



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

J. Wanvoeke, Jean-Philippe Venot, M. Zwarteveen, C. de Fraiture

► To cite this version:

J. Wanvoeke, Jean-Philippe Venot, M. Zwarteveen, C. de Fraiture. Performing the success of an innovation : the case of smallholder drip irrigation in Burkina Faso. *Water International*, 2015, 40 (3), p. 432-445. 10.1080/02508060.2015.1010364 . hal-03511789

HAL Id: hal-03511789

<https://hal.science/hal-03511789>

Submitted on 2 Mar 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

Author version of

Wanvoeke, J.; Venot, J.P.; de Fraiture, C. and Zwarteveen, M. (2016). Smallholder Drip Irrigation in Burkina Faso: The Role of Development Brokers. *The Journal of Development Studies* 52:7, 1019-1033.

Abstract (96 words)

Over the last 15 years, smallholder drip irrigation has gained an 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 paper 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, NGOs staff and exemplary farmers.

Keywords: Actor-Network Theory; Development; Innovation; Smallholder; Sub-Saharan Africa

Introduction

About 15 years ago, *Water International* published an article entitled “Drip irrigation for small farmers: a new initiative to alleviate hunger and poverty”. 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” (Postel, Polak, Gonzales, & Keller, 2001, 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 size, 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, Ibrahim, Pasternak, & Ndjeunga, 2011; Woltering, Pasternak, & Ndjeunga, 2011). Almost all studies published to date that document these travels share Postel et al.'s optimism about 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 - itself is 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, Akuriba, Issaka, & Bhattarai, 2010), reaching at least as many farmers.¹ In 2012, only 1 of these farmers was still using drip irrigation kits.² Since the first experiences of AMG in Burkina Faso in 2003 and for all the successive projects that have been promoting drip afterwards (Table 1 & 4), we observed that drip kits had only been used on experimental/demonstration sites established by promoters (NGOs, Projects, etc.) and that farmers involved are generally considered as pilot farmers. Like 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 tamper the enthusiasm of different development actors. Projects involving the technology abound, also in Burkina Faso (table 4). Rather than questioning the (potential) promises and success of the technology, disappointing results tend to be interpreted as indicating weaknesses in dissemination, a lack of support services or farmer's lack of abilities 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 shaped as a promising and successful technology regardless of what happens in farmers' fields and users' perspectives on this technology. Drawing on Actor-Network Approaches (ANT), (Akrich, Callon, & Latour, 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 African Market Garden (AMG) program (and of its upshots), which was the first large-scale initiative aimed at promoting smallholder drip irrigation systems in the West African context.

After having provided some theoretical background in the next section, section 3 provides some information on smallholder drip irrigation in general, and, more specifically, on the AMG. We then (in section 4) identify the actors (individuals and organizations) who have actively worked to create enthusiasm (funds and support) for smallholder drip irrigation systems and the AMG– and describe the multiple strategies they used to do so.

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, Callon, Latour, & Monaghan, 2002a, 2002b). Different from ‘classical’ innovation analyses, the innovation theory of Akrich et al. (2002a, 2002b) 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 (ibid., 203): this is what they call the *model of interressement* (Akrich et al., 2002a, 2002b)

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) have 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” (p.279). 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 the 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 different devices (Drevetton & Rocher, 2009; Johansson, 2012).

Callon (1986) outlines four stages in the process of translation of a technology: problematisation, interressement, 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/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 main actor who formulated the ‘problem to be solved’ aims to stabilize the identity, and identify and trace the potential role, of other actors (Callon, 1986). Here, the main actor (the spokesperson) aims to make her/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, negotiate to give 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 transversal 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, but rather 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/her own project.

Smallholder drip irrigation and the African Market Garden (AMG)

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. 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, thereby improving water use and application efficiencies (van der Kooij, Zwarteveen, Boesveld, & Kuper, 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 called Chapin Watermatics Inc. (Postel et al., 2001). 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. 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 2000 (for instance, Polak et al., 1997; Postel et al., 2001), which in turn has raised much enthusiasm regarding the prospect of drip irrigation in sub-Saharan Africa. In the literature, different 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 smallholder³ drip irrigation in the remaining part of 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 kits. Depending on the designers and manufacturers, smallholder drip systems have drip laterals of 8-16 mm in diameter and are made of thick-tube, rigid polyethylene with in-line drips emitters, PVC, or flexible tape. Regardless of the system and the manufacturer, the principle is the same: the "drip kits" operate under low gravity to irrigate small plots from a few square meters to a few hundred square meters.

The African Market Garden (AMG), 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, Pasternak, et al., 2011). 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 500m²–1000m² and a complete FDS kit consists of four component - a "water tank", "a simple control head (valve)", "a filter" and "the drip lines" (Figure 1). Apart from the water tank, all the components of the kit are supplied in one carton-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 1 near here]

Deciphering success: The case of smallholder drip irrigation

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. We complemented this literature review with interviews with people involved in the development, promotion and dissemination of smallholder drip irrigation systems in sub-Saharan Africa. We used the snowball sampling methodology to identify individuals and organisations involved in the AMG, and its multiple upshots. 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). The first person we identified and interviewed was the former agricultural technician of the AMG project in Burkina Faso. From that interview, we built our web of contacts of individuals and organisations which played a role in the AMG project and its multiple upshots. 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.

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, as (1) there is a large scientific and development consensus that drip irrigation is a “proven technology” that allows for an 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) the fact that small-size, low cost, drip irrigation systems that fit smallholder farm size and investment capacity 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 (Shah & Keller, 2002).

The art of interessement: A core network

The year 2002 marks 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 a lot of 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 is 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 Bank⁴ to extend similar activities to the African continent, where smallholders traditionally irrigate vegetable with watering cans. IPALAC had been 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) while 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; March 5, 2014). 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 convinced them that ICRISAT would be an interesting partner in 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 (interview with Dov Pasternak on June 27, 2013). 100 FDS would be installed in Niger during the project. Unfortunately, there is no available information about 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 the Consultative Group for International Agricultural Research (CGIAR), provided scientific legitimacy to projects promoting smallholder drip irrigation and allowed 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.⁵ He, indeed, can be identified as a key spokesperson that 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.

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 1). In the same vein, the support of USAID to the AMG principles and projects was triggered by a talk given by Dov Pasternak in their regional office in Mali (Interview with Dov Pasternak, June 17, 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, different projects emerged in many countries of sub-Saharan Africa (table 1). These projects, however, shared the principles of 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 1 near here]

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, Pasternak, et al., 2011). By presenting the 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 m² and offering multiple options (80 m², 500 m², clusters and collective systems of more than 500 m²; Woltering, Pasternak, et al., 2011), 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 allowed for 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 to grow 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, Ibrahim, et al., 2011). 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 be actually used by farmers). As put by a former

301 technician of the AMG in Burkina Faso: “We were just distributing the drip kits, for free, to
302 anyone, either to individuals or to organisations who requested it. We were not interested on
303 where the kits would end up and whether they would be used”. (INERA technician, pers comm,
304 2012). ICRISAT (2006) for instance presented the distribution of 2,000 drip kits in nine
305 Sahelian countries as a “Sahelian success”. Remarkably little has been reported on the actual
306 use of these smallholders drip irrigation kits (Kay, 2001). Among the 2000 kits, 500 kits were
307 said to be successfully distributed in Burkina but little efforts were actually done to evaluate
308 whether these kits were actually used or not (Dittoh et al., 2010).

309 *Scientific publication as legitimization on the international stage*

311 Publication in academic journals served as another effective way to build the scientific
312 legitimacy of the AMG and its multiple upshots and played an integral part in harnessing the
313 support of multiple actors. We were in a position to identify five peer reviewed articles listed
314 in the Web of Knowledge database that directly deal with the AMG or one of its upshots (see
315 table 2).

316
317 [Table 2 near here]

318
319 What is striking from table 3 is that four of these five peer reviewed articles (and the
320 large majority of the grey literature; not shown) that document the AMG and similar initiatives
321 have, among their authors, at least one person who was directly involved in the implementation
322 of these projects. Most of the papers conclude that smallholder drip irrigation has the potential
323 to increase the profitability of vegetables gardening, enhance livelihoods and reduce poverty,
324 on the basis of results obtained from experimental/demonstration sites – where farmers had
325 access to much more support and advice than usual.

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

333 334 *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, radios, public or private television companies reported on the AMG. We identified not less than fifteen news cuttings or blog-posts on the AMG whereby the major source of information was Dov Pasternak. All 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 upshots, featuring people (researchers and farmers) who have been directly involved in project activities and demonstration sites. They provide testimonies about the potential of drip irrigation to increase yields.

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 likely been at play in other countries of sub-Saharan Africa.

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, AVRDC) and maybe 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 3).

[Table 3 near here]

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, International Development Enterprises (iDE), which had a long experience of promoting smallholder drip irrigation in the Asian context (Polak, Nanes, & Adhikari, 1997; Postel et al., 2001) has now become a central player in Burkina Faso. iDE activities were largely funded by agencies, which had earlier supported the AMG initiatives (such as USAID and SDC) (Tables 1 and 4).

[Table 4 near here]

Conclusion

This paper 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 interesement, this article has shown how the enthusiasm for the technology can be largely traced back to the relentless efforts of one particular person, an Israeli scientist. With a missionary-like 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 not in use anymore. In the 10 years time-span that separates 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 as tracing the beneficiaries (villages/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/water savings. Instead, farmers' engagements with the technology are short-lived and their interest in it mainly stems from the side-benefits that come with the project of which drip irrigation is an element (Wanvoeke, Venot, & Zwarteveen, 2015). Such observation makes 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 and who had been involved in the AMG project in Burkina Faso. Hence, rather than by 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, improvements in nutrition, food security, and agricultural productivity; with economic growth and women's empowerment; and 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 exemplary 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 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 but 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.

This study holds important lessons for policy makers. First, the need for in-depth independent evaluation of drip irrigation projects that would reflect the perspectives of smallholders and not only of the promoters of the technology. Second, the 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.

Acknowledgements

This research was supported by the Netherlands Organisation for Scientific Research (NWO) under Grant 313-99-230 in the framework of the MVI project ‘Drip Irrigation Realities in Perspectives’.

Notes

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

References

- 468 Akrich, M., Callon, M., & Latour, B. (1988). A quoi tient le succès des innovations? 1: L'art
469 de l'intéressement; 2: Le choix des porte-parole. *Gérer et comprendre. Annales des*
470 *mines*(11 & 12), 4-17 & 14-29.
- 471 Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002a). The key to success in innovation
472 part I: the art of interessement. *International Journal of Innovation Management*, 6(02),
473 187-206. doi: 10.1142/S1363919602000550
- 474 Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002b). The key to success in innovation
475 part II: The art of choosing good spokespersons. *International Journal of Innovation*
476 *Management*, 6(02), 207-225. doi: 10.1142/S1363919602000562
- 477 Andersson, L. (2005). *Low-cost drip irrigation: on farm implementation in South Africa.*
478 (Master of Science), Luleå University of Technology, Luleå, Sweden.
- 479 Callon, M. (1986). Some elements of a sociology of translation: domestication of the scallops
480 and the fishermen of St Brieuc Bay. In J. Law (Ed.), *Power, action and belief: A new*
481 *sociology of knowledge?* (pp. 196-233). London: Routledge & Kegan Paul.
- 482 Callon, M., & Latour, B. (1981). Unscrewing the big Leviathan: How actors macro-structure
483 reality and how sociologists help them to do so. In K. D. Knorr & A. Cirourel (Eds.),
484 *Advances in social theory and methodology: Toward an integration of micro-and*
485 *macro-sociologies* (pp. 277-303). London: Routledge & Kegan Paul.
- 486 Dittoh, S., Akuriba, M. A., Issaka, B. Y., & Bhattarai, M. (2010). *Sustainable Micro-Irrigation*
487 *Systems for Poverty Alleviation in The Sahel: A Case for "Micro" Public-Private*
488 *Partnerships?* Paper presented at the 3rd Annual AAAE/49th Annual AEASA
489 Conference, Cape Town, South Africa.
- 490 Drevetton, B., & Rocher, S. (2009). *The success story of a 'successful' management device.*
491 Paper presented at the New public sector seminar, Edinburgh, United Kingdom.
492 <http://halshs.archives-ouvertes.fr/halshs-00479810>
- 493 Faugier, J., & Sargeant, M. (1997). Sampling hard to reach populations. *Journal of advanced*
494 *nursing*, 26(4), 790-797. doi: 10.1046/j.1365-2648.1997.00371.x

495 Huang, S. (2012). *Evaluation of pre-packaged agricultural drip irrigation kits*. (Bachelor of
 496 Science), Massachusetts Institute of Technology, Cambridge, United States. Retrieved
 497 from <http://hdl.handle.net/1721.1/74494>

498 ICRISAT. (2005). *Market Garden in the Sahel. Fruit-trees and vegetables for land*
 499 *regeneration and management* (Final technical Report). Niamey, Niger: International
 500 Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

501 Johansson, J. (2012). *Matching Innovation-Introducing new innovations on the BoP market*.
 502 (Master of Science), University of Gothenburg, Gothenburg, Sweden. Retrieved from
 503 <http://hdl.handle.net/2077/29738>

504 Kay, M. (2001). *Smallholder irrigation technology: prospects for sub-Saharan Africa*
 505 (Knowledge Synthesis Report No.3). Rome, Italy: FAO/IPTRID.

506 Kulecho, I. K., & Weatherhead, K. E. (2005). Reasons for smallholder farmers discontinuing
 507 with low-cost micro-irrigation: A case study from Kenya. *Irrigation and drainage*
 508 *systems*, 19(2), 179-188. doi: 10.1007/s10795-005-4419-6

509 Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*.
 510 Cambridge Massachusetts: Harvard university press.

511 Mahamadou, O. S. (2005). *Diffusion des systèmes d'irrigation goutte-à-goutte dans la zone*
 512 *péri-urbaine de Niamey et dans la région de Dosso au Niger*. (Mémoire de Fin de
 513 Cycle), IPR/IFRA, Katibougou, Mali.

514 NETAFIM. (2008). *Sustainable irrigationn: Climate change in aridzones & other challenge*.
 515 Paper presented at the Climate Change Conference of the United Nations Framework
 516 Convention on Climate Change (UNFCCC), Poznań, Poland.

517 Oumarou, S. (2008). *Etude comparative de l'irrigation goutte à goutte à basse pression JPA*
 518 *et de l'arrosage manuel sur la production de la laitue en zone sahélo soudanienne du*
 519 *Niger*. (Mémoire de Fin de Cycle), IPR /IFRA, Katibougou, Mali.

520 Phocaides, A. (2007). *Handbook on pressurized irrigation techniques* (2nd ed.). Rome, Italy:
 521 Food & Agriculture Organisation (FAO).

- 522 Polak, P. (2008). *Out of poverty - What Works When Traditional Approaches Fail*. San
523 Francisco, CA: Berret-Koehler.
- 524 Polak, P., Nanes, B., & Adhikari, D. (1997). A low cost drip irrigation system for small farmers
525 in developing countries. *Journal of the American Water Resources Association*, 33(1),
526 119-124. doi: 10.1111/j.1752-1688.1997.tb04088.
- 527 Postel, S., Polak, P., Gonzales, F., & Keller, J. (2001). Drip irrigation for small farmers: a New
528 Initiative to Alleviate Hunger and Poverty. *Water International*, 26(1), 3-13. doi:
529 10.1080/02508060108686882
- 530 Rosegrant, M. W. (1997). *Water resources in the twenty-first century: Challenges and*
531 *implications for action* (Vol. 20): International Food Policy Ressource Institute.
- 532 Shah, T., & Keller, J. (2002). *Micro-irrigation and the poor: A marketing challenge in*
533 *smallholders irrigation development*. Paper presented at the Regional seminar on
534 Private Sector participation and Irrigation Expansion in sub-Saharan Africa, Accra,
535 Ghana.
- 536 van der Kooij, S., Zwarteveen, M., Boesveld, H., & Kuper, M. (2013). The efficiency of drip
537 irrigation unpacked. *Agricultural Water Management*, 123, 103-110. doi:
538 10.1016/j.agwat.2013.03.014
- 539 Van Leeuwen, N. H. (2001). *Affordable small-scale drip irrigation in Africa: potential role of*
540 *the private sector*. Paper presented at the Regional Seminar on Private Sector
541 Participation and Irrigation Expansion in Sub-Saharan Africa, Accra, Ghana.
- 542 Venot, J. P., Zwarteveen, M., Kuper, M., Boesveld, H., Bossenbroek, L., Kooij, S. V. D., . . .
543 de Fraiture, C. (2014). Beyond the promises of technology: a review of the discourses
544 and actors who make drip irrigation. *Irrigation and Drainage*, 63(2), 186-194. doi:
545 10.1002/ird.1839
- 546 Wanvoeke, J., Venot, J. P., & Zwarteveen, M. (2015). *Adopting technology versus accepting*
547 *projects: Farmers' logics in engaging with drip irrigation projects in Burkina Faso*.
548 Manuscript submitted for publication.

549 Woltering, L., Ibrahim, A., Pasternak, D., & Ndjeunga, J. (2011). The economics of low
550 pressure drip irrigation and hand watering for vegetable production in the Sahel.
551 *Agricultural Water Management*, 99, 67-73. doi: 10.1016/j.agwat.2011.07.017

552 Woltering, L., Pasternak, D., & Ndjeunga, J. (2011). The African market garden: The
553 development of a low-pressure drip irrigation system for smallholders in the Sudano
554 Sahel. *Irrigation and Drainage*, 60(5), 613-621. doi: 10.1002/ird.610

555

556

Table 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

561 Table 2: Peer reviewed articles published on the AMG and associated initiatives

Article title	Journals and 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	Woltering, L., Pasternak, D. & Ndjeunga, J	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	Woltering, L., Ibrahim, A., Pasternak, D. & Ndjeunga, J	AMG project leader and implementing staff
African Market Garden	Encyclopedia of Water Science, 2003	Pasternak, D., & Bustan, A	AMG project leader and implementing staff
Smallholder Irrigation as a Poverty Alleviation Tool in Sub-Saharan Africa	World Development, 2012	Burney, J. A. & Naylor, R. L. 2012	AMG Project research associates
Intensification and improvement of market gardening in the Sudano-Sahel Region of Africa	Chronica Horticulturae, 2006	Pasternak, D., Nikiema, A., Senbeto, D., Dougbedji, F. & Woltering, L.	Project leader and project implementers

Table 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

565 Table 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	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

566

567 Figure captions list

568 Figure 1. Family Drip System (FDS)

569 Source: NETAFIM (2008); (Phocaides, 2007)