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► **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

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

2 **Faso**

3

4 **Author version of**

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

7

8 **Abstract (96 words)**

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

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

18 **Introduction**

19 About 15 years ago, *Water International* published an article entitled “Drip irrigation for small
20 farmers: a new initiative to alleviate hunger and poverty”. The article applauded the emergence
21 of a new range of drip irrigation systems specifically targeting smallholder farmers. It
22 articulated the expectation that these new systems “could form the backbone of a second green
23 revolution, this one aimed specifically at poor farmers in sub-Saharan Africa, Asia, and Latin
24 America” (Postel, Polak, Gonzales, & Keller, 2001, p. 3). The article's optimism was
25 importantly fed by first experiences of Non-Governmental Organizations (such as International
26 Development Enterprises (iDE) with the promotion of these small size, low cost irrigation
27 technologies in South Asia (Bangladesh, India and Nepal).

28 Since then, initiatives aimed at promoting smallholder drip irrigation have indeed
29 “travelled” to sub-Saharan Africa (Andersson, 2005; Van Leeuwen, 2001; Woltering, Ibrahim,
30 Pasternak, & Ndjeunga, 2011; Woltering, Pasternak, & Ndjeunga, 2011). Almost all studies
31 published to date that document these travels share Postel et al.'s optimism about the potential
32 promises that smallholder drip irrigation holds. Although acknowledging the multiple obstacles

33 and constraints that (may) impede widespread adoption and use by smallholder farmers, most
34 reports and articles agree, in principle, that the dissemination of smallholder drip systems is a
35 promising idea. This agreement is anchored in the belief that the technology – the smallholder
36 drip system - itself is intrinsically good, a goodness that is attributed to its technical design
37 characteristics: affordability, small size and infinite expandability (Polak, 2008), coupled to
38 notions of efficiency and productivity that are associated with drip irrigation systems in general
39 (Venot et al., 2014).

40 The widespread positive interest in the technology in development cooperation circles
41 stands in stark contrast with what happens in sub-Saharan farmers' fields. To give just the
42 example of the main project discussed in this article, the African Market Garden (AMG) Project
43 distributed 500 drip kits in Burkina Faso (Dittoh, Akuriba, Issaka, & Bhattarai, 2010), reaching
44 at least as many farmers.¹ In 2012, only 1 of these farmers was still using drip irrigation kits.²
45 Since the first experiences of AMG in Burkina Faso in 2003 and for all the successive projects
46 that have been promoting drip afterwards (Table 1 & 4), we observed that drip kits had only
47 been used on experimental/demonstration sites established by promoters (NGOs, Projects, etc.)
48 and that farmers involved are generally considered as pilot farmers. Like Kulecho and
49 Weatherhead (2005) described in a study on smallholder drip irrigation in Kenya, pilot farmers
50 stopped using the technology when external support from projects ended. These observations,
51 however, have done little to tamper the enthusiasm of different development actors. Projects
52 involving the technology abound, also in Burkina Faso (table 4). Rather than questioning the
53 (potential) promises and success of the technology, disappointing results tend to be interpreted
54 as indicating weaknesses in dissemination, a lack of support services or farmer's lack of
55 abilities to properly operate and use the technology.

56 This article proposes a different analysis of the fate of smallholder drip systems in West
57 Africa, explaining how it has been shaped as a promising and successful technology regardless
58 of what happens in farmers' fields and users' perspectives on this technology. Drawing on
59 Actor-Network Approaches (ANT), (Akrich, Callon, & Latour, 1988; Latour, 1987) it argues
60 that the resonance that smallholder drip irrigation has acquired among a broad range of
61 development actors does not so much stem from what it does in farmers' fields. Instead, it is
62 the result of a carefully designed and staged promotional campaign by people (key
63 spokespersons) believing in the (potential of the) technology. The active efforts of these key
64 spokespersons have generated widespread interest in (and support and funding for) the
65 technology from a broad coalition of actors, by aligning it with a diversity of interests, projects
66 and discourses. We provide a detailed historical analysis of this campaign on the basis of the

67 trajectory of the African Market Garden (AMG) program (and of its upshots), which was the
68 first large-scale initiative aimed at promoting smallholder drip irrigation systems in the West
69 African context.

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

75

76 **Shaping the success of technologies: Some theoretical insights**

77 Our explanation for the continued ‘success’ of smallholder drip irrigation is theoretically
78 anchored in the practice-based theory of innovation proposed by (Akrich, Callon, Latour, &
79 Monaghan, 2002a, 2002b). Different from 'classical' innovation analyses, the innovation theory
80 of Akrich et al. (2002a, 2002b) does not ascribe the success or failure of a technology to its
81 'intrinsic' properties (the diffusion model), but instead looks at technologies-in-context to
82 suggest that innovations are only taken up if they manage to interest more and more actors
83 (ibid., 203): this is what they call the *model of interressement* (Akrich et al., 2002a, 2002b)

84 This model postulates that for different actors to become interested in a technology, the
85 technology needs to be *translated* to fit different contexts, interests and discourses. Callon and
86 Latour (1981) have defined translation as “the negotiations, intrigues, calculations, acts of
87 persuasion and violence, thanks to which an actor or force takes, or causes to be conferred on
88 itself, authority to speak or act on behalf of another actor or force” (p.279). Translation theory
89 was originally developed as a framework to reveal that “scientific facts” are built through
90 networks; hence shedding light on the underpinnings of controversies that surround these
91 “facts”. Latour (1987) broadened the scope of the translation theory to the analysis and
92 socialisation of tools and machines. Since then, scholars have applied this theoretical
93 framework to study the creation, acceptance, and success of different devices (Dreveton &
94 Rocher, 2009; Johansson, 2012).

95 Callon (1986) outlines four stages in the process of translation of a technology:
96 problematisation, interressement, enrolment and mobilisation. *Problematisation* refers to the
97 articulation of a problem on the basis of observations or experiences drawn from the “real
98 world”. A main actor (spokesperson) articulates a problem (s)he is interested in addressing and
99 that “talks” to a broader network, and establishes her/himself as an indispensable resource to

100 solving the very problem (s)he formulated. *Interessement* refers to a series of actions and
101 strategies through which the main actor who formulated the ‘problem to be solved’ aims to
102 stabilize the identity, and identify and trace the potential role, of other actors (Callon, 1986).
103 Here, the main actor (the spokesperson) aims to make her/his immediate interest (in solving
104 the problem (s)he articulated) a “shared concern”. Akrich et al. (1988) suggest that the success
105 of the process of interessement (which they call “the art of interessement”) in building a support
106 network, strongly depends on the choices made regarding the recruitment of representatives
107 and intermediaries who interact, negotiate to give shape and transform the innovation until it
108 finds its “market”. In her view, the fate of innovation but also its content and chances of success
109 importantly rest on the choice of these individuals or organisations, as these have a key role in
110 “translating” the innovation so that it is adapted and adopted by other actors, who will then
111 become allies. In this paper, we show that the spokesperson has not just created
112 ‘interessement’; he has played a transversal role throughout the four stages of the translation
113 model. *Enrolment, or the establishment of a wider supporting coalition*, follows through a
114 process of coercion, seduction, or consent. The spokesperson seeks to engage a series of
115 stakeholders so as to form a stable network of alliances. Callon (1986) highlighted that this
116 phase is characterized by multilateral negotiations, power grabs or ruses; it enables the “art of
117 interessement” to come to fruition. *Mobilisation* finally occurs as the proposed solution gains
118 wider acceptance in an ever larger network.

119 We make use of this analytical framework to explain the trajectory of smallholder drip
120 irrigation in sub-Saharan Africa. Based on empirical evidence, mostly drawn from Burkina
121 Faso, we show that the four phases of the “innovation translation model” do not take place one
122 after the other, but rather occur concomitantly and reinforce each other. Our contribution to the
123 translation model notably lies in the identification of the strategies used by the spokesperson
124 to co-opt and enrol other individuals or organisations that will contribute to building the
125 legitimacy of his/her own project.

126

127 **Smallholder drip irrigation and the African Market Garden (AMG)**

128 Drip irrigation is an irrigation method whereby small quantities of water drip directly to the
129 root zone of crops through a network of plastic pipes, valves, emitters or drippers, and ancillary
130 devices. Research and development efforts on drip irrigation have long been inspired by
131 expectations that the technology would allow more precisely adjusting irrigation to crop water
132 demands, thereby improving water use and application efficiencies (van der Kooij,
133 Zwarteveen, Boesveld, & Kuper, 2013; Venot et al., 2014). Irrigation scholars and

134 professionals generally consider drip irrigation a more sophisticated form of irrigation as
135 compared to, for instance, surface irrigation. Its use is commonly associated with
136 modernization and progress, and with larger and wealthier farmers.

137 Drip systems for smallholder farmers in the developing world were first developed in the
138 1970s by a US based company called Chapin Watermatics Inc. (Postel et al., 2001). Over the
139 last 20 years, several other organizations, such as the Non-Governmental Organization
140 International Development Enterprises (iDE), as well as the two major manufacturers of drip
141 irrigation equipment, NETAFIM and Jain irrigation Systems Ltd. have also engaged in efforts
142 to design and disseminate smallholder drip irrigation systems meant to irrigate relatively small
143 gardens in the developing world. Such initiatives are said to have had beneficial impacts at
144 scale on smallholders' livelihoods in south Asia in the early to mid 2000 (for instance, Polak
145 et al., 1997; Postel et al., 2001), which in turn has raised much enthusiasm regarding the
146 prospect of drip irrigation in sub-Saharan Africa. In the literature, different names are given to
147 these smallholder drip irrigation systems: 'low cost drip system', 'low pressure drip system',
148 'low-tech gravity system'. For the sake of clarity, we will use the term smallholder³ drip
149 irrigation in the remaining part of this paper. Depending on the size of the plot they can irrigate
150 and the type of water storage, Postel et al. (2001) distinguished between three different types
151 of smallholder drip systems, all referred to by the generic term "kit": bucket kits, drum kits and
152 family drip kits. Depending on the designers and manufacturers, smallholder drip systems have
153 drip laterals of 8-16 mm in diameter and are made of thick-tube, rigid polyethylene with in-
154 line drips emitters, PVC, or flexible tape. Regardless of the system and the manufacturer, the
155 principle is the same: the "drip kits" operate under low gravity to irrigate small plots from a
156 few square meters to a few hundred square meters.

157 The African Market Garden (AMG), described by its designers and promoters as an
158 integrated horticultural production system, had the objective to improve the profitability of
159 small farmers' horticultural production in the Sudano-Sahelian region of Africa by means of
160 drip irrigation, high-quality crop varieties and an adapted operation and management package
161 (Woltering, Pasternak, et al., 2011). The drip system used was the Family Drip System (FDS)
162 designed by NETAFIM. It is a pre-packaged kit using rigid polyethylene pipes that are pre-
163 fitted with advanced drippers and can be adapted to variable plot sizes (Huang, 2012). The
164 typical system size ranges from 500m²–1000m² and a complete FDS kit consists of four
165 component - a "water tank", "a simple control head (valve)", "a filter" and "the drip lines"
166 (Figure 1). Apart from the water tank, all the components of the kit are supplied in one carton-
167 box (Phocaides, 2007). The FDS is commonly seen as the most hi-tech, high-quality and

168 expensive option among all available smallholder drip irrigation systems on the market (Kay,
169 2001).

170
171 [Figure 1 near here]
172

173 **Deciphering success: The case of smallholder drip irrigation**

174 ***Methodology***

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

190

191 ***Problematization: Drip irrigation for poverty alleviation***

192 Smallholder drip irrigation in sub-Saharan Africa, and globally, is seen as an answer to a double
193 problem statement. First, smallholders in the developing world are poor and highly vulnerable;
194 they have not yet benefitted from technological advances in the field of irrigation (Postel et al.,
195 2001). Second, water resources are scarce and increasingly unreliable; they need to be secured
196 and used more efficiently (Rosegrant, 1997). Smallholder drip irrigation is presented as a
197 solution to these two problems, as (1) there is a large scientific and development consensus that
198 drip irrigation is a “proven technology” that allows for an efficient water use (of secured water
199 supplies) and higher yields of vegetable and fruit crops that can be sold for a profit and generate

200 income and (2) the fact that small-size, low cost, drip irrigation systems that fit smallholder
201 farm size and investment capacity exist and have been used in south Asia.

202 In addition to this high level problematisation in terms of poverty and environmental
203 sustainability, smallholder drip irrigation is also presented as a way to reach yet another
204 important development objective: the empowerment of women. Small drip systems would
205 allow women to grow their own crops, on their own small plot of land, and decide what to do
206 with the money earned out of the vegetables produced (Shah & Keller, 2002).

207

208 *The art of interessement: A core network*

209 The year 2002 marks the first attempts of international development and agricultural research
210 actors to promote smallholder drip irrigation systems in the West African region, and the
211 beginning of a period when such initiatives started attracting a lot of attention (until then, efforts
212 of charitable organisations such as Chapin Living Waters and other NGOs aiming at supporting
213 the use of such systems remained limited in scope, and had not been ‘brought to scale’).

214 This is linked to a convergence of interests of four major actors: NETAFIM (an Israeli
215 company and the biggest manufacturer of drip irrigation equipment worldwide), the World
216 Bank, IPALAC (the International Program for Arid Land Crops of the Ben-Gurion University
217 of Negev), and ICRISAT (the International Crops Research Institute for the Semi-Arid-
218 Tropics). NETAFIM had long engaged in developing small-scale drip irrigation systems
219 (targeting small Chinese greenhouses) and was looking for support from the Development
220 Marketplace initiative of the World Bank⁴ to extend similar activities to the African continent,
221 where smallholders traditionally irrigate vegetable with watering cans. IPALAC had been set
222 up in 1994 by an Israeli researcher named Dov Pasternak with the objective of transferring new
223 crops to semi-arid regions, notably in sub-Saharan Africa (interview with Dov Pasternak on
224 June 27, 2013) while ICRISAT engaged in promoting crop diversification in the region from
225 the late 1990s onwards (http://www.icrisat.org/what-we-do/wit/wit_3/wit_3.htm; March 5,
226 2014). This convergence of interests created favourable conditions for Dov Pasternak to join
227 ICRISAT in 2001. The institute would, in turn, host the IPALAC program from its office in
228 Niger and use it as a conduit to pursue its objective of agricultural diversification.

229 As an Israeli scientist involved in the field of irrigation, Dov Pasternak had close
230 relationships with NETAFIM and convinced them that ICRISAT would be an interesting
231 partner in the perspective of submitting a collaborative project to the Development Marketplace
232 initiative of the World Bank. The project was funded in 2002 (\$250,000; Huang, 2012) and

233 aimed at promoting date palm cultivation through means of low pressure irrigation (interview
234 with Dov Pasternak on June 27, 2013). 100 FDS would be installed in Niger during the project.
235 Unfortunately, there is no available information about the results of this project and what
236 happened to the kits since then.

237 At an organizational level, the involvement of ICRISAT, a research centre of the
238 Consultative Group for International Agricultural Research (CGIAR), provided scientific
239 legitimacy to projects promoting smallholder drip irrigation and allowed for harnessing support
240 from international and bilateral funding agencies. At an individual level, the first
241 intermediation of Dov Pasternak (between NETAFIM and ICRISAT) would soon be followed
242 by others that would establish him as the “public figure” and scientific guarantor of smallholder
243 drip irrigation experiments in the Sudano-Sahel region of Africa.⁵ He, indeed, can be identified
244 as a key spokesperson that played a very active role in the innovation translation process. He
245 engaged in constant negotiations aiming at enrolling new actors in an ever extending network
246 of supporters.

247 ***Enrolment: Shaping a coalition and strategies to enlist allies***

248 *Building alliances*

249 Scaling up the activities conducted between 2002 and 2004 in Niger in the framework of the
250 first AMG project funded by the World Bank required identifying other individuals and
251 agencies that would support the idea of crop diversification through the means of smallholder
252 irrigation. After a talk given at the World Summit on Sustainable Development held in South
253 Africa in 2002, Dov Pasternak managed to create such 'interessement' among Israeli diplomats
254 operating in sub-Saharan Africa and staff of MASHAV (the organization responsible for the
255 implementation of international collaboration at the foreign ministry of Israel). MASHAV
256 would eventually fund several projects based on the AMG principles, implemented through
257 ICRISAT, but also through other local NGOs (table 1). In the same vein, the support of USAID
258 to the AMG principles and projects was triggered by a talk given by Dov Pasternak in their
259 regional office in Mali (Interview with Dov Pasternak, June 17, 2013). USAID found in
260 smallholder drip irrigation a (potential) means to achieve its food security and poverty
261 reduction goals. As more funding agencies came into play, different projects emerged in many
262 countries of sub-Saharan Africa (table 1). These projects, however, shared the principles of the
263 AMG and had been triggered by the same individual. The multiplication of initiatives and
264 funding agencies and the wide geographical scope of these projects were instrumental in
265 establishing smallholder drip irrigation as a “success”. After all, if so many organizations
266 promoted it, “it had to be good”.

267

268 [Table 1 near here]

269

270 *Using development discourses and recruiting pilot farmers*

271 The AMG was presented as a holistic crop management package allowing crop
272 diversification through the means of drip irrigation (Woltering, Pasternak, et al., 2011). By
273 presenting the drip irrigation technology as a tool to achieve a broader goal and as one
274 important element of an integrated agricultural development project, the promoters of the AMG
275 harnessed the support of development agencies, for which “integration” had been a key word
276 since the 1970s. Further, by adapting the initial FDS system of 500 m² and offering multiple
277 options (80 m², 500 m², clusters and collective systems of more than 500 m²; Woltering,
278 Pasternak, et al., 2011), the promoters of the AMG demonstrated the adaptability of
279 smallholder drip irrigation to local conditions and to different types of farmers. This also
280 contributed to making it attractive to development agencies and allowed for recruiting “pilot
281 farmers” who, in turn, played a key role in harnessing support from international and bilateral
282 agencies. Pilot farmers tested the AMG system on demonstration sites and were showcased as
283 successful examples of drip irrigation in use during the many “field visits” that were organized
284 to these demonstration sites. About 1200 pilot farmers, extension agents, and NGOs personnel
285 were trained on the use of drip irrigation systems to grow vegetables and fruits (ICRISAT,
286 2005). This was presented as evidence of success and proved central to enrolling new actors in
287 similar activities.

288

289 *Experimental results and distribution numbers as “proof of success”*

290 Several scientific publications reported the success of smallholder drip irrigation in terms
291 of water, time, and labour savings as well as increases in yields. These results were obtained
292 on the experimental sites where the AMG was implemented (Mahamadou, 2005; Oumarou,
293 2008; Woltering, Ibrahim, et al., 2011). Such results, corroborated during many field visits
294 organized for development agents but also farmers, were widely circulated as evidence for the
295 potential contribution of drip irrigation to improving food security and land use, increasing
296 household income, and reducing poverty (ICRISAT, 2005). But field visits and experimental
297 results were also used by the AMG promoters and technicians to convince other organizations
298 and individual farmers to stock up on drip irrigation kits. The number of drip kits distributed,
299 in itself, quickly became an objective, even a measure of success of the AMG project
300 (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

310 *Scientific publication as legitimisation 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 interest 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*

335 Scientific publications were not the only communication tool used to create
336 intersement and enrol donors and development agencies. The AMG promoters also made
337 intensive use of mass media to advertise the agronomic and economic performance of
338 smallholder drip irrigation. The same pilot sites that served as a basis for collecting data for
339 scientific publications also served for public shows where journalists from newspapers, radios,
340 public or private television companies reported on the AMG. We identified not less than fifteen
341 news cuttings or blog-posts on the AMG whereby the major source of information was Dov
342 Pasternak. All reports focused on drip irrigation (rather than on the integrated horticultural
343 management package of the AMG) and its potential to alleviate hunger and poverty and
344 improve food security. In the same way, the large majority of videos available on the web were
345 staged during the implementation phase of the AMG project and its upshots, featuring people
346 (researchers and farmers) who have been directly involved in project activities and
347 demonstration sites. They provide testimonies about the potential of drip irrigation to increase
348 yields.

349

350 ***Mobilization: the network extends...***

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

355 In the mid to late 2000s, ICRISAT coordinated smallholder drip irrigation initiatives in
356 sub-Saharan Africa by partnering with other international research centres (such as the World
357 Vegetable Center, AVRDC) and maybe more significantly, with national agricultural research
358 organizations. In Burkina Faso, this was the ‘Institut de l’environnement et Recherches
359 Agricoles (INERA)’. Since 2010, other actors have taken the centre stage, with smallholder
360 drip irrigation moving from the “research” to the “development” field. This is largely because
361 the national government saw initiatives involving smallholder drip irrigation as offering a
362 potential contribution to its food security agenda, while NGOs and drip irrigation
363 manufacturers saw in smallholder drip irrigation a conduit to pursue their own goals (see table
364 3).

365

366 [Table 3 near here]

367 There are important overlaps between the research and development networks that help
368 explain the speed of the mobilization process. For instance, the “micro-irrigation” officer of

369 the IFAD funded governmental project PIGEPE was a former INERA technician trained by
370 Dov Pasternak. Also, International Development Enterprises (iDE), which had a long
371 experience of promoting smallholder drip irrigation in the Asian context (Polak, Nanes, &
372 Adhikari, 1997; Postel et al., 2001) has now become a central player in Burkina Faso. iDE
373 activities were largely funded by agencies, which had earlier supported the AMG initiatives
374 (such as USAID and SDC) (Tables 1 and 4).

375

376 [Table 4 near here]

377

378 **Conclusion**

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

387 A systematic and independent review of the use and impact of drip irrigation kits in Sub-
388 Saharan Africa is lacking. Drip irrigation is widely regarded as a success despite a lack of data
389 on its (un)sustained use in farmers' field. Our field work provides evidence that in Burkina
390 Faso AMG drip kits are not in use anymore. In the 10 years time-span that separates our study
391 from the moment they first "hit the field", these drip kits might have been in use with positive
392 impact on farmers but this is difficult to assess as tracing the beneficiaries (villages/farmers)
393 of these kits itself is a challenge. In-depth analysis of current projects implemented in Burkina
394 Faso reveals that kits are seldom used by rural farmers for food/poverty/water savings. Instead,
395 farmers' engagements with the technology are short-lived and their interest in it mainly stems
396 from the side-benefits that come with the project of which drip irrigation is an element
397 (Wanvoeke, Venot, & Zwarteveen, 2015). Such observation makes it doubtful that AMG drip
398 kits were used with significant positive impacts even at the height of the project – something
399 that was hinted at by several people we interviewed and who had been involved in the AMG
400 project in Burkina Faso. Hence, rather than by what it actually does in the field, the technology
401 obtained its status as a "success" through a professional and carefully crafted promotional

402 campaign, legitimized by scientific results obtained in experimental or pilot fields. Through
403 this campaign, smallholder drip irrigation has come to be seen as a technology that is
404 potentially instrumental in simultaneously meeting a large number of objectives. It is associated
405 with poverty alleviation, improvements in nutrition, food security, and agricultural
406 productivity; with economic growth and women's empowerment; and with water conservation,
407 environmental protection and adaptation to climate change. Through these associations,
408 smallholder drip irrigation thus acquired properties that allowed it to attach itself to a wide
409 coalition of actors, including development agents, researchers, NGO staff and some exemplary
410 farmers. These actors find in smallholder drip irrigation a way to meet their own goals: social
411 entrepreneurs looking for good causes to support; drip irrigation manufacturers looking for new
412 markets; development organisations looking for 'best practices' they can use to convince
413 funders; etc (table 4).

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

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

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433 **Acknowledgements**

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

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438 **Notes**

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

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

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

454 4. The Development Marketplace initiative of the World Bank was set up in 1998 to provide
455 start-up funds to (social) entrepreneurs for them to develop, and bring to scale, their
456 innovative ideas (<https://wbi.worldbank.org/developmentmarketplace/>; accessed March 5,
457 2014)

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

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557 Table 1: Smallholder drip irrigation projects based on the AMG principles in the Sahel region
 558 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

559 Source: Authors interviews and literature review

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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 interesement	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)