through on farm training and demonstrations while project staff visited the site weekly for monitoring purpose.

During training courses, PIGEPE staff and agricultural extension officers pointed out that women plots equipped with micro-drip kits needed to be watered three times a day due to the high temperature, the aridity of the soil and the small size of the water reservoir that had been provided. Having to irrigate thrice daily clashed with the usual practice whereby women

irrigate their garden once in the morning and once in the evening, devoting the rest of the day to all kind of domestic chores (cooking food, washing clothes, collecting wood in the forest, brewing the traditional alcohol and baking cakes for sale). Further, the long distance between the garden site and their homesteads made it cumbersome for women to use the micro-drip kits, which, according to them did not result in significant time savings nor increases in yields. Interestingly, even though they seldom used the micro-drip kits, women left them apparent in the field to ensure the goodwill of extension agents and project staff. Only few men were interested in the kits, with only three out of 14 asking for one. The men were mostly interested in the wells, pumps and fence; a feeling that was reinforced by the early experiences of women.

Drip irrigation as part of a development assistance package

Farmers' experiences with micro-drip kits in Bapla Birifor were not very positive. However, the president of the group continued using one. This was not so much motivated by the results obtained in the field, but by the need to maintain the good reputation of the group in the eyes of the project staff and extension officers to ensure potential future support, notably in the form of diesel pumps to replace the treadle pumps that had been supplied until then. Similar to the first case study, our interviews revealed that farmers 'went along' with micro-drip kit because it helped them to access other things, as illustrated in the following quotes:

> "*We joined the project because one of the project officers told us we would get treadle pumps and wells in addition to the drip kits. We were happy at the prospect of getting wells. In the past, we carried water from a distance to irrigate, but now we have the wells close to the plots"* (field interview, male farmer, December 2012)

> *"We were told that in addition to the drip kits we would get seeds to grow tomatoes and chilli pepper and also credit and that our field would be fenced against animals. That is why we use it. But we are still waiting for the credit"* (field interview, women farmer, December 2012)

3.4.4 Case 3: The example of an "innovative" farmer

The story of an innovator

When asked to discuss how he came to use drip irrigation kits, El Hadj Lassané Sawadogo started retracing his own history. Born in 1952, he presented himself as an agricultural

entrepreneur dividing his life between agriculture and Islam. He also proudly declared to be among the first farmers to test drip irrigation in Burkina Faso. Well known by fellow villagers and development agencies as an agricultural risk taker in the Yatenga province, he traced his involvement in the agricultural sector back to his childhood.

He recounted that his first encounter with drip irrigation dated from 1998, through an Israeli documentary broadcasted over an international TV channel in Ivory Coast. Driven by the idea of making more money with less effort, he started exploring whether drip irrigation could be used in Burkina Faso. He recalled how, in 2000, he created the Professional Association of Market Gardeners of Yatenga (ASPMY-*Association Professionnelle des Maraichers du Yatenga*) together with another agricultural entrepreneur. Meanwhile, he was informed by the Institute for the Environment and Agricultural Research (INERA-*Institut de l'Environnement et Recherches Agricoles*) that a project called the African Market Garden (AMG) was active in Niger and had provided drip irrigation kits to a private advisory services agency promoting small-scale irrigation in Burkina Faso, APIPAC.[8] He approached APIPAC to seek assistance and obtained a 500 m² drip kit, which he tested without any training or support. APIPAC also contributed to the construction of a cement water reservoir on his field.
With the start of the AMG project in Burkina Faso from 2004 onwards (Wanvoeke et al., 2015a), Lassané Sawadogo further engaged with drip irrigation. He was identified by the AMG project as one of their pilot farmers and participated in several courses on drip irrigation, seed cultivation, and nursery planting techniques. The AMG project also supported the construction of a second cement water reservoir and supplied him with two new drip kits of 500 m². Finally, he was also trained in building cement reservoirs and started selling his services.
In 2011, the Générale des Services (GEDES), a Burkinabè NGO, started promoting micro-drip kits as part of a project funded by the Swiss Agency for Development and Cooperation (see table 3.1). Lassané Sawadogo benefited, again, from two drips kits of 500m² and further training regarding their use. Being a large landowner and wealthy farmer, owning three cemented water wells and four motorised pumps, in combination with his entrepreneurial spirit and experience, made him an ideal anchor point for development agencies that wanted

[8] APIPAC: Association des Professionnels de l'Irrigation Privée et des Activités Connexes was set up in the framework of a World Bank Project.

to experiment with and communicate about the potential benefits of micro-drip kits. Lassané Sawadogo for example partnered with INERA in a trial to test onion cultivation with drip irrigation. In return for making his plots available for these trials, INERA built another cement water reservoir and provided him with additional drip kits.

Lassané Sawadogo might be the only Burkinabè farmer to have continuously used micro-drip kits since 2004, thanks to his ability to network and maintain good relationships with projects, NGOs and research institutions. The latest association of Lassané Sawadogo with initiatives promoting micro-drip kits in Burkina Faso is with iDE, which set up another 500m² drip irrigation kit on his land and supplied him with a polytank reservoir. In 2013, there were different brands of micro-drip kits and four water reservoirs on Lassané Sawadogo's fields. He was very enthusiastic about it.

Drip irrigation as part of a development assistance package

Lassané Sawadogo did not conceal what he derived from his sustained use of micro-drip kits over the last 10 years: this had established him as a reference farmer in the region vis-à-vis fellow farmers and development agencies, and thus helped him to acquire significant social prestige as illustrated in the following quote:

> *"Everybody knows I use drip. If you want to see drip, they (extension services or NGO) will bring you to my field. The extension workers visit me periodically and many big cars and white people come to visit me in the field. Anytime you see a car coming in the village, be sure it is for me, because of drip" (*field interview, June 2013)

Such social prestige was not only acquired through the visits of "outsiders" to Lassané's fields but also through Lassané's participation in meetings, conferences and seminars organized by these outsiders and during which he is asked to bear witness of the benefits of drip irrigation:

> *"I am often invited to attend meetings concerning drip irrigation out of the village and in the capital. They (NGOs) often finance my travels so that I talk about drip irrigation in other villages or during workshops, shows or any events" (*field interview, June 2013*).*

Finally, the story would not be complete without stressing the fact that given steady water supply (through wells, storage and pumps), using micro-drip kits to cultivate vegetables over several thousands of square meters actually is a very profitable avenue. Lassané Sawadogo is

also in a position to sell services for which he has acquired experience through these multiple engagement with development projects – notably regarding the building of cement reservoirs.

3.5 Conclusion

In Burkina Faso, drip irrigation has raised the enthusiasm of the government and of various funding and development agencies and non-governmental organisations. To date, the number of farmers using drip irrigation kits has remained quite small, yet many (roughly 1,000 to 2,000) have willingly engaged in projects promoting this technology over the last decade. In this paper, we explored why farmers engage in projects promoting micro-drip kits, even though it is clear they are not interested in using them as was intended by their promoters: as small-scale irrigation technologies that allow growing vegetables with less water and labour than traditional irrigation methods.

Different from most studies that look at how and why farmers use micro-drip kits, and tend to look for explanations in farm economics, farming systems and livelihood strategies, our investigation was not based on an a priori identification with engineers and disseminators (and an associated belief in the intrinsic 'goodness' of the technology); neither did we aim to identify ways to improve dissemination and adoption. Rather, we set out to understand how farmers perceive and define micro-drip kits from their logics, in the specific *arenas* defined by the actor-networks of development projects. To do so, we used the theoretical model of *interessement,* engaging in particular with its insight that (the meaning of) a technology changes according to the actor-network it is or becomes part of or mobilizes.

Using our theoretical model to make sense of the cases presented in this paper, we conclude that one important reason why farmers nevertheless engage in projects promoting micro-drip kits is because, in development *arenas*, the latter acquire other meanings for them than for those promoting the technology. Or, the technologies become and do something else for farmers than saving water or labour. Our analysis thus extends that of Olivier de Sardan (2005), in showing how it is not only the meanings of development but also the involved technologies that are re-negotiated in the *arena* of the development project. Where promoters focus on the field-level promises of improved agricultural productivity and water and labour savings, for many farmers micro-drip are just one element in a larger development package. Micro-drip kits thus come together with other benefits and services that can be acquired within the sphere of the project. Micro-drip kits may also serve as a tool to acquire prestige or

forge new alliances. Here, our analysis is similar to that of Olivier de Sardan (1988, 2005), who concluded that farmers' logics when engaging in development projects are often different from the logics of development agencies.

Development agencies depend on success stories to stay in business and to safeguard their reputation. These often make use of a single indicator (such as the number of beneficiaries) or anecdotal life histories and pictures of some prototypical farmers. In sub-Saharan Africa, farmers understand this perfectly well and do not mind providing these agencies with such success stories by accepting a technology and pretending to use it, even if it does not really fit their needs. They might agree to this because they are attracted by what development agents say about the ways the technology may enhance their system of production but also, as shown in the three case studies we documented, if there is chance that the technology under the spotlight comes with other (less advertised) benefits and services, such as a facilitated access to agricultural inputs (seeds, fertiliser, pesticides), water lifting devices (motorised pumps), micro-credit, and infrastructures (wells, fences, doors), or a connection to an interesting network (of funders and service providers), or again an increase in prestige.

Better understanding these negotiations and games, and a better appreciation and recognition of how both developers and developees (to use Olivier de Sardan's terms) strategically manipulate and negotiate meanings and technologies in different *arenas,* as well as construct or perform successful outcomes is important. For one, it sheds a revealing light on the performativity of any measurement of development project success. At the most basic level, it suggests that mere acceptance by farmers is not a very good indicator of use and adoption, let alone of achieved outcomes. Also, our analysis suggests that poor adoption rates are not necessarily caused by a lack of awareness, knowledge, capacity or support services - as most analyses have it - but may be the result of a lack of fit with farmers' logics.

Rather than interpreting this as a failure of projects, we suggest that insights in how and why farmers choose to deal with new technologies and the development projects promoting them provide revealing entry-points for further dialogues and experiments, in a process of joint discovery and learning that is beneficial for both developers and developees.

Chapter 4

Smallholder drip irrigation in Burkina Faso: The role of development brokers

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Smallholder drip irrigation in Burkina Faso: The role of development brokers

Abstract

Smallholder drip irrigation is widely held as a promising technology for water saving, poverty reduction and food security despite a dearth of evidence of benefits to farmers, especially in sub-Saharan Africa. In this article, we document three development programmes promoting drip irrigation in Burkina Faso. Using Actor Network Theory and insights from critical development studies, we show that development brokers play a key role in aligning interests, shaping activities and interpreting project outcomes. They are accountable towards each other rather than to farmers. This means that success is interpreted through development agencies lenses and with the intention of continuing involvement in future projects. Small farmers' interests and uptake of the technology are of secondary importance.

Key words: Brokerage, innovation, development aid, water resources, sub-Saharan Africa.

4.1 Introduction

Drip irrigation is a method to supply water in small and frequent quantities to the root zone of crops through a system of perforated plastic pipes. Initially associated with capital-intensive forms of agriculture, efforts to specifically design drip irrigation systems for smallholder farmers began in the late 1990s, first for small scale farmers in South Asian countries. Smallholder drip systems take the form of 'drip kits'[9] (See Polak et al., 1997c; Postel et al., 2001) and exist in different types (see figure 4.1). Regardless of the type and the manufacturer, the overall principle is the same: the 'drip kit' operates under low pressure to provide localised irrigation to a small plot, from a few square meters to a few hundred square metres.

Smallholder drip irrigation is widely presented as a promising option for poverty alleviation and sustainable intensification because it allows to efficiently use water for the

[9] In 2015, iDE indicates a price of about $30 for a 100 m^2 drip kit (with a similar amount needed for the water reservoir and ancillary equipment). Depending on the manufacturer, prices range between $125 and $250 for a 500 m^2 kit (these prices do not include the costs of the pump and reservoir needed to make the kit work, which are more expensive than the kit per se)

production of high-value vegetable crops (for example Pasternak et al., 2006; Postel et al., 2001; Woltering et al., 2011a).

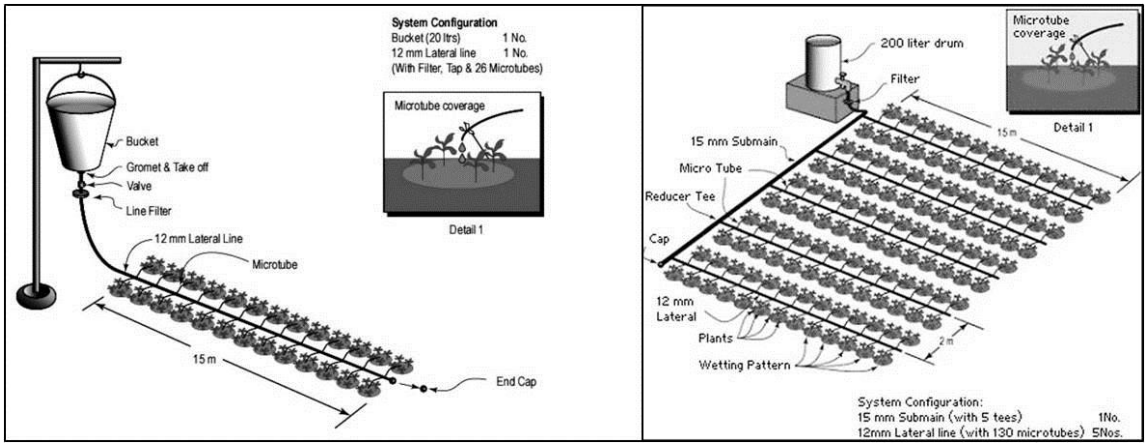

Figure 4.1 Schematic diagrams of smallholder drip irrigations systems

Source: Left: Postel et al. (2001); Right: Polak and Yoder (2006)

As such, and from the mid 2000s onwards, international research institutes, non-governmental organisations, national governments and aid agencies have started promoting it in sub-Saharan Africa. Although often dubbed as an 'agricultural water management strategy', smallholder drip irrigation is significantly different from the soil and water conservation strategies that have long been promoted in sub-Saharan Africa. The latter aimed at rehabilitating degraded soils through better control of rainfall and runoff and improving soil fertility management; they often built on 'indigenous' practices to increase the productivity of rainfed cereals, the mainstay of rural livelihoods (see, for instance Douxchamps et al., 2014; Reij et al., 2005). Smallholder drip irrigation, in contrast, is an alternative method to the calabash and watering cans that are commonly used for vegetable gardening, which is an off-season activity conducted on small plots and depending on labour and water availability.

Burkina Faso is one of the countries where development initiatives centred on the promotion of smallholder drip irrigation have multiplied over the last 10 years (see Wanvoeke et al., 2015a). This multiplication of development projects is testimony of a widely shared enthusiasm for smallholder drip irrigation among a variety of actors: national government, local and international NGOs, private companies, research organisations, aid agencies. So far, this enthusiasm is not backed up with evidence of success in farmers' fields. Our own observations are in line with studies that suggest that the use of drip irrigation remains limited to experimental or pilot sites. Farmers seldom use drip irrigation without external support and

almost invariably stop using it once development projects come to an end (Belder et al., 2007; Kulecho & Weatherhead, 2005). Similar to what has been observed in many other cases in which specific crops or technologies are being promoted by development agencies, this lack of uptake and enthusiasm of farmers can be attributed to a number of factors. These include the still high costs of initial investments (Dittoh et al., 2010); technical problems (with emitters and filters clogging and deterioration of material) due to unreliable and low quality water supply and harsh environmental conditions (for example Friedlander et al., 2013); lack of spare parts, supply chains and support mechanisms (Belder et al., 2007); difficulties to access markets (Kulecho & Weatherhead, 2006); a lack of capacity and knowledge on the part of smallholders and a misfit between the technology and the cultural setting (Garb & Friedlander, 2014). New projects often explicitly set out to address the above constraints: for instance, through technological improvements, more integrated approaches (including micro-credit schemes and links to market), enhanced participation, and so forth.

We turn towards the field of Anthropology of Development, and more specifically towards recent ethnographic studies of aid, to propose a different explanation of the discrepancy between the lack of results on farmers' fields and the continued enthusiasm of development actors for smallholder drip irrigation. We focus on the 'making' of ongoing development efforts around this technology and draw from Mosse (2005) suggestion that it is the interpretation of events, rather than the events themselves, that is pivotal in creating policy enthusiasm for particular development approaches or technologies. It follows that the success of a project (or of a technological package) not so much stems from what it does for its end-users, but instead is the result of the existence and activities of a supportive coalition: a network of actors devoting their energies to maintaining a coherent representation of that specific project or technological package. In our case, this representation is that of drip irrigation as a suitable technology (because of its size and affordability, and because of the efficiency with which it uses water) to meet the needs of smallholder farmers in sub-Saharan Africa, and thus to realise the goals of water saving (or environmental conservation) and poverty alleviation, while also helping improve food security.

Our analysis thus aims to unravel the network of development actors who shape and underpin the promotion of drip irrigation in Burkina Faso, a Sahelian country in West Africa. We describe the strategies they use and the reasons they have to do so, as well as the relations of interdependency that tie these multiple actors together. The next section further develops

the analytical framework of the study around the notion of brokerage as discussed by anthropology of development and science and technology scholars. We then present our methodology, before a detailed description of three development programmes promoting drip irrigation in Burkina Faso. The discussion draws generic lessons about the networks and practices of drip irrigation development in Burkina Faso. Finally, a short conclusion reflects on what brokerage means in the context of development, beyond the facilitation of an innovation process.

4.2 Brokerage and translation

In Burkina Faso, and more generally in West Africa, drip irrigation reaches smallholder farmers through development projects, which still are the preferred mode of intervention of development agencies and non-governmental organisations despite repeated calls for programmatic and sectoral support since the Paris declaration in 2005 (OECD, 2005).

Anthropology of development scholars have long highlighted the key role played by development brokers (in French , *courtiers en développement*) in shaping the reality of these projects (Bierschenk et al., 2000, 2002). They have proposed understanding brokerage as a process, go beyond the normative representation generally associated with this activity of intermediation, as for instance found in rural innovation studies (Klerkx et al., 2009).

Discussing brokerage in relation to place-specific interventions, scholars of the anthropology of development have defined development brokers as these 'project's local social carriers, at the interface between the people (the 'target group') aimed at by the project and the development institutions" (Bierschenk et al., 2000, p. 7). Development brokers are the "social actors implanted in a local arena who serve as intermediaries who drain off external resources in the form of development aid' (Bierschenk et al., 2000, p. 7). They can be extension agents, project staff, community leaders, locally elected officials, and so forth.

Within critical development studies, ideas of brokerage also exist, but do not just apply to the 'local'. Drawing from Actor Network Theory (ANT), Lewis and Mosse (2006) talk of 'translation' to refer to an activity that encompasses the production and stabilisation of knowledge, meanings and interpretations. In a similar vein, Rottenburg (2009) sheds light on the important role that development experts and consultants have in 'translating' projects activities and outcomes as they often mediate between funding agencies and national governments. Lewis and Mosse (2006) go one step further in arguing that the mutual

enrolment and interlocking of interests within networks of actors (funding and governmental agencies, NGOs, research centres, private companies, pilot farmers, and so forth) is what produces project 'realities': multiple actors engage in joint work to produce and sustain a coherent vision regarding a specific sphere of intervention.

Through their use of the notion of translation, these scholars in critical development studies deal with themes that have long been central to science and technology studies and innovation studies. These two fields are particularly relevant to us given our study object, drip irrigation, which has a strong material dimension. Scholars in innovation system studies tend to adopt a more structural view on brokerage than development anthropologists. They indeed see brokers as 'key facilitators' for the diffusion of technological innovations, or in other words, for their success (see, among others, Klerkx et al., 2009). Science and technology scholars and notably ANT theorists, on the other hand, highlight that the very definition of the success of a technology is the result of creating interest and coalition building (Akrich et al., 2002a)

Though using slightly different definitions of the terms brokerage and translation and though used in relation to different study objects, scholars in critical development studies, innovation studies and Science and Technology Studies all shed light on a similar phenomenon, that of '(inter-) mediation' within a network of actors (people, organisation) and objects. Because of the key importance of intermediation in shaping policy interventions, development projects or technological artefacts, they argue that intermediation deserves thorough analysis.

In this article we analyse the process of intermediation for the case of smallholder drip irrigation in Burkina Faso. We use three case studies to illustrate the role of brokers, interpreting it beyond that of facilitating the diffusion of this new technology. We map the actors involved in drip irrigation, describe their activities and identify their relations of dependency and accountability. By doing so, we set out to generate a different interpretation of the fate and travels of smallholder drip irrigation. To date, most if not all, drip irrigation studies have focused on understanding the constraints and opportunities smallholders in the developing world face in using drip irrigation. In our analysis, we turn the research gaze to those promoting the technology in an attempt to shed light on how 'it makes its way' to them.

4.3 Methodology

We used a three-tier methodology. First, from June 2011 to November 2012 we interviewed 44 employees from international and national development agencies, government officials, Non-Governmental Organisations and private companies involved in the promotion of smallholder drip irrigation in Burkina Faso. Second (November 2012 to November 2013), we visited 28 out of the 87 drip irrigation sites we had identified through interviews, to gain a better understanding of the implementation modalities of drip irrigation projects and of drip irrigation in use. In addition to interviews and field visits, we participated in two promotional (demonstration) events organised in Ouagadougou and Koudougou around smallholder drip irrigation. Third, we selected three case studies of development programmes promoting smallholder drip irrigation at the time of our study (2011-2014). Our primary objective with these case studies was to analyse the network of actors that underpinned these initiatives. We selected the Scaling Up Micro Irrigation Technologies project (SUMIT); the *Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle* (PIGEPE, Small Scale Irrigation and Water Management Project); and two linked SDC projects namely *Approche Intégrée pour le Développement de la Maraîcherculture* (AIDEM, Integrated approach for vegetable farming development) and its successor the *Programme de Développement du Maraichage par l'Irrigation Goutte à Goutte* (PDMIG, Programme for the Development of Vegetable Farming through Drip Irrigation). The three cases were selected to cover a diversity of institutional arrangements between multiple actors; they were also described by many as being the most prominent initiatives promoting drip irrigation at the time. In each case, we conducted an in-depth analysis of the projects' documentation (notably appraisal, progress, and evaluation reports), we interviewed staff of the funding and implementing agencies and of the organisations providing support and services to the main implementing agencies. Finally, we visited some of the sites of these projects and participated in project events (Table 4.1). In the case of the SUMIT project, we conducted follow-up interviews to collect additional information in February 2015.

4.4 Development projects: brokering drip irrigation

4.4.1 Case 1: Scaling Up Micro Irrigation Technologies project

The SUMIT project is a five-year-long and US$ 4 million project (2011-2015) funded by the Swiss Agency for Development and Cooperation. It aims at creating a market for drip

irrigation in Burkina Faso. The project is implemented by international Development Enterprises (iDE), an international NGO, seen by many in the sector as a social enterprise.

Table 4.1. Characteristics of the case-studies

	Scaling Up Micro irrigation Technologies (SUMIT)	Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	Programme de Développement du Maraichage par l'Irrigation Goutte à Goutte (PDMIG)
Funding agency	Swiss Agency for Development and Cooperation (SDC)	International Fund for Agricultural Development (IFAD) and Organization of the Petroleum Exporting Countries Fund for International Development (OPEC/OFID).	Bureau de Cooperation Burkina/ Swiss Agency for Development and Cooperation (Buco/SDC)
Implementing agency	International Development Enterprise (iDE)	Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques (MAHRH)	General des Services (GEDES)
Regions of implementation	North, Centre	South West, Central-West, Central South	North, Centre
Number of interviews	8	10	7
Number of field sites visited	7[10]	5	10
Number of projects events attended	2	1	1

Source: Field data, 2011-2015

Moving away from subsidies, iDE insists on selling rather than giving products for free or at reduced prices. It received significant attention for its work in south Asia in the late 1990s/early 2000s and extended its operations to sub-Saharan Africa in the late 2000s. iDE has long focused on designing affordable water technologies. In line with its development

[10] SUMIT strategies are different from the strategies of PIGEPE and PDMIG. SUMIT has two demonstrations sites in which periodic promotional events are organized. We visited these two demonstration sites as well as five other sites in which drip irrigation equipment disseminated in the framework of the SUMIT project are used.

philosophy of supporting the emergence of small-scale entrepreneurs, it disseminates these technologies according to market principles. iDE believes that system guarantees the sustainability of development interventions (Heierli & Polak [2000]; see Venot et al. [2014] for a critical analysis).

iDE opened its Burkina Faso office in 2011 and used the project to structure its operations in that country.[11] Significant efforts went into raising awareness about drip irrigation. First, iDE created a 'technology centre' in Yamtenga (close to the capital city, Ouagadougou). The centre is a facility where affordable water technologies (such as drip irrigation systems and treadle pumps) are developed and tested. It can also be used to train farmers, public extension agents and NGO staff in installing, maintaining and monitoring drip irrigation systems. At the same time, the technology centre is an element of iDE's marketing campaign to promote its products (in September 2014, for instance, senior officials of the World Bank and partners in the region coordinating the Sahel Irrigation Initiative visited iDE's technology centre). In addition to the technology centre, iDE has established demonstration sites in four provinces of the country (Yatenga in the Northern region, Kadiogo in the Centre region, and Sanguié and Boulkiemdé in the Centre-west region). iDE heavily invests in promotional campaigns through local media (TV channels, newspaper, radio, and so forth), where results obtained in the technology centre and other demonstration sites are showcased.

At the time of the writing of this article, iDE worked with eight retailers and nine farm business advisors who serve as intermediaries to disseminate drip irrigation systems (www.ideburkinafaso.org). iDE and retailers have a contractual agreement establishing the conditions under which iDE products are sold. Retailers are small scale merchants and traders often, but not always, specialised in selling agricultural equipment. They do not provide further support to farmers other than selling the equipment. Farm Business advisors (FBAs) are currently full staff of iDE with a base salary, a percentage on each product sold and a bonus both meant as financial incentives to further FBAs initiative.[12] iDE expects the drip irrigation market to expand and volumes of sales to increase: hence, it envisions that FBAs

[11] SDC is a historical partner of iDE; it financed some its projects in India in the early 2000s.

[12] The bonus is calculated on the basis of sales volumes, the quality of maintenance of the demonstration site overseen by the FBA, the quality of the support provided to farmers, and the FBA's marketing dynamism.

will be independent and profitable ventures on their own by 2017 (without any further financial support from iDE)[13]

FBAs are located throughout the four target provinces of the project, and their contract with iDE includes maintaining and monitoring drip irrigation demonstration sites, promoting and selling iDE's products, providing after-sales services[14] and serving as relays between retailers selling iDE products and smallholders who express an interest in using drip irrigation. Most FBAs have been hired for their marketing and communication skills, and often have an agricultural background. Further training regarding drip irrigation's technical aspects was provided to them.

One of the cornerstones of iDE's philosophy is that poor farmers and small entrepreneurs only buy what they really need; they will therefore only invest in specific products if these yield rapid benefits (Polak, 2008). This philosophy establishes the volume of sales as the primary indicator of success, and frees the promoter of the responsibility of evaluating the actual use of the technology by smallholder farmers (who, indeed, being poor, would buy something (s)he expects would not have positive results). The distinct focus on the volume of sales clearly transpired during several of our interviews with FBA and other technical and management staff of iDE. It also clearly transpires from the blackboard that welcomes every visitor to iDE office in Ouagadougou and indicates the volumes of sales achieved by the organisation, updated monthly.

In parallel to the SUMIT project, iDE is also involved in other initiatives. According to the iDE-Burkina Faso director, the idea of social enterprise and more generally of private-led rural development appears to have little traction in Burkina Faso (interview, October 2013). This observation echoes findings by Abric et al. (2011), who highlight that the Ministry of agriculture is reluctant to devolve the implementation of externally funded development projects to private companies, despite experiments held as promising by development aid agencies. This is why, in order to expand its activities and establish itself as a key player in

[13] At the time of writing, iDE is experimenting to grant a larger degree of autonomy to some FBAs (this translates in a decrease in base salary and an increase in the level of interessement FBAs receive on each sale).

[14] Our interviews reveal that after sales services are mostly limited to supporting farmers in installing the drip irrigation systems they bought. FBA sometimes monitor drip irrigation systems "in use" but they do not see long-term support as part of their responsibilities, nor does iDE management (partly because of the costs that would be involved).

the sector, iDE has actively sought partnerships with other NGOs and development projects, to which it sells drip irrigation kits and, in some instances, its expertise in installing and monitoring drip irrigation use. In January 2015, 85 per cent of all kits (that is nearly 3,600 kits) had been sold to other development organisations (including Burkinabè associations and NGOs, international NGOs, and governmental projects) and the remaining 15per cent (about 650 kits) to private farmers. This strategy to engage with other development actors was clearly articulated by the iDE- Burkina Faso director during one of our interviews:

> I made a lot of efforts to get contracts with projects and development agencies without it, there is little prospect for farmers to buy and use drip irrigation. Projects and NGOs are our best opportunities to sell our drip irrigation equipment (iDE-Burkina Faso director, interview, 6 December 2012)

4.4.2 Case 2: Scale Irrigation and Water Management Project

PIGEPE is a project funded by the International Fund for Agricultural Development (IFAD) and OFID/OPEP. With a total budget of US$19 million over six years (2008-2014), the project was implemented by the *Ministère de l'Agriculture de l'Hydraulique et des Ressources Halieutiques* (MAHRH, Ministry of Agriculture, Hydraulic and Fisheries), through a Project Management Unit (PMU) specifically set up for this purpose and operating from Gaoua, the regional capital of the South-Western region of Burkina Faso. The project targeted six provinces, located in three regions of Burkina Faso (South West, Central West, Central South), and aimed at improving the living conditions of 19,500 rural families by increasing agricultural productivity through better access and control over water resources (IFAD, 2007). This was meant to happen through the implementation of demand-driven micro-projects submitted by farmers with the support of intermediaries (NGO, extension agents, mayors, and so forth). However, the choice for smallholder drip irrigation had already been done at the design stage; one of the targets of the project indeed was the dissemination of 15,000 drip kits over 600 sites (IFAD, 2007).

To do so, the PMU first entered in an agreement with Irrigation du Faso (IRRIFASO), a Burkinabé private company created in September 2009 to distribute smallholder drip irrigation systems manufactured by the biggest irrigation equipment company worldwide, the Israeli firm NETAFIM. The first agreement between PIGEPE and IRRIFASO was established in 2011 for the provision of 390 drip irrigation kits and did not include support or after sales

services, even though, according to the executive officer of IRRIFASO, this is what is the most profitable to them:

> We don't gain enough money if we only sell NETAFIM drip kits. The sale of our expertise is more beneficial to us than the sale of the drip kits themselves (IRRIFASO executive officer, interview, 18 October 2012).

Despite the limited profitability of this first contract according to IRRIFASO staff, the establishment of an alliance with a large-scale governmental project is in line with the company multi-fold strategy to establish itself as the country's major provider of drip irrigation systems (hardware) and expertise (software) in this field. IRRIFASO often claims being the sole and official representative of NETAFIM in Burkina Faso;[15] it has set up a drip irrigation demonstration site used during conferences, workshops and international visits to showcase the potential of drip irrigation and the expertise of the company, with the aim of extending its customer base for the provision, installation, maintenance and support of drip irrigation. Furthermore, and as clearly expressed by the company's manager, IRRIFASO aims to participate in all major meetings pertaining to water and agriculture in Burkina Faso:

> No one can talk about drip irrigation in Burkina without IRRIFASO. We are not only selling drip kits. We provide technical expertise on the installation and maintenance of drip irrigation which is more important for our company. We are always invited to workshops and conference and to train people to use drip irrigation (IRRIFASO executive officer, interview, 18 October 2012).

IRRIFASO's strategy clearly was successful. In 2012, a new contract between the PMU and IRRIFASO was signed for the training of 60 extension agents of the Ministry of Agriculture and some pilot farmers (PIGEPE, 2012). The training sessions focused on the technical basics of drip irrigation: recognising, assembling and installing the different elements of the drip irrigation kits.

PIGEPE nevertheless ran into difficulties in achieving the targets set by the project design document. By the end of 2012, IRRIFASO had supplied 1,260 kits of 100 m² and 282

[15] We could not verify the validity of this claim. Another small Burkinabé private company, Kali's Service, contested IRRIFASO's claim of being the exclusive retailer of NETAFIM in the country. Kali's Services stated it also imported NETAFIM equipment.

kits of 500 m², and the PMU declared having installed 488 drip irrigation kits without specifying their type (PIGEPE, 2013). It is remarkable that the only indicator of progress used in project reports is the number of drip kits installed. Indicators such as the number of kits in actual use, production levels, profitability for farmers, the extent of water and labour savings and so forth are conspicuous by their absence. It is assumed that kits are actually used by farmers, and that this use is leading to improved food security and livelihoods, without any studies being done to confirm whether this is the case or not. For the PMU and the funding agency, distributing drip kits appears to be an end in itself.

In 2013, and following difficulties in ensuring a steady supply of good quality drip irrigation kits from IRRIFASO,[16] the PMU entered into an agreement with iDE for the supply of 2,700 kits, the establishment of several demonstration sites, and the training of private distributors and extension agents regarding the technical aspects of drip irrigation. The signing of this contract followed an evaluation mission of the PIGEPE project in June 2012; it also has its roots in personal professional relationships. Based on previous work experience, the evaluation mission leader (who was also part of the PIGEPE formulation team in the mid-2000s) was indeed well-acquainted with iDE's experience in the promotion of low-cost drip irrigation elsewhere. He also knew the Burkina Faso country director personally (from his previous employment at IFAD), who joined the evaluation mission in 2012 as an observer (interview, October 2013).[17] The contract had to be discussed at length, because of the strong ideological differences between PIGEPE (operating on a subsidy and transfer mode) and iDE (which aims to operate according to market principles). An agreement was finally reached whereby the kits are subsidised at 85 per cent but sold through a network of small private distributors allowed to make a profit. This agreement served both the objectives of the PMU (that is reaching the project's goals) and those of iDE (that is extending its sphere of operations and strengthen small rural entrepreneurs). In October 2014, during a phone interview, the agent of the PMU in charge of overseeing the dissemination of drip irrigation

[16] The difficulties of meeting the project's targets were attributed to cumbersome administrative procedures within IFAD, and to difficulties related to the import of equipment from Israel.

[17] This PIGEPE project design document predates the establishment of IRRIFASO (in 2009) and of the iDE country office in Burkina Faso (in 2011). However, it mentions iDE as a potential supplier of drip kits, to be imported from India.

mentioned that 310 kits of 500 m^2 and 1,260 kits of 100 m^2 had been installed, still much less than the ambitious objective of the design document.

4.4.3 Case 3: Projects financed by SDC-Burkina Faso: AIDEM and PDMIG

The Burkina Faso office of the Swiss Agency for Development & Cooperation (SDC-BuCo) started financing drip irrigation projects in 2007, immediately after the end of the African Market Garden (AMG) project.[18] The first project SDC-Buco financed was called AIDEM. It was implemented in three villages (Ouahigouya, Koumbri and Tikaré) of the northern region by Optima Conseils Services (OCS) between 2007 and 2010. OCS is a private consulting company (in French, Bureau d'étude) that was set up for the occasion by a former staff member of SDC-BuCo. Following a similar institutional setup and partly involving the same project partners as in the AMG project, AIDEM was implemented in collaboration with the decentralised offices of the MAHRH. The *Institut National de l'Environnement et des Recherches Agricoles* (INERA, National Institute for Environment and Agricultural Research) and the *Centre Suisse pour la Recherche Scientifique* (CSRS, Swiss Centre for Scientific Research) supplied OCS with drip irrigation kits (left over from the previous AMG project) and coordinated research to evaluate the performance of drip irrigation. Additional drip irrigation kits were procured from IRRIFASO.

Following a positive evaluation of AIDEM (BuCo, 2011), SDC-BuCo decided to fund another four-years (2011-2014) project, the PDMIG. GEDES (Générale des Services), another private consulting company, replaced OCS. As a result of this, OCS, whose very existence depended on the promotion of drip irrigation through AIDEM had to close. This new partnership is no coincidence. GEDES, a bigger organisation than OCS created in 2000, had a history of collaboration with SDC-BuCo in the fields of decentralisation and governance. In 2010, GEDES added water and natural resources management (as well as health and sanitation) to its portfolio of activities, positioning itself as a 'natural partner' of SDC-BuCo for the implementation of PDMIG. PDMIG allowed GEDES to significantly grow in size (in addition to the purchase of material and vehicles, the organisation indeed hired eight new staff). A private company called Kali Service was identified through an open call

[18] The AMG project initiated and implemented by ICRISAT marked the start of smallholder drip irrigation promotion efforts in West Africa (see Chapter 2).

for tenders to sell drip irrigation kits. Our interview with the manager of this company clearly revealed that this was an opportunistic move on her part. Selling drip kits was a business opportunity, like any other:

> I started with drip irrigation just as a business and to make money. I don't know anything about the technical aspects of drip irrigation. My job is to buy and sell. I am a business person selling drip kits to GEDES (Director of Kali's service, interview, 21 September 2012).

Once the contract was awarded and the drip irrigation kits sold, she stopped working in this field to focus on her poultry farm located in Ouagadougou.

The PDMIG project mostly consisted of the establishment of 15 drip irrigation demonstration sites, seen by many as farmer field school (in French, Champ Ecole Paysan), a widespread modality of agricultural extension adopted by projects in Burkina Faso. GEDES identified pilot farmers through the provincial farmers' union, built a cemented water reservoir and installed a drip irrigation system on their respective plots without any contribution from the farmers.[19] GEDES extension agents visited the pilot sites every two weeks and organised collective field-trainings that, in practice, amounted to awareness raising events and brought together about 30 farmers in each pilot site. The number of participants (15 x 30 = 450) to these mediatised events was then used as a key indicator of project's progress even though GEDES' programme officer recognized that:

> We are doing our best to show farmers that drip irrigation is important for agriculture. Adoption level is low. All our farmers irrigate the drip irrigation plots with watering cans when we are not there. We know it but we cannot do anything. It happens everywhere (GEDES program officer, interviews, 12 August 2013 and 11 September 2013).

[19] GEDES considered land and motorised pump ownership as a prerequisite to be a pilot farmer under the project, meaning that only better-off farmers (linked to farmers' union) were directly engaged in PDMIG. GEDES justified this as the project involved building infrastructure (a cemented reservoir), a prerogative of landowners versus tenants. Farmers also needed to have the means to invest in vegetable gardening (pump ownership served as a proxy for investment capacity and was a guarantee that farmers had access to water).

4.5 Discussion: interdependencies and accountability

Our survey and key informant interviews identified eight projects for the promotion of smallholder drip irrigation in Burkina Faso since 2004. Table 4.2 shows that many development actors are involved in more than one project. The Swiss Development Cooperation (SDC) funded or co-funded four out of eight projects. USAID financed different projects too, while IFAD is involved in a single large-scale project that builds on previous experiences acquired in other countries such as Madagascar, India and Guatemala. iDE figures in four different projects, either as implementing agency or as supplier of kits and expertise. IRRIFASO supplied kits and training for two initiatives. INERA did research in one project and provided kits in another project.

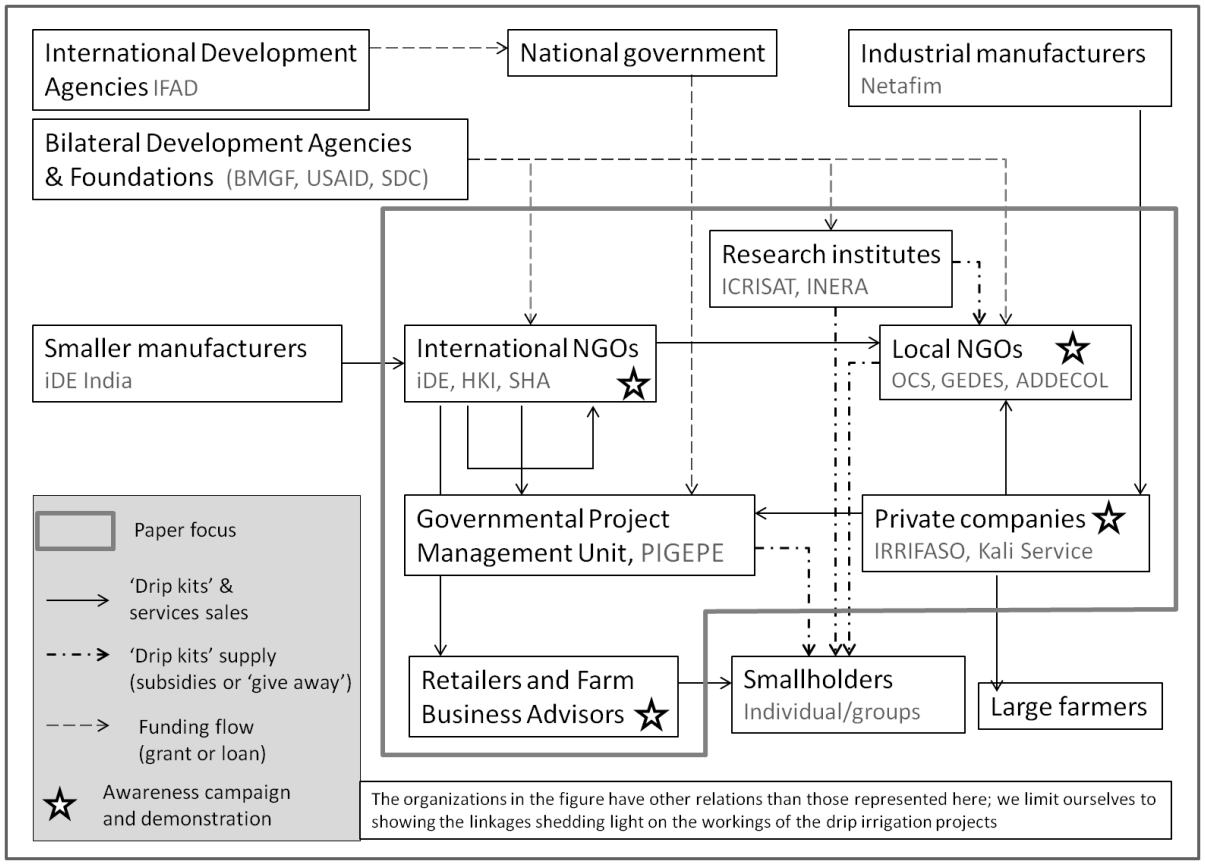

Figure 4.2 Actors' linkages for the promotion and provision of drip irrigation in Burkina Faso. Source: field data, 2011-2015

A closer look at four of these projects allows an in-depth mapping of the different actors involved in the sector and of their mutual relationships, represented in figure 4.2. This article

focuses on the organisations involved in 'implementing' drip irrigation projects in Burkina Faso (in the square in figure 4.2). These organisations act as intermediaries between farmers and those organisations whose role mostly consists of financing development projects (international and bilateral development agencies, the national government) or supplying drip irrigation equipment.

Organisations in the square of figure 4.2 can be broadly grouped into six categories. First, are research institutes coordinating research for development projects that are focused on demonstrating the suitability and performance of drip irrigation through pilot studies. Second, Burkinabé NGOs and, third, governmental development projects promoting drip irrigation, often in the form of demonstration sites (farmers' field schools) where drip irrigation systems are provided for free or at highly subsidised rates. The fourth category of actors consists of international NGOs providing drip irrigation equipment and expertise to local NGOs and governmental development projects. International Development Enterprise (iDE) holds a particular position among those international NGOs. It has preferential access to drip irrigation equipment from India (and supplies other actors with it), supports the emergence of small-scale private-sector actors (retailers and farm business advisors, a fifth actor category, still very much dependent on iDE). Selling equipment and expertise to development agencies is crucial for iDE-Burkina Faso, but this also implies that iDE has less influence on the way drip irrigation kits are reaching farmers, and notably the level at which they are subsidised. Though it insists on fostering private sector entrepreneurship and despite its business-oriented rhetoric, iDE appears fully embedded and partly contributes to the public development aid sector. Small private companies selling drip irrigation equipment to NGOs, governmental projects and farmers constitute the sixth category of actors.

Figure 4.2 shows the relations between the different actors who form the coalition supporting the promotion of drip irrigation. Since 2004, when smallholder drip irrigation was first introduced in Burkina Faso, most of the development projects engaged in the promotion of drip irrigation made use of existing networks. The network is supported and sustained through personal relationships, flows of funds, equipment, project staff and concepts. For example, the PIGEPE PMU entered in an agreement with iDE following recommendations by the project evaluation mission in 2012. This collaboration was facilitated through the personal professional relationships between one member of the mission and iDE's country coordinator.

Table 4.2 Smallholder drip irrigation projects in Burkina Faso: An extended network of actors

Project Name	Funding agencies	Implementing agency (promotion, technical support, extension)	Kits and expertise providers	Periods
African Market Garden (AMG)	USAID/ Africa Care/ Swiss Development Cooperation (SDC)	ICRISAT, INERA	NETAFIM	2004-2007
Approche Intégrée pour le Développement de la Maraîcherculture (AIDEM)	SDC-Burkina Faso Office (SDC/BuCo)	Optima Conseils Services (OCS)	INERA	2007-2010
Drip irrigation promotion	IFAD	IFDC	IRRIFASO	2008-2012
Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	IFAD , OPEC/OFID & Government of Burkina Faso	Ministry of Agriculture (MAHRH)	IRRIFASO , iDE	2008-2014
Enhanced Homestead Food Production (EHFP)	United States Agency for International Development /Office of US Foreign Disaster Assistance (USAID/OFDA)	Helen Keller International (HKI)	iDE	2009-2012
Programme de Développement du Maraichage par l'Irrigation Goutte à goutte (PDMIG)	SDC-Burkina Faso Office (SDC/BuCo)	General des Services (GEDES)	Kali Service	2010-2014
Scaling Up Micro Irrigation(SUMIT)	SDC	iDE	iDE	2011-2015
Water use and sustainability in market gardening in Burkina Faso (WUSMK-BF)	Self Help Africa (SHA)	SHA, ADECCOL	iDE	2012-2013

Source: The authors (2015)

Our interviews also revealed that the involvement of Kali Service in one of the projects was based on the manager's acquaintance with the programme officer of SDC-BuCo. Further, drip

kits left over from one project (that is the AMG implemented by ICRISAT) were used in a different project later on (that is AIDEM implemented by OCS). This was facilitated by one actor (INERA) that was involved in both projects, albeit in a different role. The concept of farmer field school is used in different projects, such AIDEM and PDMIG, that take their clues from research organisations, such as INERA and ICRISAT. Another example of a staff transfer is that of the drip irrigation technician of the PIGEPE-PMU who was previously working for INERA during the AMG project and was hired on the basis of this experience. Further, some of the distributors and FBAs now working with iDE had been working earlier with some of the other NGOs (such as HKI, GEDES or SHA) promoting drip irrigation.

Our analysis shows that development is shaped by multiple interactions between actors of different statuses, with varying resources and dissimilar goals. For these actors, drip irrigation often constitutes a means (among others) to achieve a broader objective; it may also represent a business opportunity or even a safety buoy supporting their own existence. Through drip irrigation, iDE, for instance, establishes itself as a key player in the agricultural water sector in Burkina Faso. This is the case for IRRIFASO, too, which also pursues the goal of being a private profitable venture through the sales of drip irrigation equipment and expertise. Some local NGOs depend on drip irrigation to continue to exist. For instance, when OCS did not manage to partner with SDC-BuCo in the PDMIG project, the organisation collapsed. For such organisations, the stakes are high. Their existence depends on actively reproducing a positive imagery around drip irrigation. The extensive use of media to showcase the successful performance of drip irrigation is important here, which is why the projects produce radio programmes and videos on pilot sites with pilot farmers. Though presented as an effective way to 'raise the awareness' of farmers, they also prove very effective in convincing donors and sustaining flows of funds from development agencies. The latter are all too happy to invest in the 'promises' of a technology that comes hand-in-hand with an agricultural model: the small entrepreneurial farmer producing high-value crops for the market.

In Burkina Faso, drip irrigation remains an artefact that rarely travels outside of development cooperation spheres. Actors who promote it are highly dependent on external funds from bilateral and international aid agencies. Drip irrigation kit providers such as IRRIFASO and international NGOs such as iDE conduct most of their activities with what they call 'institutional clients' such as the government and NGOs implementing drip irrigation

projects. Direct sales to smallholders are very rare.[20] At best, the organisations we have discussed are in contact with farmers through small-scale retailers and business advisors. Most contractual agreements are between two development organisations; smallholders hardly feature in them. Contracts relate to the sales of a certain number of drip irrigation kits, at a certain price, and sometimes to monitoring and after-sales support, which remain at best patchy. What happens after the sale is of little concern to the drip irrigation kit providers. Here, indeed, the market-based rhetoric takes over: if a 'rational actor' is ready to buy a drip irrigation kit, this must signify that he or she expects this to yield a positive return. Linked to the features attributed to the drip irrigation technology (modern, productive and efficient), this willingness to pay is sufficient guarantee. In this way, the supportive coalition can function 'without the farmers', which also means that the actors in the network are hardly accountable to them. In the coalition of smallholder drip kit supporters, sales or dissemination volumes become the primary indicator of success and are the focus of reporting, not the number of drip kits in use or the livelihood impacts. The latter are not ignored, they are just assumed to happen on the basis of experimentation in pilot sites receiving significant external support.

4.6 Conclusion

The number of development actors involved in the promotion of smallholder drip irrigation in Burkina Faso has been increasing since it was first introduced in 2004. Over the last decade, we identified eight major development projects involved in the dissemination of drip kits. Despite a lack of systematic data on uptake and livelihood impacts, aid agencies, government officials and NGOs staff widely present drip irrigation as a promising innovation for smallholders, one that allows turning subsistence farmers into small agricultural entrepreneurs. We show that such positive imagery comes about and is sustained through the strategic efforts of multiple development brokers and is reinforced via its circulation within this coalition.

In conventional innovation studies, brokers are seen as key facilitators who form an essential link between the providers/funders of an innovation and its end-users (see, for example,

[20] In February 2014, a monitoring and evaluation study conducted by an iDE consultant evaluated that iDE had 104 individual clients (using 213 kits) and that the corresponding drip kits covered 4 hectares only. In January 2015, iDE had sold 650 kits to farmers.

Klerkx et al. 2009). They are a 'positive force'. In the case of drip irrigation, the role of brokers and intermediaries has for instance been shown to be pivotal to the rapid expansion of this technology in the North African context (see, for example, Benouniche et al., 2014; Poncet et al., 2010). In the context of development, conventional innovation theory positions brokers or intermediaries as dependent on and accountable to both international development agencies (upwards) as well as to smallholder farmers (downwards). In this setting, negative feedback on the usefulness of an innovation is immediately felt by brokers and project implementers: if smallholder farmers would not be using drip kits because they do not see the advantages, they would stop buying them, putting local NGOs and retailers out of business. Project implementers would not be able to reach project goals and, ultimately, funding agencies would stop financing these projects. However, what we observed in Burkina Faso deviates substantially from this theory. We combined practice based theory of innovation (Akrich et al., 2002a) with insights from Anthropology of Development (Bierschenk et al., 2000; Lewis & Mosse, 2006) to explain why.

From our case studies we conclude that development brokers do much more than bridging the gap between those who design, fund and implement projects and smallholder farmers, that is, the intended beneficiaries of innovations: they actively contribute to shaping the representations and successful outcomes of development projects. A large diversity of actors, such as local and international NGOs, government agencies, private companies and local retailers act as development brokers. In fact, there is not one single (type of) broker, but rather a brokering network. This network of actors, often supported and sustained by personal relationships, facilitates the flows of money, equipment, ideas and staff (that is experience and knowledge) between different projects, and thus substantially influences project design and implementation modalities. Actors within the network create coalitions and interdependencies (for example, by signing contracts for the provisioning of equipment or training). Although their objectives of engaging in drip irrigation projects may be different, these objectives are nevertheless compatible or made compatible (that is selling equipment for profit, receiving funding, creating a market, reputation).

These actors are united in their desire to build and maintain an image of a 'successful innovation', something that is achieved by reporting high numbers of drip kits disseminated, showcasing demonstration sites, and telling success stories of pilot farmers on radio and television. Rather than to smallholders, actors in the network are accountable to each other

and to those who provide funds for project activities. The consequence is that the actor network, which only includes a few select pilot farmers held as successful examples of innovators and entrepreneurial farmers, shapes new project activities and determines the ways success is measured and reported.

Thus, shifting the analytical focus away from smallholder farmers (project beneficiaries) to the actors who promote smallholder drip irrigation yields a different explanation of why the technology continues to be hailed as a success in spite of little evidence of impacts in farmers' fields. We show that drip irrigation development projects work as resource arenas into which multiple actors tap to fulfil their objectives (Bierschenk et al., 2000; Meyer, 1995; Platteau, 2004). The motives of these actors are both altruistic - a desire to help farmers - and pragmatic - the wish to ensure personal advancement, status, or remuneration. The positive imagery and discursive success of drip irrigation in the developing world is not only linked to the technical attributes of the technology, but also importantly stems from the fact that drip irrigation serves important other functions: it helps generate hopes and funds; it creates new markets; it helps build and mobilise social networks, and so forth.

Our analysis of the making and practices of development projects and policies has relevance beyond the case of drip irrigation in pointing at how feedback loops and accountability relations become distorted when development projects and actors overly depend on outside sources of funding. As for Burkina Faso, our case studies highlight the still central role that public agencies have in shaping the way the epistemic community of development agents works, in spite of the private sector rhetoric of many development aid agencies. More broadly, our findings point to a worrisome lack of downward accountability in development cooperation. Concerns about reputations and survival create pressures to report success, providing strong incentives to all involved to use very selective measures and accounts of impact. Rather than reporting to end-users or final clients, or being influenced by the opinions and feedback of ultimate beneficiaries, development actors depend for the continuation of their operations on the approval of each other and of funders. This vicious web of mutual dependencies can only be broken by allowing, and indeed actively promoting beneficiaries to co-determine how development funds are (to be) used.

Chapter 5

Why development interventions continue despite evidence of lack of success: the case of low cost drip irrigation in Burkina Faso

A modified version of this chapter is submitted as book chapter:

Wanvoeke, J., Venot, J. P., Zwarteveen, M. and de Fraiture, C. (2015). Why development interventions continue despite evidence of lack of success: the case of low cost drip irrigation in Burkina Faso

Why development interventions continue despite evidence of lack of success: The case of low cost drip irrigation in Burkina Faso

Abstract

This paper tells the story of the promotion of low-cost (micro) drip irrigation in Burkina Faso over the last two decades. It describes the processes that allow this technology to continue to exist as a valuable development device even though farmers seldom use it beyond the arenas of exogenously-led development interventions. Our analysis shows that the persistent image of smallholder drip irrigation as an effective tool to alleviate poverty, improve food security and save water is the result of the active efforts of a tight network of enthusiastic development actors, and is only true within this network. Partly inspired by their belief in the potential of the technology, these actors tell stories, make analyses and design interventions that help sustain and reinforce the technology as a success. They in turn need this success to maintain their own reputation and guarantee future funds for their activities. What the technology is and means to the farmers who are supposed to use it is, or has been consciously made, irrelevant to its survival as a successful development tool.

Key words: Low cost drip, development intervention, water resources, sub-Saharan Africa.

5.1 Introduction

Research and development efforts around drip irrigation have traditionally been geared towards intensive commercial farming in developed economies, focusing on ways to improve efficiencies and productivities. From the late 1990s onwards, an increasing number of research institutes and non-governmental organizations (NGOs) have engaged in efforts to make drip irrigation accessible to smallholder farmers in developing countries. This entailed attempts to design much smaller drip systems, which would be cheaper and easier to operate than the high-tech systems used by farmers in developed economies. The idea of making an advanced and modern technology suitable for use by poor smallholder farmers acquired wide resonance among a diverse group of actors working in the fields of agriculture, water governance, irrigation, and more generally the environment and development (Cornish, 1998; Kay, 2001; Polak et al., 1997c; Postel et al., 2001). Smallholder drip irrigation has now become a popular technology, promoted by many organisations that aim at improving smallholder farming in the South.

Broadly speaking, two types of smallholder drip irrigation systems (also called 'drip-kits') can be identified. The first one has come to be known as the Family Drip System (FDS) and is manufactured by NETAFIM, the biggest irrigation equipment company worldwide. Another type of systems can be pulled together under the generic name Pre-packaged Drip Irrigation Kit (PDIK); these systems are manufactured by smaller companies generally located in India or China. Several NGOs, of which the most well known is international Development Enterprise (iDE), actively promote PDIKs. According to (Kay, 2001), the FDS is a relatively sophisticated system of high quality that has been "down-sized" to make it suitable for smallholders (it can be adapted to variable plot sizes, but was designed for a plot size of 500 m^2). Because of its in-line drippers that require good water filtration and a minimum water pressure, proponents of PDIKs highlights the FDS is still rather expensive and difficult to operate for most smallholder farmers in developing countries. In contrast, the same proponents of PDIKs, highlight the latter have been specifically designed for "1 acre farmers" (Polak, 2008). These kits are available for plots of multiple sizes, ranging from $20m^2$ to $1000m^2$; the drip tubes are made of thinner plastic (sometimes called flat pipes) fitted with micro-tubes, which makes them cheaper and less prone to clogging than the FDS of a similar size (Polak et al., 1997a) (see Figure 5.1).[21] Regardless of the system and the manufacturer (the debate on the pros and cons of each option remains the affair of a few "experts"), the overall principle is the same: the drip system operates under low pressure to provide localized irrigation to small plots, which extend from a few square meters to a few hundred square meters. Apart from the water reservoir (tank), the system comes in the form of an all inclusive "kit" packaged in a plastic bag (smaller kits) or a carton box (larger kits).

[21] Interestingly, due to significant decrease in the cost of the equipment proposed by major manufacturers (such as NETAFIM and Toro) and to difficulties met to ensure a steady supply of standard quality material from small scale producers, iDE is currently considering partnering with large manufacturers to use their material in their programs.

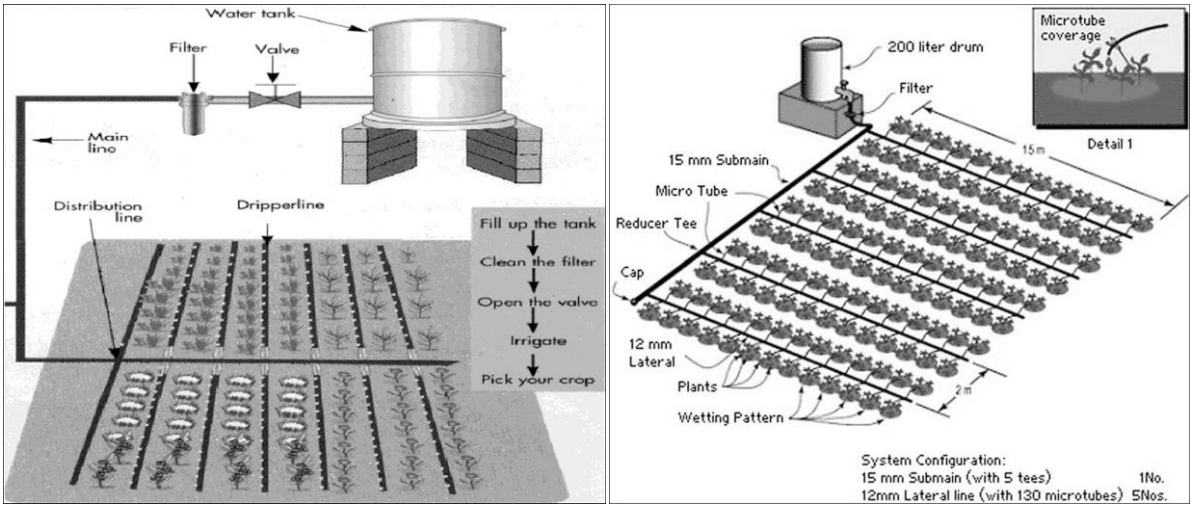

Figure 5.1 NETAFIM Family Drip system (FDS) and iDE's Variant

Source: Left: (NETAFIM, 2008); Right: (Polak & Yoder, 2006)

5.2 Early enthusiasm, a wealth of projects and illusive drip kits

In the late 1990s and 2000s, several wide audience books (Polak, 2008; Postel, 1999) and specialized publications (Polak et al., 1997a, 1997c; Postel et al., 2001) reporting on a limited number of experiments conducted in South-Asia voiced their enthusiasm for smallholder drip irrigation systems. These publications highlighted that smallholder drip irrigation offered the prospect to save labour and water, while improving yields and food security, and boosting incomes at household level. In the early 2010s, other publications reporting on development projects conducted in sub-Saharan Africa shared the same enthusiasm on the prospect offered by micro-drip irrigation (Polak et al., 1997c; Postel et al., 2001; Woltering et al., 2011a; Woltering et al., 2011b).

Since the 2000s, research institutes, development agencies, NGOs, and national governments have engaged in a multitude of collaborative efforts to test and promote micro-drip irrigation systems in developing countries. This resulted in the widely advertised dissemination of thousands of micro-drip kits to smallholders in sub-Sahara Africa (Abric et al., 2011; Chitsiko & Mudima, 2002; ICRISAT, 2005; Kabutha et al., 2000; Karlberg et al., 2007; Pasternak & Bustan, 2003). Burkina Faso is no exception and from 2004 to 2015, there were not less than eight projects aimed at promoting smallholder drip irrigation (Table 5.1).

Table 5.1 List of drip irrigation projects initiated since 2004 in Burkina Faso

N°	Dates	Project Name	Funding agencies	Main implementers
1	2004-2007	African Market Garden (AMG)	USAID/ Africa Care/ Swiss Development Cooperation (SDC)	ICRISAT, INERA
2	2007-2010	Approche Intégrée pour le Développement de la Maraîcherculture (AIDEM)	Swiss Development Cooperation (SDC), Burkina Faso Office (BuCo)	Optima Conseils Services (OCS), GEDES,
3	2008-2012	Drip irrigation promotion	IFAD Grant (820 & 1174)	IFDC
4	2008-2014	Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	IFAD & Government of Burkina Faso	Ministry of Agriculture (MAHRH)
5	2009-2012	Enhanced Homestead Food Production	USAID	Helen Keller International (HKI)
6	2010-2014	Programme de Développement du Maraichage par l'Irrigation Goutte à goutte (PDMIG)	BuCo/SDC	GEDES, OCS, CSRS, Kali Service
7	2012-2013	Water use and sustainability in market gardening in Burkina Faso	Self Help Africa (SHA)	SHA, ADECCOL NGO, and iDE
8	2011-2015	Scaling Up Micro Irrigation (SUMIT)	SDC	iDE

Source: Field data, 2011-2015

At the time of conducting field work for this research (2011-2014), enthusiasm for smallholder drip irrigation in Burkina Faso was still high, with several new projects starting. This multiplication of projects is testimony of the fact that (past) drip irrigation dissemination efforts are held as successful (or at least promising) by a wide range of development actors. In contrast, however, when we first ventured in the field nearly 10 years after the first projects promoting drip irrigation in Burkina Faso had started, we found it challenging to locate sites, that would not be demonstration plots, in which farmers were using use micro-drip irrigation with significant external support (Wanvoeke et al., 2015a, 2015c). For instance, of the several hundreds of farmers that are said to have benefitted from the African Market Project (AMG), we could only identify one that had continued using drip irrigation after the project ended in 2007. Likewise, in February 2015, just after the *Programme de Développement du*

Maraichage par l'Irrigation Goutte à Goutte (PDMIG) ended in December 2015, none of the 15 sites demonstration sites that the NGO implementing the project had said to have set up seemed to be in use. At the pick of the vegetable gardening season, fields remained idle and drip lines were lying in messy heaps in the corners of the fields. As for the PIGEPE project, the main government initiative promoting drip irrigation at the time of our fieldwork (see chapter 2 and 3), field visits highlighted that drip lines were indeed dotting the landscape (in 2012, 450 kits out of the 15,000 envisioned had been disseminated to farmers). Although farmers left them in the field, they preferred using watering cans and hoses to irrigate their plots (see picture 5.1). These observations were echoed by other studies. For example in Kenya and Zimbabwe researchers reached the conclusion that the use of smallholder drip irrigation remained limited to experimental plots where 'pilot farmers' used the technology during the lifetime of the project, but stopped using it as soon as the project ended to revert to their earlier irrigation practices (use of calabash and watering cans) (Belder et al., 2007; Kulecho & Weatherhead, 2005).

Picture 5.1 Women using buckets and hoses to irrigate drip irrigation plots.

Clearly, however, the absence of sustained use of micro-drip irrigation by farmers did little to temper the enthusiasm of its promoters, and has not dented the reputation of the technology as a successful development device. This last section of the thesis synthesizes the different elements presented in the previous chapters of the manuscript; it explains how the sustained enthusiasm and positive imagery that surrounds micro-drip irrigation has been crafted and been able to persist, even in the absence of sustained used by farmers. To do this, we use the socio-anthropology of development for its analysis of the way development cooperation works, and combine it with Science and Technology Studies and their analysis of how technologies travel.

In the section that follows, we further describe the analytical framework that has guided our analysis and the methodology used. In section 3, we identify the five main ways development actors use to bring into being, make up or indeed perform micro-drip irrigation development as a success. A short conclusion summarizes our main finding, which is that drip irrigation in Burkina Faso is an exemplary case of how development cooperation works: rather than experiences of use by farmers, its success is the result of the active work of story-telling, designing and staging interventions, analysing and reporting by the parties promoting drip irrigation. The survival of these development actors importantly depends on their reputation among funders and the wider audience, which in turn strongly depends on their ability to present themselves and their work as a success. They therefore have an interest in constructing and presenting smallholder drip irrigation as a triumph.

5.3 Theories and methodology

Within the broad discipline of anthropology of development, there is a tradition of work that has investigated the narratives and practices of development projects, and aimed at explaining why projects are seen as failures or successes (Mowles, 2010; J. P. Olivier de Sardan, 2005; Rottenburg, 2009; Van Assche et al., 2012). For our analysis, we notably draw on David Mosse (2005). His argument is that the reality of a development project is not merely proclaimed or reported, but is a social performance. It is indeed “determined through the interpretive work of experts who discern meaning from events by connecting them to policy ideas, texts, log frames, and project documents” (Mosse, 2005, p. 157). As stated by Mosse (2005), "development success is not merely a question of measures of performance, it is also about how particular interpretations are made and sustained socially. It is not just about what a project does, but also how and to whom it speaks, [and] who can be made to believe in it" (Mosse, 2005, p. 158). This does not mean that measures of performance, as we will see, are not important: they are socially produced.

A very similar type of argument has been put forth by scholars in the field of Science and Technology Studies who focus on technological projects and systems rather than on development projects. In his study of a failed Parisian rapid transport system, Latour (1996) for instance showed that a technological project is framed in time by those who instigate it, map it, and translate it. Latour even goes a step further by stating that “a technological project is not in a context; it gives itself a context, or sometimes does not give itself one” (Latour, 1996, p. 133). Transposed to the field of development, this argument establishes development

projects as entities through which realities are generated and interpreted; they happen through the production of specific data, results, outcomes and their interpretation by specific actors and circulation in specific networks.

These ideas are suitable for analyzing the travels and travails of smallholder drip irrigation. They allow understanding its image - of a successful and appropriate technology for smallholders that improves food security and reduces poverty - not as something that stems from its intrinsic characteristics, but that is the result of the efforts (reports, information, data, interpretations, stories) of the coalition of development practitioners, funding agencies, scientists and policymakers who are involved in its design, testing, promotion and dissemination. Through these efforts, this coalition of actors creates a specific smallholder drip irrigation reality, one in which the technology figures as something promising. We have identified 5 specific ways through which this happens: (1) fitting smallholders to the technology; (2) aligning the technology to broader development narratives; (3) creating a network of actors around the technology; (4) demonstrating success through the use of experimental plots and pilot farmers; and (5) using specific metrics of success. We further describe these in the following sections.

This last chapter brings together the insights that have been detailed in the previous sections of this thesis. Similarly to these, we base our analysis on a broad literature review on past experiences and current trends in the promotion and dissemination of micro-drip irrigation in developing countries, and on an in-depth analysis of the grey literature (project documents, reports, web-based information) of projects implemented in Burkina Faso. This yielded a comprehensive list of all actors involved in the sector in Burkina Faso, most of whom we contacted for interviews and discussions.

The field work was conducted in four main phases. First, from June 2011 to November 2012 we interviewed 44 agents from international and national development agencies, government officials, Non-Governmental Organizations, and private companies involved in the promotion of smallholder drip irrigation in Burkina Faso. Second (November 2012 to November 2013), we visited 28 of the 87 drip irrigation projects' sites we had identified through these interviews. Through these visits, we aimed at gaining a better understanding of the implementation modalities of drip irrigation projects and of drip irrigation-in-use. Third and during the same period (November 2012 to November 2013), we selected three projects (PIGEPE, SUMIT, and PDMIG) for more detailed cases studies. We also used this period for additional interviews with staff and partners, visits to projects sites

and for participatory observations during project events (promotional campaigns). Fourth, in February 2015, and after some of our initial conclusions had raised questions among the organisations promoting drip irrigation in Burkina Faso, we conducted a short visit to assess how the situation had evolved in some of the sites we had previously visited and documented.

5.4 Beyond events: staging interpretations, performing realities

5.4.1 Fitting smallholders to the technology

As noted in the introduction, drip irrigation is a high-tech technology that is normally associated with modern and well-to-do farmers. Largely spearheaded by engineers committed to helping solve problems of poverty and hunger, the last decades have seen a number of attempts to make this technology also accessible and suitable to smallholder farmers in developing countries (Postel et al., 2001). The engineers working to re-design and re-adjust the technology to this new group of users were guided by (largely untested) assumptions about smallholder farmers: they were thought to be poor, un-educated, and technologically unskilled. Hence, the systems were to be low-cost, requiring a relatively low initial capital investment needed (a few hundred dollars for systems covering 500 to 1,000 m^2), whereas they were also designed and tested for ease of operation and maintenance (Cornish, 1998; Keller & Keller, 2003; Maisiri et al., 2005). An additional requirement that guided its design was that it had to be readily reproducible in a variety of regions (Abric et al., 2011).

Perhaps more than referring to any living rural person in Africa, the poor farmer for whom low-cost drip irrigation was designed existed above all as the iconic rural development client that aid organizations and funders need to justify their existence. What is clear is that the story of such a poor farmer as the grateful recipient of a simple and appropriate irrigation technology was and is a very attractive one to market and sell development aid to a donor audience. It is telling in this respect that almost irrespective of where low-cost drip kits are disseminated, very similar documentaries and short press articles with photos appear, relating comparable stories of how drip kits were the stepping stone to help poor farmer families escape poverty. Against the near absence of any farmer actually using smallholder drip systems in their fields, the continued persistence and production of such stories is ironic. In Actor-Network terms, one could say that in the process of designing a new technology, also a new user was invented: the small, poor, uneducated farmer. This farmer, however, is real only

in the very development aid networks through which (s)he was brought into being - (s)he exists because of and through these networks.

5.4.2 Aligning the technology with development buzzwords

A second way that members of actor-coalitions establish smallholder drip irrigation as a successful development device consists of skilfully aligning it with development buzzwords and framing it in the terms of mainstream development narratives. Four important buzzwords and narratives in this respect are: food security; gender and women's empowerment; water scarcity and entrepreneurship. We describe each of them in more detail below.

Food security

An effective way to boost the popularity of smallholder drip irrigation in development cooperation circles is to make a convincing claim about its potential to alleviate hunger and poverty (Bala, 2003; Burney & Naylor, 2012; Postel, 2001; Postel et al., 2001) and to enhance food security (Burney et al., 2010; Lewis, 2010). To do this, promoters of smallholder drip irrigation argue that the vegetables produced with the help of drip kits can be consumed by the household, which will improve nutritional status. These vegetables can also be sold on the local market, thereby generating family income, particularly during the dry season when income from other agricultural sources is low. In sub-Saharan Africa, ICRISAT and partners, mostly as part of the AMG project, did experiments on pilot plots and in controlled field conditions to show that smallholder drip irrigation could improve yields and the quality of vegetables. They then assumed that farmers using the technology would be able and willing to obtain similar results in their own fields, and hypothesized that this would improve their income as well as help save labour and water (ICRISAT-WCA, 2009; ICRISAT, 2006; Pasternak et al., 2006; Woltering, et al., 2011a; Woltering et al., 2011b). Again, who these farmers are or would be was assumed, or one could say invented in the process. The poor rural people eager to save water and labour for producing vegetables for own consumption or for the market only exist in the narratives of the researchers, and are seldom compared to any living human being. These narratives nevertheless seem legitimate as they are constructed on the basis of scientific findings and published in peer-reviewed journals. Creating enthusiasm for smallholder drip irrigation thus partly happens by constructing it as a device that will help achieve goals of food security and poverty alleviation. This construction gains legitimacy and indeed becomes true with the help of science, and goes accompanied with the creation of a ‘poor farmer’.

Gender & women empowerment

Given the importance of gender equity and women's empowerment on development agendas, another strategy to increase the popularity of smallholder drip irrigation in development cooperation circles is by positing it as a tool that is particularly suitable for women. This is indeed what has happened and is still happening. The reasoning is that because of its small size, ease of operation and its labour-saving potential, the technology is a perfect match with the needs and capacities of poor rural women in Africa. Covering small areas, the use of smallholder drip irrigation does not require access to large stretches of agricultural land, which is an additional advantage as access to land is a recognized challenge for many women in the sub-Sahara African context (van Koppen, 2000; van Leeuwen, 2001). This also partly explains why the smallest drip kit sizes are specifically designated for use by female farmers: even smaller plots are needed. Further, drip irrigation (presumably) requires less labour than conventional irrigation techniques. The smallholder drip-women association gains additional strength through the fact that smallholder drip is to be used for growing vegetables: in the development literature, home-garden and vegetable production often figure as a feminine component of African farming systems (Dittoh et al., 2013). By targeting women organized in groups, drip irrigation can be combined with another popular development strategy to empower women: micro credit. The idea is that group credit can be used by women for the initial purchase of the drip irrigation systems (see the link in Heierli & Polak, 2000). The story thus becomes that drip irrigation is a technology that contributes to the empowerment of women by reducing their workloads and providing them a source of income. In telling this story, the female farmer appears and comes into being as a smaller (and poorer, and even less well educated and skilled) version of the iconic poor farmer.

Water scarcity

The fact that drip irrigation is associated with high water use efficiencies (see van der Kooij et al., 2013; Venot et al., 2014) lends it with an aura of 'greenness' that also works well to promote it in development cooperation circles. Burkina Faso and many other African countries are part of the semi-arid region of the Sahel where agriculture is mainly rainfed and takes place only four months per year for growing cereals. The rest of the year is devoted to irrigated agriculture with the amount of water available for off season crops such as vegetables. But this off season agriculture is hampered by a lack of water. Water scarcity in general is widely recognized as a significant problem for the success of agricultural systems

in Burkina Faso (Niemeijer & Mazzucato, 2002), and helping solve it is therefore a key ingredient of development strategies. The status of drip irrigation as a water efficiency enhancing tool thus can be effectively mobilized to contribute to its popularity.

Entrepreneurship

Another important buzzword that promoters of smallholder drip irrigation are strategically invoking to boost the popularity of the technology is entrepreneurship. The idea of entrepreneurs and private companies as motors of development is emerging as a new orthodoxy, particularly appealing to large private foundations (see among others Venot, 2015). This idea is also spreading to agriculture and rural development, most prominently in strategies to turn poor smallholder farms into profit-making businesses. Presenting drip irrigation as a tool that will help achieve this transformation is therefore an effective way to increase its attractiveness for development actors. The idea that development aid should not consist of 'free hand-outs' but be channelled through the market is part of the entrepreneurial rhetoric. The most well known organization promoting drip irrigation for smallholders, international Development Enterprises (iDE), for instance insists it adopts a business approach to development whereby drip kits are sold through local dealers instead of being handed out for free. According to iDE this is a major move away from public development aid, as they consider smallholders as customers and entrepreneurs instead of as recipients of charity (Heierli & Polak, 2000). In this narrative, smallholder farmers and women in particular, are portrayed (and indeed come into being) as poor, illiterate yet inventive, hardworking, persevering and caring for their families. They are people with special needs who, when given the right support and tools, will evolve into entrepreneurial and successful farmers.

5.4.3 Creating a supportive coalition

The above stories in which smallholder drip irrigation figures as a successful device to help meet a large range of development objectives are not merely de-incarnated entities. They are actively produced, articulated and circulated by individuals and organisations for specific purposes. Their existence in turn, influences what happens in projects: the narratives and the ideas that they contain are connected, circulated and indeed made true through networks of people, flows of money and equipment (Mosse 2005). Our research shows that since 2004, when drip irrigation was first introduced in Burkina Faso by ICRISAT and INERA in the framework of the AMG project (see Wanvoeke et al., 2015a on the story of the AMG), the

network of actors promoting this technological package has significantly extended, creating an upward spiral of success. It now includes several funding agencies, international and national NGOs, research organizations, private companies and small-scale entrepreneurs as well as the national government (see figure 5.2). These actors are closely connected to each other through the different smallholder drip projects that have been implemented in the country over the last ten years. This network is supported and sustained by personal relationships and substantially influences project design and implementation modalities (Wanvoeke et al., 2015b). The similarities between the different projects disseminating smallholder drip irrigation are thus no coincidence: all of them are based on the identification of pilot farmers, the establishment of demonstration sites, and large-scale promotional campaigns around the results obtained in these sites (see next section).

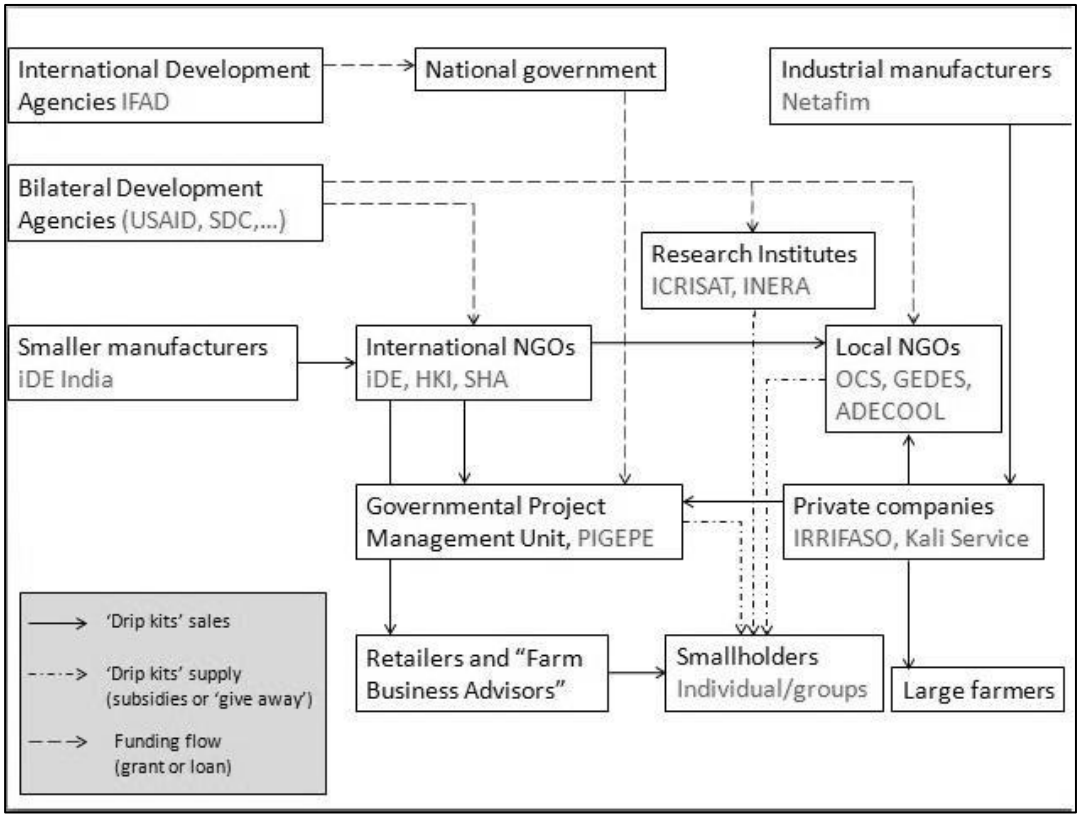

Figure 5.2. The coalition of actors supporting the promotion of drip irrigation in Burkina Faso. Sources: Field data, 2011-2015

The precise terms on which these actors engage with smallholder drip irrigation may differ, but they are nevertheless compatible and complementary (see table 5.2). Because all actors largely depend on finance provided by international development agencies, they are accountable to each other and united in their desire to bring smallholder drip irrigation into

being as a successful and effective development tool, in the process also actively creating the context through and in which this becomes true.

Table 5.2 Discursive regimes, practices and indicators used by different actors to engage in drip irrigation projects in Burkina Faso

Actors	Discursive regimes	Practices and Terms of interessement	Indicators to assess the relevance of drip
Drip irrigation manufacturers (and retailers)	Entering the African market and Corporate Social Responsibility	Selling equipment	Number of drip kits sold
Research organizations	Contributing to poverty alleviation via science and technology for crop diversification	Demonstrating effectiveness in experimental plots Scientific publications	Scientific publications Media coverage. Number of farmers trained.
Funding agencies and NGOs	Alleviating poverty in a sustainable and gender friendly way Developing a market and business oriented agricultural sector	Demonstrating how funding and activities contribute to poverty alleviation	Level of funds disbursed Number of drip kits distributed Number of farmers reached Yields, volumes of water used, and revenues obtained by pilot farmers & demonstration sites
Governments	Modernizing smallholder farming and alleviating poverty	Demonstrating how funding and activities lead to rural development	Funding acquired Number of drip kits distributed, number of farmers trained
Farmers	Increasing yields	Pilot farmer	Training received, 'Side' benefits: seeds, fertilisers, pumps Status and exposure

Source: Survey data, 2011-2015

5.4.4 Demonstrating success through experimental plots and pilot farmers

One oft-used strategy to literally create the context for drip kits to be effective and successful is for projects to make use of experimental plots involving 'pilot' farmers. Devoted field extension agents actively support these farmers during the project implementation phase, helping them become the entrepreneurs of development narratives and project documents. By using the results obtained in the controlled conditions of these experimental plots - i.e. water and time savings, and yield gains - in their analyses and promotional campaigns, researchers and development agents use the realities that they themselves actively helped construct to provide evidence of their own and the technology's effectiveness. Pasternak et al. (2006),

ICRISAT (2005), iDE (2014) and PIGEPE (2010, 2012) are examples of projects documents relying on this type of results. Also, thanks to the heavy investment, experimental sites look attractive and well-organized: the literally perform the reality that projects aim to realize and thus function as a bill board to advertise the success of the projects as well as of the technology. Projects bring outside visitors and potential donors to these sites, using them as successful examples of what drip irrigation could look like and what benefits the technology potentially brings to smallholders (see picture 5.2).

Picture 5.2 Experimental plots of drip promoters. Source (Wanvoeke, 2013)

This specific drip reality performed on experimental sites is also the one against which what is happening on farmers' field is measured and assessed. Hence if results obtained in farmers' fields are disappointing, this tends to be interpreted as a failure of farmers, for instance caused by a lack of training or proper dissemination, instead of being used to question the adequacy and the relevance of low cost drip irrigation technology or to re-assess the project's strategy.

5.4.5 Using metrics of success

A last way to establish low-cost drip irrigation as a positive and effective development tool is choosing specific indicators for measuring of success. All drip irrigation projects in Burkina Faso used the number of kits disseminated and/or the number of farmers trained as their most important measures of success (table 5.3). In most cases these numbers are self-generated and not verified by any independent assessor or evaluator, or backed up by feed-back from users. Projects that use the sales volume as an indicator of success justify this with reference to the previously discussed ideas of entrepreneurship: by reasoning that poor farmers only buy what they need and see the added value of, every drip kit sold is itself becomes proof a farmer’s interest, irrespective of whether or how it is being used. Yet, the mode of operation of most

projects is that the vast majority of drip kits are sold to other development agents (NGO's, government agencies) as opposed to individual farmers directly. These agents disseminate the kits to farmers, often heavily subsidized or for free, as part of their development projects. Direct purchase by farmers is rare. For example, iDE reported that since 2012 they sold 4000 drip kits. However, 85% was sold to 'institutional clients', that is development organisations. These in turn distribute subsidized or free drip kits to their farmers.

Table 5.3 The metrics of success of different projects

Projects names	Metrics of success
African Market Garden (AMG)	2000 kits distributed among farmers (500 in Burkina)
Approche Intégrée pour le Développement de la Maraîcherculture (AIDEM)	- 14 drip sites installed - 28 drip kits of 500m^2 distributed
Drip irrigation promotion (IFAD Grant)	- 60 kits of 10 m^2
Projet d'Irrigation et de Gestion de l'Eau à Petite Echelle (PIGEPE)	- 4200 kits are acquired - 450 kits are disseminated
Enhanced Homestead Food Production	- 300 drip kit of 20 m^2 installed
Programme de Développement du Maraichage par l'Irrigation Goutte à goutte (PDMIG)	- 15 drip sites installed - 30 kits of 500m^2 distributed - 450 farmers trained - 60 000 have visited the pilot sites - 3450 farmers have adopted drip kits
Water use and sustainability in market gardening in Burkina Faso	- 7 gardens for drip are installed - 21 kits of 500 m^2 and 7 kits of 100 m^2 distributed
Scaling Up Micro Irrigation(SUMIT)	4000 kits of different sizes are sold

Source: Data collected from projects reports

Using quantities of drip kits sold as an indicator of their effectiveness is, in other words, yet another way to help bring about or perform the reality of development cooperation actors, a reality in which low-cost drip irrigation is what farmers need which is why it is worthwhile to continue financing its promotion.

5.5 Conclusion

Development agencies, NGOs and government actors widely present smallholder drip irrigation as a promising technology that has the potential to boost incomes and improve food

security. The technology figures in multiple development efforts as a tool to alleviate poverty. In Burkina Faso, and more generally in sub-Saharan Africa, these development efforts that started more than a decade ago have failed to trigger wide-spread use of drip irrigation by smallholders. Indeed, the use of smallholder drip irrigation is not spreading beyond the experimental setting in which development interventions take place. Remarkably, this has done little to tamper enthusiasm regarding the technology among development agents and funding agencies, which still (want to) believe in its grand promises.

Drawing from the anthropology of development, we show how the positive imagery associated to smallholder drip irrigation is the result of conscious and carefully crafted strategies on the part of development actors, united in a supportive coalition. These actors articulate a specific vision of smallholder farmers and farming in sub-Saharan Africa: an activity turned towards deriving profit from the sale of vegetables. They also strategically present smallholder drip irrigation in relation to dominant environmental and development discourses, thus positioning it as an option to solve grand challenges and making it attractive to development financers. Finally, inspired by an engineer-based understanding of technology and technology transfer that still dominates the field, actors in the coalition have established the indicators against which the success of drip irrigation projects is measured: measures of potential obtained in experimental conditions and number of kits disseminated, which say little on how farmers perceive and use drip irrigation. This deflection of success assessment highlights that the smallholder drip irrigation coalition remains little accountable to farmers.

As previously argued by Mosse (2005) in another field and context, our findings clearly show that the success of smallholder drip irrigation is not grounded in the way farmers perceive the technology, or even in the outcomes it yields in their fields. Instead, smallholder drip irrigation is successful because it is performed as such by ‘a development community’ who wants and has an interest to believe in its promises and potential. Development outcomes are indeed socially produced or performed, and though one can hope that the lack of farmers’ uptake may eventually tamper the current widespread enthusiasm for smallholder drip irrigation projects, it is very likely that other “iconic technologies” will emerge and be described as solutions to grand challenges, with a likely similar fate. For this not to happen there is a need for establishing accountability between development agents and intended beneficiaries, which could partly be achieved through truly independent project evaluations and a drastically changing the interdependencies between development professionals.

Chapter 6

General Discussion and Conclusion

This chapter discusses the overall findings of the research presented in the previous chapters. It addresses the central research question. This is followed by a theoretical reflection based on the outcomes of the research. The chapter ends with the implications for policy and future research.

General Discussion and Conclusion

6.1 Introduction

In West Africa and specifically in Burkina Faso, development actors promote low-cost drip irrigation for use by smallholder farmers through multiple development projects, because they consider it as a promising technology for reducing poverty and improving food security. National and international organizations enthusiastically invest in developing the technology, fund its dissemination, and encourage farmers to adopt it. Despite this enthusiasm among donors, policy makers, kit designers and NGOs, and irrespective of more than a decade of promotion and dissemination efforts, the use of drip irrigation by smallholders has remained limited to experimental plots. There is an apparent discrepancy between the expectations of the development actors who promote the technology in Burkina Faso and actual levels of use in the fields of farmers. In my thesis, I have explained the reasons for the existence of this discrepancy. I addressed the following research questions:

- How has smallholder drip irrigation been framed as a success and which actors were pivotal in such construction? (chapter 2)
- What does smallholder drip irrigation represent for different actors, and why do they engage in projects promoting it? (chapters 3 and 4)
- Why do development interventions persist even though there is little evidence of sustained use of drip by farmers? (chapter 5)

This chapter summarises the answers to these questions by explaining how smallholder drip irrigation became a success, and by unravelling actors' motivations to invest in or promote the technology. I also use this chapter to reflect on how the results of this thesis contribute to wider debates on the social dimensions of technology and the workings of development assistance. The chapter ends by highlighting the implications of this research for policy making and identifies areas for further research.

6.2 Major findings

The main findings of the thesis are presented in this section. I highlight the reasons why smallholder drip irrigation is seen as a successful technology, look at why it has raised the enthusiasm of development agencies, and explains how it has becomes a "success" in

development arenas. I show that what drip irrigation is and does is not limited to bringing water to crops. Smallholder drip irrigation is and does something different for different actors. It is because of how these different 'drips' come or are brought together within supportive networks that enthusiasm for the technology is sustained and that it continues to be promoted, even though farmers seldom use it as a water-saving and productivity enhancing technology.

6.2.1 The network of actors making drip irrigation successful in the development arena

In Burkina Faso, different actors are involved in the dissemination of smallholder drip irrigation through development projects (see chapter 2). These actors can be grouped into four categories:

- Donors and policy makers (Ministry of agriculture, IFAD, USAID, SDC) who finance drip irrigation projects. They provide funds for the promotion of smallholder drip irrigation and present the latter as a way to modernise smallholder farming. They see in drip irrigation a way to alleviate poverty and trigger economic growth through a better management of scarce water resources.
- Intermediaries, mainly represented by research organisations, projects staff and public and private extensions services (IFDC, INERA, iDE, national and international NGOs, *bureau d'étude*). These serve as conduits between donors and the intended users, i.e. the farmers. Donors fund these organisations to disseminate and promote smallholder drip systems in rural communities in Burkina. By reporting on the number of kits they disseminate or sell and reporting on results "from the field" (i.e. experimental or demonstration plots) these intermediaries have a key role in framing drip irrigation has a promising and successful technology.
- Drip kits providers, generally small or large scale private ventures (NETAFIM, IRRIFASO, Kali's Service), whose role is limited to selling drip irrigation kits to users and, above all, to the above intermediaries. They present smallholder drip irrigation as a "modern" agricultural technology and communicate on the low-cost of the products they have on offer.
- 'Users' of the kits, that is, farmers and farmers' groups. They are presented by other actors as the ultimate beneficiaries of development projects, meant to benefit from the use of drip irrigation (higher yields, higher incomes). Yet, their involvement remains

limited to the "pilot/experimental" phases of projects and their interest in the technology is often a different one than what is advanced by development agents

Together, these actors form a network: they are connected through flows of money and discourses. The creation of this network, which has become a true "supportive coalition" for smallholder drip irrigation, was triggered by the relentless efforts of one particular spokesperson. Out of enthusiasm for the technology and because of a desire to make a difference to poor smallholder farmers in Africa, he managed to convince funders, researchers and others of the many benefits of the technology (see chapter 2). Through promotional campaigns, and legitimacy building in the form of peer-reviewed scientific articles, he succeeded in establishing drip irrigation as a technology that could help achieve a large number of objectives simultaneously: poverty alleviation; improvements in nutrition, food security, and agricultural productivity: women's empowerment; water conservation, environmental protection and adaptation to climate change. The fact that smallholder drip irrigation resonated with a multiplicity of development and environment discourses explains why such a wide coalition of actors (including development agents, researchers, NGO staff and pilot farmers) became interested in the technology.

This coalition of actors, often supported and sustained by personal relationships, is now instrumental to sustain flows of money, equipment, ideas and staff (i.e. experience and knowledge) from project to project. It now works without the initial spokesperson, as other individuals and organisations have emerged as "nodes" in the coalition. As we highlighted above drip irrigation means and does different things for different actors in the network. Although most shared a commitment to make a difference in terms of development and poverty alleviation, many also found in smallholder drip irrigation a way to meet their own goals: social entrepreneurs looking for good causes to support; drip irrigation manufacturers looking for new markets; development organisations looking for 'best practices' they can use to convince funders (chapters 4 and 5).

6.2.2 Framing drip irrigation as a success

Despite the apparent lack of farmers' interest in using drip irrigation in their fields without external support, the community of development agents continue to present the technology as promising and successful. This positive image of smallholder drip irrigation is sustained through conscious strategic efforts by actors in the coalition we presented above. Indeed, the

thesis clearly highlights that the "success" of drip irrigation is not related to what the technology does in farmers' field, but instead stems from (or is performed through) (i) continuous promotional efforts (presentations at workshops, speeches, media campaigns, newspaper articles, small documentaries on YouTube and television or radio, carefully staged events, etc.) (ii) an emphasis on the potential of the technology to grow (more) crops with less water that is established through trials on experimental plots and backed up by scientific studies published in peer-reviewed journals; (iii) a careful alignment of the promises of the technology with dominant development and environmental narratives, and (iv) the use of specifics metrics (such as the number of drip kits distributed, or better, sold) to measure success. The metrics are used to provide proof that smallholder drip irrigation effectively travels to farmers. Yet, because of the way they are chosen they say little about what farmers actually do with the technology (it is just assumed that they use it as intended by their designers). What farmers do with drip kits, and derive from it, becomes less important than dissemination indicators. Actors in the coalition are united in their interest to present drip irrigation, if not as successful, at least as promising to justify further involvement in the sector (see chapter 5).

6.2.3 The different meanings of smallholder drip irrigation

As a whole, drip irrigation is generally considered by its designers (irrigation engineers) as an efficient irrigation technique allowing for improved agricultural productivity. In the eyes of the people who designed it, the "smallholder" version has other key attributes, such as its low cost and eases of use. In this thesis, I show that drip irrigation is much more than an irrigation tool; it allows different actors to do different things. Though the following sections are presented in a "one actor-one logic" way, it is important to realize that actors can attribute multiple meanings to drip irrigation and be involved in its promotion for multiple reasons. Rather than being exclusive, the logics of involvement and discursive regimes that underpin them are reinforcing each others. These are summarized in Figure 6.1.

Drip as a poverty alleviation and food security enhancing device (for funding and development agencies)

Funding and development agencies chose to become enrolled in projects promoting drip irrigation because they saw in it an appropriate technology to help alleviate poverty and improve food security (see chapter 2). By aligning the technology with these development

narratives (chapter 5), drip kit designers and believers (spokespersons) made it attractive to donors and development agencies searching for miracle solutions. For development agencies, therefore, drip irrigation became a means through which they could achieve their goals by contributing to improving smallholders and rural farmers' livelihood.

Drip as a funding and partnership building device (for NGOs and private agencies)

NGOs and private agencies implement development projects. For them, smallholder drip irrigation is a way to establish themselves within the development community by portraying themselves as effective intermediaries (through the number of kits they disseminate and sell), in the process securing their reputation and future funding and mobilizing partnerships.

Drip as a source of business and profit (for kit providers)

As fully private ventures, drip kit providers see in smallholder drip irrigation a way to improve their profit. For them, water and labour savings are not objectives per se, but rather act as "sales-pitch". At present, given the coalition of actors we presented in chapter 4, drip kits providers make most profit by selling kits to organisations rather than to farmers themselves.

Drip as a source of prestige and a gateway to receiving other benefits (for farmers)

In Burkina Faso, most farmers using drip irrigation do so as "pilot farmers" within the framework of development projects. Development agencies often use pilot farmers as proof of farmers 'use' or 'adoption' of drip irrigation. However, pilot farmers do not seem to engage with these projects because of the performance of the technology in terms of water and labour saving, but because of other benefits that come with the promotional package such as agricultural inputs (seeds, fertiliser, pesticides), water lifting devices (treadle pumps, motorised pumps), micro-credit, and infrastructures (wells, fences, doors). To farmers, drip may also serve as a tool to acquire prestige or to forge new alliances with funders and services providers (chapter 3). These "side benefits" appear most important to farmers; they are what explain why these 'pilot farmers' initially engage with the project but quickly stop using drip kits as soon as the project ends.

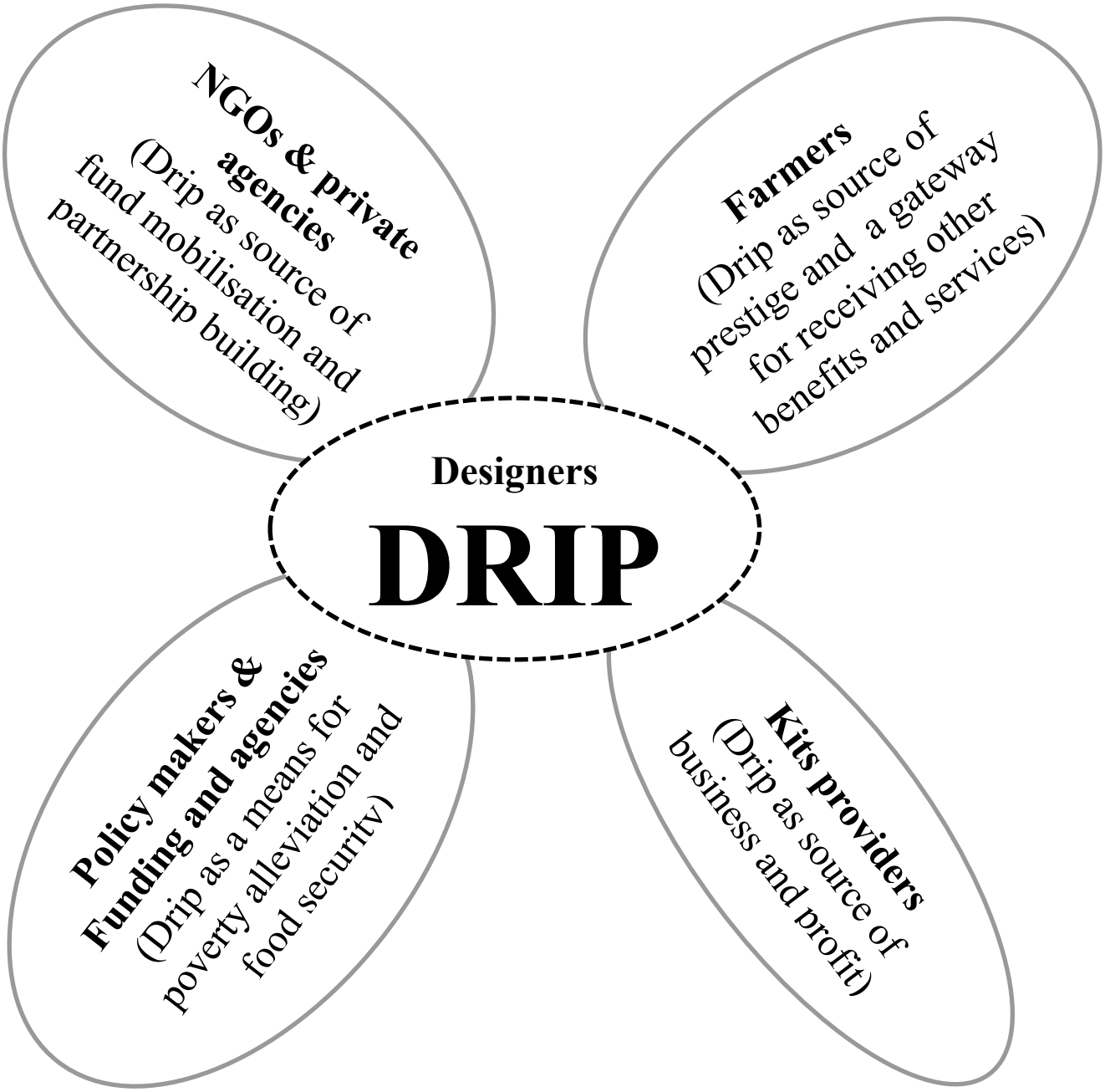

Figure 6.1 Multiple meanings of drip during processes of translation

6.3 Discussion and theoretical reflections: contribution to scientific debates

Most previous studies on smallholder drip irrigation have taken for granted what it is and does - i.e saving water and labour or increasing yields - , and spent their energies on identifying factors that may help to "make drip work (better)". What is striking, though, is that most research and publications on drip irrigation in sub-Saharan Africa were sponsored or conducted by people directly involved in the design and dissemination of the technology.

They may thus have been keen to demonstrate that it is a promising and successful technology. More or less explicitly, these studies and their authors adopted a diffusion model of innovation.

Throughout this thesis, I instead used a practice based theory of innovation, drawing from Science and Technology Studies (STS) which I combined with insights from the Anthropology of development. Rather than anchoring the ontological definition of smallholder drip irrigation in its intrinsic technical characteristics, in my approach the technology is defined in relation to the networks (of people, other technologies, meanings or discourses) in which it is positioned. I thus focused my attention on how smallholder drip irrigation is connected to actors and the meanings they attribute to it. By doing this, my thesis contributes to the debate about the social dimensions of technology, notably by engaging with the notion of innovation in the development context. I established then the dialogue between STS and Anthropology of development.

STS has been mainly used and applied by scholars on advanced technologies in the context of developed countries (see among others Callon, 1986; Latour, 1987; Law, 1992). I considered the contexts in which smallholder drip irrigation is promoted and used to be of a particular nature, i.e. that of developing countries (mainly the sub Saharan African countries) and of development cooperation. Hence, applying STS insights to this Burkina Faso context required a way to characterise and conceptualise the specificity of this context. For this, I drew on the anthropology of development, looking mainly to those scholars who have tried theorizing and understanding social relations between development actors in developing countries in development cooperation programmes or projects. STS is an interesting addition or complement to insights from the anthropology of development in how it allows grasping that a technology or technical object is not neutral but always comes from specific contexts, but also 'creates' its own context when travelling. This is the most important contribution of this study in terms the analysis of drip irrigation in Burkina Faso. It shows that drip irrigation technology should not be considered as inactive. However, what it does or brings about cannot be predicted outside of the contexts in which it is or travels. Interestingly, the conceptual repertoire of STS and the Anthropology of development resonate positively with each other. In particular, the notion of *brokerage* invoked by the latter resembles the STS concept of *translation*. What these concepts have in common is that they draw attention to the

work needed to make ideas or objects travel, work that itself may change these ideas and objects.

6.3.1 Enrolling actors during the drip irrigation translation process

One of the key strategies of smallholder drip irrigation designers has been to convince the development aid community of the potential of the technology. To analyse and understand this process of creating interest and enrolling other actors into their project, and drawing on practice-based theories of innovation, I traced how alliances and coalition of actors around drip irrigation were created and sustained. Smallholder drip irrigation promoters have tried to strategically translate the technology to make it fit with the interests of a large group of development actors, in the process creating a socio-technical chain of alliances. Akrich et al. (2002a) called this process of translating the technology to fit different contexts, interests and discourses the 'art of interessement'. What is interesting in the case of smallholder drip irrigation is that the perpetuation and use of this chain of actors involved in successive development projects (see chapters 2 and 3) happened without smallholder drip irrigation achieving any of the goals for which it was originally designed. This might be because, far from being a "one-off", *interessement* is a highly dynamic phenomenon leading to shaping coalitions with blurred boundaries. Callon (1986) sees *interessement* as one of the four stages in the translation process: problematization, interessement, enrolment and mobilization. However, in my study, I find that the four stages of the innovation translation model do not take place one after the other. Rather, they occur concomitantly and reinforce each other (see chapter 2). My contribution to the innovation translation model notably lies in the identification of strategies used by smallholder drip irrigation promoters to co-opt and enrol other individuals or organizations in supporting their view of the technology, which they end up articulating as well.

6.3.2 The importance of a spokesperson during for translation and brokerage in development projects

During the translation process, some actors have played a pivotal role in enrolling other actors in the promotion and dissemination of smallholder drip irrigation and in aligning it with their respective interests. In ANT terms, this role is devoted to a 'spokesperson' and the art of "choosing" a good spokesperson is crucial for the success of any innovation (Akrich et al., 2002b). Chapter 2 has shown how the efforts of one individual, recognized by his peers, in

negotiating and shaping the innovation were instrumental in establishing smallholder drip irrigation as a promising development device. Since the early steps of smallholder drip irrigation, though, other individuals and organisations have become pivotal in sustaining the interest of the development community for smallholder drip irrigation (see chapter 4).

Conventional innovation studies, instead of talking about spokespersons, use the term brokers. Brokers are seen as key facilitators who form an essential link between the providers/funders of an innovation and its end-users (Klerkx et al., 2009). In the context of development, conventional innovation theory position brokers or intermediaries as dependent on and accountable to both international development agencies as well as to smallholder farmers (Bierschenk et al., 2000, 2002). My study has shown that, within the different project cases in Burkina Faso, development brokers do much more than bridging the gap between those who design, fund and implement projects and smallholder farmers. They actively contribute to shaping the representations and successful outcomes of development projects. A large diversity of actors, such as local and international NGOs, government agencies, private companies and local retailers act as development brokers. Drip irrigation projects work as resource arenas in which multiple actors tap to fulfil their objectives (chapters 3 and 4).

This thesis thus contributes to bringing empirical depth to the notions of ‘spokespersons’ used by ANT theorists and ‘brokers’ used by conventional innovation theory and development anthropologists. While the notion of spokesperson is reserved to the innovation translation process, a spokesperson's activities during the translation of smallholder drip irrigation are comparable to what brokers do during development interventions. While implementing drip irrigation projects, some development actors play the role of brokers and mediators by translating the project outcomes into success to sustain their activities (chapters 4 & 5). I conclude that the notions of ‘spokespersons’ and ‘brokers’ used respectively by ANT theorists and anthropologists as identified in the context of drip irrigation are similar and resonate positively with each other.

6.4 The end of my journey: Lessons learnt, concluding remarks and implications

I decided to engage in this study of drip irrigation in Burkina Faso after I discovered that there was a discrepancy between the number of development interventions promoting the technology and the fact that farmers seldom used it in their fields. After four years of research, I understand the reasons and underpinnings of this paradox; it is mostly linked to the

way development assistance “works” in sub-Saharan West Africa. The paradox -development enthusiasm/lack of use - is grounded in the existence of a network of development actors who use different strategies to present drip irrigation as a successful, or at least promising, technology. Success stories on drip irrigation as reported in projects reports and scientific publications are carefully orchestrated by drip irrigation promoters, based on results obtained in experimental sites; they aim at, and allow for, justifying the continued promotion of smallholder drip irrigation.

Hence even though farmers in Burkina Faso seldom use smallholder drip irrigation, it is still promoted because of (i) its image of a promising technology aligned with a set of mainstream development narratives (poverty alleviation, food security, women entrepreneurship) that drive the interventions of a ‘development community’ focused on “helping poor African farmers” and (ii) a lack of financial and political accountability towards the intended beneficiaries, i.e. the farmers. As such the “success” and “promises” of smallholder drip irrigation do not refer to the way farmers perceive the technology, or even the outcomes it yields in their fields; drip irrigation is instead successful because it is performed, and perceived as such, within ‘the development community’. As stated by (Mosse, 2005), it is the interpretation of events, rather than the events themselves, that matter in this case.

In relation to my own multi-faceted trajectory and my previous experiences, I can draw various lessons from my study that may be relevant for others.

As a development practitioner, I realized that projects outcomes are not neutral but are performed by project implementers for specific purposes. Projects reports are often written according to what donors want to see, so that funding flows can continue. This is what happens with smallholder drip irrigation, with development actors appearing to be less accountable to farmers than to funding agencies, which are, in turn, fascinated by outputs expressed in terms of numbers of drip kits distributed. To continue their operations, development actors depend on each other's approval and recognition. This vicious web of mutual dependencies can only be broken by allowing and indeed actively promoting beneficiaries to co-determine how development funds are (to be) used. For policy makers, there is a need for establishing accountability links between development agents and intended beneficiaries and to set a system in place that allows more independent project evaluations.

As a development researcher, I also learned that research is not neutral. It is often guided by personal and organisational interests, and it plays a key role in legitimising and popularizing development interventions. In the specific case of smallholder drip irrigation, most studies showing the benefits of drip irrigation were actually authored by people who were directly involved in its promotion and might have been keen to depict it as a successful technology, to enrol other actors. In this sense, an irrigation technology should not only be analysed and appreciated only by the technical performance. What a technology 'does' is not limited to its intended uses. Evaluating a new technology solely on the basis of its intended use is therefore limited; the use or the promotion and dissemination of a technology may also serve many other goals, some of which may be symbolic or political.

As a water professional, I would like to avoid being too radical and dismiss low pressure drip irrigation as un-interesting irrigation option altogether. However, my research reveals that the technology has never worked sustainably in Burkina Faso or anywhere else in sub Sahara Africa. It only works with significant external support, when and where development projects are running. Many authors attribute these shortcomings to lack of knowledge, capacity and support to farmers; for me, if smallholder drip irrigation has failed to spread over the last decade, it is because the technology doesn't fit African farmers' needs. More attention should be put in how farmers use and perceive new irrigation technologies differently than other actors, instead of limiting the analysis to attempts to realize the potential of the technologies.

However, this study couldn't cover all the aspects and actors involved in smallholder drip irrigation. Actors like funding agencies outside Burkina Faso or at global level with a stake in smallholder drip irrigation were not approached. To shed further light on the fate, travels and performance of smallholder drip irrigation in sub-Saharan Africa it would be highly relevant to conduct research on funding agencies on two related topics (1) their strategies and practices of evaluating smallholder drip irrigation projects and on how they integrate the contribution of farmers in their review process and (2) their motivation to continue funding the promotion of smallholder drip irrigation despite the lack of uptake over more than a decade. As far as the drip irrigation technology itself is concerned, further investigation of the technical dimension of smallholder drip irrigation, and notably its low-pressure nature, versus its high pressure counterpart widely adopted by smallholder farmers in North Africa is also needed. This would allow refining all-encompassing claims on domains

of applicability and the desirability to continue promoting smallholder drip irrigation in sub-Saharan Africa.

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Summary

Smallholder drip irrigation is presented by its designers and promoters as an efficient tool for agricultural water management. Because of its small size and low cost, it would also be particularly adapted to the needs of smallholders in the developing world and, as such, a promising option for poverty alleviation at global level. Smallholder drip irrigation was first introduced in Burkina Faso in 2004 through the Africa Market Garden (AMG) project, the largest development initiative to date to have promoted drip irrigation in sub-Saharan West Africa. Presented as a promising and successful project by its proponent, the AMG triggered the enthusiasm of policy makers and development agents and laid the ground for not less than eight other projects that promoted smallholder drip irrigation and were implemented over a decade. Each of these projects argued that drip irrigation kits could contribute to poverty alleviation and food security while making efficient use of scarce water resources. Despite significant development assistance and the involvement of an ever increasing number of development actors over more than a decade, farmers seldom use drip irrigation without external support. In most cases, a limited number of individuals are involved as 'pilot farmers' during the lifetime of the project but stop using drip irrigation as soon as these end. There is a discrepancy between the enthusiasm of development actors and the lack of interest of farmers towards drip irrigation.

Most of the existing studies on drip irrigation in the developing world focus on the "potential of the technology" and identify the changes that using it can bring upon in terms of yield, water, labour, time and crop productivity. These studies go on by identifying the constraints and opportunities for large scale adoption and invariably conclude that lack of knowledge, capacity and support deters widespread dissemination. This thesis differs significantly from earlier studies: it looks at the social dimension of drip irrigation and sees it through what it allows achieving from multiple actors, rather than seeing it as an object with intrinsic characteristics. The study shows that drip irrigation assumes different meanings for different actors: farmers, NGOs, small scale private entrepreneurs, national governments, international and bilateral aid agencies. In an attempt to contribute to the wider debate about the social and political nature of technological artefacts, this thesis show how drip irrigation is "made successful", even in the absence of sustained used by smallholders, in the process acquiring different meanings to different actors, who all gain from this positive imagery.

This dissertation is structured in six chapters. Chapter 1 starts by recalling my personal encounter with drip irrigation in Burkina Faso and builds on this to present research objectives and questions, and the methodology followed. It presents the different theories that have inspired a dissertation dealing with the (notion of) Innovation in Development arenas and shows how the subsequent chapters combine insights from Science and Technology Studies (STS), with Socio-Anthropology, and Development Studies. Chapter 1 presents the main theoretical perspectives that underpin the thesis, that is, the 'Practice-base theory of innovation' (an application of actor network theory) and the notions of 'Brokerage and Translation' that have acquired some resonance among anthropology of development scholars.

The findings that are presented in the subsequent chapters (2 to 4) are based on an intensive literature review and extended fieldwork carried out from June 2011 to February 2015 in four regions of Burkina Faso where micro drip irrigation has been heavily promoted. It uses qualitative methods of data collection combining interviews, focus group discussions, life histories and participant observation to unravel the multiple realities and meanings of drip irrigation. I interviewed 44 key informants involved in eight projects promoting drip irrigation in Burkina Faso and visited 28 (out of the 87) project sites where drip irrigation was in use at the time of the research. In three of these sites, detailed information was sought from farmers through the means of interviews and focus group discussions.

Chapter 2 comes back in time to recall the history of the AMG project. It shows how this large scale project has been framed as a success and the technology it promoted as a promising option for poverty alleviation. It describes the substantial efforts of the AMG proponents to create a supportive coalition to the technology through carefully crafted promotional campaign, legitimized by scientific results (and related publications) obtained in experimental or pilot fields. The emergence of a supportive coalition to smallholder drip irrigation is largely traced back to the relentless efforts of a spokesperson who acted as a mediator. It is through these efforts, and the high profile of the organisations involved in the AMG project in the mid 2000s, that smallholder drip irrigation imposed itself as a technology that held the promises of solving some of the grand challenges of our time: poverty, food insecurity and water scarcity.

Chapter 3 turns from the promoters to the farmers. Intrigued by the contrast between the enthusiasm of development actors and the lack of sustained used of drip irrigation by

farmers, I wanted to understand the reasons and motivations farmers had to engage with drip irrigation projects if, repeatedly, they stopped using it as the projects came to an end. One important reason why farmers engage in projects promoting micro-drip kits (yet do not use them in their fields) is because drip acquires other meanings and realities for them than the meaning they may have for their designers and promoters. Where drip irrigation represents, for its promoters, an agricultural productivity tool and a water and labor savings device, for many farmers micro-drip irrigation systems are mostly a gateway to other benefits, such as agricultural inputs (seeds, fertiliser, pesticides), water lifting devices (treadle pumps, motorised pumps), micro-credit, infrastructures (wells, fences, doors) or a way to acquire prestige and forge new alliances. These are acquired within the sphere of the project, almost irrespective of what happens in the fields.

Chapter 4 extends the analysis initiated in chapter 1 by looking at present-day development projects promoting smallholder drip irrigation. Looking at three major development initiatives, it describes the daily practices and motives of local and international NGO's, government agencies, private companies and local retailers involved in drip irrigation projects. Although the objectives of different actors in engaging in drip irrigation projects may be different, these objectives are compatible or made compatible: selling equipment for profit, receiving funding, mobilising network, creating a market and reputation. The chapter shows how these actors are connected and inter-dependant to each others in a coalition whose very existence and *raison d'être* depends on sustaining the positive imagery that surrounds smallholder drip irrigation.

Finally, Chapter 5 draws from the previous thematic chapters to explain how the apparent contradiction between sustained development enthusiasm and limited use by farmers can persist over time. The chapter argues this happens because a supportive coalition actively performs the positive imagery that surrounds drip irrigation. It does so by articulating a very specific vision of smallholder farming and farmers in sub-Saharan Africa (one that fits the drip irrigation technology), by linking drip irrigation to dominant development and environment discourses and by using demonstration plots and specific metrics such as the number of kit disseminated or sold, which are disconnected from farmers' use but talk to development funders, as measure and proof of success. As such, smallholder drip irrigation, like other improved agricultural technologies (such as HYV seeds) illustrates how the epistemic s of development still largely remains little accountable to farmers.

Chapter 6 concludes the thesis. It recalls the research questions, summarizes and discusses the major findings, and draw lessons for policy makers and development agents involved in the promotion of drip irrigation. One of the main lessons is that the success of drip does not depend on what it does on farmers' field. The acceptance of a technology by farmers is not a very good indicator of measuring the use and the adoption. As a whole, the thesis demonstrates that (irrigation) technologies are not mere artefact with intrinsic and essential characteristics but social constructs. The positive imagery and discursive success of drip irrigation in the developing world is not only linked to the technical attributes of the technology (what it does in the field); it is largely performed by a coalition of inter-dependent actors who attribute different meaning to drip irrigation and derive different benefits from it.

Samenvatting

De ontwerpers en promotoren van goedkope en kleinschalige druppelirrigatie kits beweren dat deze technologie een efficiënt gereedschap is om water te beheren in de landbouw. Omdat ze klein en goedkoop zijn, worden de kits ook geacht bij uitstek geschikt te zijn voor kleine boeren in ontwikkelingslanden. Dit maakt ze tot een interessant onderdeel van strategieën ter bestrijding van armoede. Deze druppelirrigatie kits voor kleine boeren werden voor het eerst geïntroduceerd in Burkina Faso in 2004 door het "Africa Market Garden" (AMG) project, het grootste initiatief tot nu toe om de technologie te promoten en verspreiden in West Afrika ten zuiden van de Sahara. Omdat degenen die betrokken waren bij het project erover rapporteerden als een groot succes, raakten ook anderen - beleidsmakers, ontwikkelingsorganisaties - geïnteresseerd in de technologie. In Burkina Faso leidde dit tot niet minder dan acht andere projecten die actief kleinschalige druppelirrigatiesystemen promootten, projecten die zijn uitgevoerd over een periode van zo'n tien jaar. Door middel van deze systemen dachten de projecten een significante bijdrage te leveren aan armoedebestrijding, voedselzekerheid en waterbesparing. Echter, ondanks enorme inzetten van geld en personeel, en hoewel er steeds meer mensen werden betrokken bij pogingen om de technologie tot een succes te maken, blijven de resultaten op de velden van boeren tot op heden teleurstellend. Na tien jaar ontwikkelingsinspanningen zijn er weinig tot geen boeren die gebruik blijven maken van de druppelirrigatiesystemen als de ondersteuning van projecten ophoudt. In de meeste projecten was er een kleine groep boeren, aangewezen als 'pilot farmers', die de technologie gebruikten tijdens de levensduur van het project. Zodra deze projecten ten einde liepen hielden ook deze boeren op met het inzetten van de druppelirrigatiesystemen op hun velden.

De discrepantie tussen het enthousiasme van ontwikkelingssamenwerkingsactoren aan de ene kant en het gebrek aan belangstelling van boeren voor kleinschalige druppelirrigatiesystemen aan de andere vormt het startpunt van dit onderzoek. Het meeste onderzoek naar druppelirrigatie in ontwikkelingslanden focust op het potentieel van de technologie. Het kijkt bijvoorbeeld naar de verbeteringen in oogstopbrengst, watergebruikefficiëntie, arbeidsinzet die gebruik van de technologie in de toekomst zou kunnen opleveren. Als zulke verbeteringen uitblijven, of als boeren geen of weinig interesse tonen in de technologie, wijten studies dit meestal aan allerlei contextuele factoren zoals een gebrek aan kennis of vaardigheden om druppelirrigatie goed te gebruiken of de afwezigheid

van ondersteunende structuren of markten. De benadering van dit proefschrift is een andere: ik neem afstand van wat druppelirrigatie zou moeten doen volgens ontwerpers en promotoren, en kijk in plaats daarvan naar wat het daadwerkelijk doet in de alledaagse praktijken van de verschillende actoren die ermee te maken hebben. Met andere woorden, in plaats van de technologie te beschouwen als iets met intrinsieke eigenschappen, benader ik de technologie als iets wat verandert afhankelijk van de context waarin het zich bevindt. Druppel irrigatie betekent iets anders voor verschillende actoren: boeren, niet-gouvernementele organisaties, kleinschalige ondernemers, nationale overheden, internationale en nationale ontwikkelingsinstanties. Bijdragend aan het debat over de sociale en politieke inhoud van technologische artefacten, laat het proefschrift zien hoe kleinschalige druppelirrigatiesystemen "succesvol gemaakt worden", zelfs al worden ze amper gebruikt door de kleine boeren voor wie ze bedoeld zijn. Dit gebeurt doordat de verschillende actoren en instanties die betrokken zijn bij het ontwerp en de promotie van deze systemen er op verschillende manieren belang bij hebben dat de technologie als positief en succesvol wordt gezien.

Het proefschrift bestaat uit zes hoofdstukken. Hoofdstuk 1 begint met een persoonlijke herinnering aan mijn eerste ontmoeting met druppelirrigatie, om vervolgens uit te leggen wat de doelstelling en hoofdvragen van de studie zijn en wat de gehanteerde methodologie is. Ik geef een kort overzicht van de verschillende theoretische inzichten waar ik gebruik van heb gemaakt voor mijn onderzoek, dat ikzelf karakteriseer als een studie naar innovatie in de context van ontwikkelingssamenwerking. Ik combineer inzichten vanuit Science and Technology Studies (STS) - vooral de zogenaamde "practice-based theory of innovation" die voortkomt uit actor-netwerk benaderingen - met ideeën gegenereerd door ontwikkelingssociologie en antropologie. Noties rondom "brokerage" en "translation", die ingaan op wat er gebeurt als verschillende leefwerelden met elkaar in contact komen, zijn daarnaast van nut gebleken voor mijn werk.

In de daaropvolgende hoofdstukken (2 tot en met 4) presenteer ik mijn gegevens en analyse. Ik baseer mijn gegevens op een studie van beleidsdocumenten en literatuur, en op uitgebreid intensief veldwerk dat ik deed in vier regio's van Burkina Faso tussen juni 2011 en februari 2015. In elk van deze regio's werd kleinschalige druppelirrigatie actief gepromoot. Ik heb vooral gebruik gemaakt van kwalitatieve onderzoekstechnieken, waarbij ik interviews combineerde met focus groep discussies, levensgeschiedenissen en participatieve observaties

om een inzicht te krijgen in de veelheid van werkelijkheden en betekenissen van druppelirrigatie. Ik heb 44 sleutelinformanten geïnterviewd; mensen die een belangrijke rol speelden of hebben gespeeld in de projecten die druppelirrigatie promootten. Ook heb ik 28 (van de 87) projecten bezocht, om te zien hoe de technologie gebruikt werd in het veld. In drie van deze projecten heb ik uitgebreid gesproken met boeren, door middel van interviews en groep discussies.

Hoofdstuk 2 gaat terug in de tijd om de geschiedenis van het AMG project te reconstrueren. Het hoofdstuk laat zien hoe dit grootschalige project bekend is geworden als succesvol, specifiek kijkend naar hoe het heeft bijgedragen aan het idee dat kleinschalige irrigatiesystemen een belangrijke bijdrage kunnen spelen in het bestrijden van armoede. Onze analyse laat zien hoe het succes van het project de uitkomst is van gerichte inspanningen en campagnes om de technologie te promoten van verschillende bij het project betrokken mensen. Zij vormden een ondersteunende coalitie rondom de technologie. Hierbij werd slim gebruik gemaakt van wetenschappelijke bevindingen en publicaties, meestal gebaseerd op onderzoeken uitgevoerd in proefvelden. Eén persoon was vooral invloedrijk en actief in deze inspanningen en campagnes; hij zette alles op alles om anderen te overtuigen van de potentie van kleinschalige druppelirrigatiesystemen. Dat hij hierin slaagde blijkt uit het steeds verder verspreidende enthousiasme voor de technologie als mogelijke oplossing voor een aantal van de grote hedendaagse uitdagingen: armoede, honger, water schaarste.

In hoofdstuk drie verplaats ik de aandacht van de promotors van druppelirrigatie naar de gebruikers, de boeren. Geïntrigeerd door het contrast tussen het enthousiasme van ontwikkelingsactoren aan de ene kant en de desinteresse van boeren aan de andere, wilde ik begrijpen waarom boeren besluiten om in zee te gaan met ontwikkelingsprojecten die druppelirrigatie promoten terwijl ze ophouden deze technologie te gebruiken zodra de projecten aflopen. Een belangrijke reden dat boeren toch meedoen met zulke projecten is dat druppelirrigatie voor hen niet een handig instrument is om hun planten te irrigeren of om arbeid te besparen, maar een manier om in contact te komen met donoren en projecten. De technologie dient dus als een middel om aan andere zaken - zoals zaden, kunstmest, bestrijdingsmiddelen, pompen, krediet - te komen, of als een manier om prestige te krijgen of toegang tot interessante netwerken.

Hoofdstuk 4 verdiept de analyse van hoofdstuk 1 door te kijken naar hedendaagse projecten die kleinschalige druppelirrigatie promoten. Dit hoofdstuk focust op drie

belangrijke initiatieven, en beschrijft de alledaagse praktijken en motieven van lokale en internationale niet-gouvernementele organisaties, overheidsinstanties, private bedrijven en lokale detailhandelaren betrokken bij druppelirrigatie. Hoewel de doelstellingen van deze actoren met druppelirrigatie verschillend zijn, liggen ze in elkaars verlengde of zijn gemakkelijk te combineren: het met winst verkopen van druppelirrigatiesystemen, het verkrijgen van fondsen, het mobiliseren van netwerken, het creëren en aanboren van markten of het opkrikken of behouden van een reputatie. Het hoofdstuk laat zien hoe de verschillende actoren in het netwerk rondom de promotie van kleinschalige druppelirrigatie onderling van elkaar afhankelijk zijn. Het bestaan en de *raison d'être* van de coalitie waarvan deze actoren deel uitmaken hangt voor een belangrijk deel af van het actief in stand houden van een positief beeld van kleinschalige druppelirrigatie.

Tot slot, in hoofdstuk 5 gebruik ik de analyses uit de vorige hoofdstukken om te verklaren hoe de ogenschijnlijke contradictie tussen aanhoudend enthousiasme van ontwikkelingsactoren over kleinschalige druppelirrigatie aan de ene kant en beperkt gebruik door boeren kan blijven voortduren. Het hoofdstuk beargumenteert dat dit te wijten is aan de aanwezigheid van een sterke ondersteunende coalitie die het beeld van kleinschalige druppelirrigatie als iets intrinsieks positiefs actief in stand houdt. Dit gebeurt door: het oproepen van een heel specifiek beeld van kleine boeren in sub-Sahara Afrika (een beeld dat past bij kleinschalige druppelirrigatie); het relateren van kleinschalige druppelirrigatie aan dominante ontwikkelingssamenwerking- en milieuvertogen ; het gebruik van resultaten behaald op proefvelden; en het gebruik van specifieke manieren om succes te definiëren en meten, zoals het aantal verkochte systemen. Net als andere kleinschalige ontwikkelingstechnologieën laat de casus van druppelirrigatie zien dat ontwikkelingssamenwerkingsprojecten en actoren bijna geen verantwoording af hoeven te leggen voor hun resultaten aan degene die ze beogen te helpen.

Hoofdstuk 6 vormt de conclusie van het proefschrift. Het haalt de hoofdvragen terug, vat de belangrijkste bevindingen samen en formuleert een aantal lessen voor beleidsmakers en actoren werkzaam in ontwikkelingssamenwerking of private bedrijven betrokken bij kleinschalige druppelirrigatie. De belangrijkste conclusie van het proefschrift is dat kleinschalige druppelirrigatie niet een succes is om wat het doet in de velden van boeren. Dat boeren besluiten om de technologie te gaan gebruiken is geen goede indicator van hun enthousiasme, noch zegt het veel over of en hoe ze het inzetten om hun gewassen te irrigeren.

Op een meer theoretisch niveau illustreert de thesis dat (irrigatie)technologieën meer zijn dan artefacten met intrinsieke eigenschappen; het zijn ook sociale constructen. Het positieve beeld en het discursieve succes van kleinschalige druppelirrigatiesystemen in ontwikkelingslanden komt niet voort uit de intrinsieke eigenschappen van de technologie en wordt niet bepaald door wat de technologie doet in het veld, maar is de uitkomst van een actieve campagne en inspanningen door een coalitie van onderling afhankelijke actoren die allemaal belang hebben bij het positieve imago van druppelirrigatie.

Curriculum vitae

Jonas Wanvoeke was born on 27 March 1971 in Cotonou, Benin. In 1993, he obtained his High School diploma in mathematics and natural sciences (Baccalaureate D). From 1993 to 1999 he joined the Faculty of Agronomic Science (FSA), University of Abomey-Calavi (Cotonou) to study agricultural sciences. He first obtained the Certificate of General Agriculture Studies in 1997, and later in 1999, the Agricultural Engineer Degree with majors in Economy and Rural Sociology. After working for the government as an extension agent in the Secteur agricole de Ouessè, CARDER Zou from 1999 to 2001, he joined Wageningen in 2001to complete his Master of Science in Management of Agricultural Knowledge Systems (MAKS) in 2003. He later worked for 5 years (2003-2007) in the field of rural development as a program and project officer with a national NGO, where he built his expertise with development projects funded by various international agencies. From 2007 till 2011, he joined the Africa Rice Center (AfricaRice), a CGIAR centre, as a research Assistant for its Learning and Innovation System Program for another 5 years. With that position, he contributed to the establishment of multi-stakeholder consultation processes for the development and management of effective, efficient national agricultural systems. This allowed him to develop a professional connection with most of the National Agricultural Research Systems (NARS) of West African countries and international centres involved in research and development activities in Africa. With his strong and extensive professional experience in the field of agricultural research for development, he decided to start his PhD in 2011 with the Drip Project of the Water Resources Management Group of Wageningen University. His PhD thesis deals with the social dimensions of low cost drip systems by unravelling the actors and their practices in the context of development in West Africa.

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Publications and Presentations

1. **Wanvoeke, J**., Venot, J. P., Zwarteveen, M., & de Fraiture, C. (2015). Performing the success of an innovation: the case of smallholder drip irrigation in Burkina Faso. *Water International, 40*(3), 432-445. doi: 10.1080/02508060.2015.1010364
2. **Wanvoeke, J**., Venot, J.-P., de Fraiture, C., & Zwarteveen, M. (2015). Smallholder drip irrigation in Burkina Faso: The roles of development brokers. *Journal of Development Studies*. doi: 10.1080/00220388.2015.1107048
3. **Wanvoeke, J**., Venot, J. P., Zwarteveen, M., & de Fraiture, C. (2015). Farmers' logics in engaging with projects promoting drip irrigation kits in Burkina Faso. *Society and Natural Resources (in press)*.
4. **Wanvoeke, J**., Venot, J. P., Zwarteveen, M. and de Fraiture, C. (2015). Why development interventions continue despite evidence of lack of success: the case of low cost drip irrigation in Burkina Faso. (Forthcoming, Book chapter).
5. Venot, J. P., Zwarteveen, M., Kuper, M., Boesveld, H., Bossenbroek, L., Kooij, S. V. D., **Wanvoeke, J**., Benouniche, M., Errahj, M. and de Fraiture, C. (2014). Beyond the promises of technology: a review of the discourses and actors who make drip irrigation. *Irrigation and Drainage, 63*(2), 186-194. doi: 10.1002/ird.1839
6. **Wanvoeke, J**. (2014). *Drip irrigation in Burkina Faso: Roles and Places of Actors*. Paper presented at the World Water Week conference on Energy and Water. Stockholm, Sweden.
7. **Wanvoeke, J**., & Zwarteveen, M. (2014). *Construction success: drip irrigation in Burkina Faso*. Paper presented at the 3rd International conference on Responsible Innovation - Values and Valorization. The Hague, The Netherlands
8. **Wanvoeke, J**., Venot, J. P., & Zwarteveen, M. (2013). *Drip irrigation in Burkina Faso: Multiples Actors, multiples rationales.* Paper presented at the 1st World irrigation forum on Irrigation and Drainage in a changing World: Challenges and opportunities for global food security. Mardin, Turquie

Completed training and supervision plan

Wanvoeke Minakpon Jonas Virgile

Wageningen School of Social Sciences (WASS)

Name of the course	Department/ Institute	Year	ECTS (= 28 hrs)
A) Project related competences			
Development of Project Proposal	WUR	2011	6
Thinking about Technology and Ethics	DRiP workshop, WUR	2012	1
Research and Reorientation of drip Topics	DRiP workshop, WUR/UNESCO-IHE	2013	1
"The success construction of the Low Cost Drip in West Africa"	WRM/WUR	2013	0.5
Ethics, Efficiency and Innovation	DRiP workshop, ENA-MEKNES	2014	2
Drip irrigation Book Writing and Planning	UNESCO-IHE	2015	0.5
"Why Development Interventions continue despite evidence of Success? Case of Drip irrigation"	WRM/WUR	2015	0.5
B) General research related competences			
WASS Introduction course	WASS	2011	1
Irrigation and Development (IWE 20806)	WUR	2011	6
PhD Discussion: Linking Fieldwork methods and Concepts	WRM	2011	0.5
Research methodology/ Topic to Proposal	WASS	2011	4
Technography, Researching Technology and Development (TAD 30806)	WUR	2012	6
C) Career related competences/ personal development			
Voice and Presentation Skills Training	WUR	2012	0
"Drip irrigation in Burkina Faso: Multiple Actors, Multiple Rationales"	1st World Irrigation Forum, Mardin, Turkey	2013	1
"Performing Innovation Success: Case of Smallholder Drip Irrigation"	Responsible Innovation, MVI, The Hague, NL	2014	1
"Drip irrigation in Burkina Faso: Role and Place of Actors"	World Water Week, Stockholm, Sweden	2014	1
"A wake up call from the Drip Dream" News item	UNESCO-IHE	2014	1
Via Water Pressing Needs	Workshop, UNECSO-IHE	2014	0.5
"Accepting versus Adopting Technology: Farmers and Drip Irrigation"	UNESCO-IHE PhD week	2014	1
Total			**34.5**

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