NJAS - Wageningen Journal of Life Sciences 57 (2011) 217–224

NJAS - Wageningen Journal of Life Sciences

journal homepage: www.elsevier.com/locate/njas

The System of Rice Intensification: Time for an empirical turn

D. Glover*

Technology and Agrarian Development Group, Wageningen University, P.O. Box 8130, NL-6700 EW Wageningen, The Netherlands

ARTICLE INFO

Article history:
Received 23 July 2010
Received in revised form
16 November 2010
Accepted 16 November 2010
Available online 31 December 2010

Keywords:
System of Rice Intensification
SRI
Practice
Performance
Technography

ABSTRACT

The System of Rice Intensification (SRI) is claimed to be a new, more productive and more sustainable method for cultivating rice. These claims have proved controversial. One dimension of the controversy has centred on the imprecision with which SRI's component practices have been defined. The supporters of SRI suggest that the system has been designed to satisfy the needs of rice itself, implying that it is a set of integrated, mutually reinforcing practices that need to be implemented as a package in order to obtain the best results. However, they also argue that the system should be understood as a suite of flexible principles to be adapted to particular agro-ecological and socio-economic settings – the antithesis of a fixed package. This poses a conceptual and practical challenge for scientific evaluation of SRI methods. However, this apparent difficulty is chiefly an artefact created by conceptualizing agricultural methods as standardized packages. A process of translation is always necessary to convert theoretical models or norms into farming practices. Smallholder farming practices, being intrinsically constrained and contingent, rarely conform precisely to abstract norms. As an alternative, the notion of performance offers a useful way to frame a methodological and analytical approach to understanding what is going on in SRI. Such an approach calls for close technographic observation of farming activities and the interaction between farmers and their fields, plants and tools.

1. Agrarian technological change is social as well as technical

Agricultural scientists often complain that it is difficult to transfer validated scientific knowledge and technologies into farmers' practice. Even if such technologies are adopted, they typically fail to reproduce the same results on farms as in the carefully regulated environments of agricultural research stations. By contrast, new agricultural knowledge and practices that do not have the clear stamp of scientific approval are sometimes taken up and spread enthusiastically among farmers. In at least some cases, significant numbers of farmers have reported remarkable results when using the new methods, even though their claims of success may not have been validated in controlled scientific experiments.

This situation seems paradoxical. Why do robust scientific knowledge and practices sometimes get stuck in the laboratory or on the agricultural research station? On the other hand, why do some farmers seem to have enthusiastically embraced new practices that have not been endorsed by science? One approach to this situation would be to start searching for the obstacles that evidently impede the progress of reliable scientific knowledge from the laboratory into practice, and try to identify the dysfunctions – presumed to be social and institutional – that apparently mislead farmers into taking up practices that supposedly have no real basis in scientific knowledge. Often blamed are incompetent agricultural extension agencies, scientifically illiterate policy makers and anti-science non-governmental organizations (NGOs) – not to mention the misled farmers themselves, who are portrayed implicitly as dupes.

That path typically leads to an unproductive impasse, in which the exasperated scientists – if they pay attention to their real-world impact at all – continue to tear out their hair in frustration, while the farmers and those who advise them continue to do their own thing, perhaps wasting their time, energy and natural resources on inefficient or unproductive agricultural practices. Since the policy diagnosis is communication failure or other institutional breakdown, development policy analysts and practitioners continue to invest fruitless time and energy in search of better channels and mechanisms to communicate good science to farmers.

A technographic approach [1; this issue] offers a useful alternative perspective on this conceptual and practical problem, which is capable of transcending the stalemate by offering a productive way of thinking about processes of agrarian social and technical change. It suggests that the paradox identified above only arises as a problem if one starts with flawed assumptions about the nature of technology and overlooks the diversity and dynamism that characterize the real world of small-scale farmers' practice. If one assumes that technologies or practices consist of more or less clearly defined, standardized and largely static products or packages – which is

* Tel.: +31 317 48 40 18.
E-mail address: dominic.glover@wur.nl (D. Glover)

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doi:10.1016/j.njas.2010.11.006

the conceptual framework within which it becomes meaningful and salient to try and identify discrete instances of technological 'adoption' and 'non-adoption' or 'successes' and 'failures' – one also obscures the experimental, adaptive, improvisational and inventive agency of farmers.

In simple words, technography is the ethnography of technology-in-use. It can be thought of as the study of 'processes of making'. Technography focuses on the uses of tools and the performance of tasks to achieve human purposes, rather than on tools alone. As a research methodology, it imposes a rigorous empirical discipline on the researcher, to observe and record the interactions among people, tools, environments and institutions in order to compile a sufficiently detailed but still parsimonious 'thin description' of how a technological system works. A technographic approach presupposes that any functioning technological system consists of social or institutional components as well as technical ones, which implies that technologies will always vary between different settings in time and space. Technography seeks to examine both the social and technical features in an integrated and even-handed way [1; this issue].

In agriculture, the technographer's focus falls on farmers' practice, which she expects to be complex, dynamic, diverse and strongly shaped by farmers' agency as well as local and temporal contexts. By placing empirical observation of farmers' actual behaviour and activity at the centre of analysis, a technographic approach enables the researcher to assume a descriptive stance rather than a normative one. Instead of condemning any departure from scientifically prescribed best practice as a fault or shortcoming that needs to be explained and corrected, the key goal is to understand and appreciate farmers' reasons for performing farming in particular ways. A technographic approach thus helpfully separates analysis from prescription.

Using the System of Rice Intensification (SRI) to illustrate the argument, this paper will propose technography as a way of thinking about the social and technical dimensions of agrarian technological change in a symmetrical way. Such an approach makes it possible to explore the intriguing hypothesis that social and institutional factors, such as organization, communication, motivation and enthusiasm, might play essential roles alongside technical factors, not merely in driving or impeding the spread of new practices and technologies but actually in producing their (supposedly technical) effects, such as increases in crop yields or productivity.

2. Technological systems are not simply fixed packages

'Technology transfer' is a hoary model for a kind of top-down agricultural development which – in spite of robust populist critiques and alternatives articulated over many years [e.g., 2,3] – still underpins many contemporary development programmes [e.g., 4]. In crude terms, the idea of technology transfer implies that existing farmers' practices, which are often characterized as changeless traditions, are faulty because they lack new technologies. These technologies take the form of standardized, mobile packages that can be introduced from outside (or 'upstream'), which farmers may adopt or not. The process of adoption is assumed to be a fairly neat switching process (though the full transition may take two or three seasons), through which the new packages are expected to permanently and completely replace existing practices, which thereby become outmoded. It is worth restating three reasons why this transfer-of-technology idea is flawed.

2.1. Farmers' practices are dynamic and differentiated

Far from being static or mired in tradition, peasant farmers' practices are dynamic. Not only do small-scale farmers adjust their practices according to the vagaries of each season, they also experiment and adapt in authentically innovative ways [3,5–9]. Small-scale farmers also typically do different things on different parts of their land, differentiating between plots according to their property rights over the land, its quality, its distance from the home, and so on. Within individual farms as well as across regions, planting systems and cultivation practices are shaped by variations in biophysical contexts, which may be highly localized and quite subtle [3,10,11]. Within a small community, household characteristics, socio-economic differences, differences in skill and idiosyncratic preferences will all lead different farmers to make different decisions about how to cultivate their land [12]. In particular, economic and technical constraints may limit the range of practices an individual farmer or household can carry out. Besides, a farmer's goals may change over time, for example if the number of her dependents rises or falls or when market conditions change [9].

2.2. Farmers' evaluative frameworks for new technical practices are multi-dimensional

The assumption that farmers will naturally opt for a new technology merely because it is more productive or considered optimal in agronomic terms is not sound. Farmers' evaluations of new technological options will include not only their technical and economic performance but also the opportunity costs and trade-offs involved as well as any social payoffs, which may qualify the outcome of a purely technical calculation. Small-scale farming is partly a social process, which may limit an individual farmer's freedom to follow an independent path. There may also be tangible benefits of farming in the same manner as one's neighbours, especially if key resources such as labour or irrigation are collectively managed [7,9,13] (this implies that some new practices may be more likely to take root among communities than in isolated individuals). Farmers may prefer traditional crop varieties over 'improved' ones for practical and cultural reasons such as taste, digestibility, storage characteristics or cooking quality [14]. They may prefer to plant well-adapted local varieties that give a dependable if unspectacular yield from season to season rather than a modern variety that has the potential to produce an excellent yield but may fail disastrously if the climatic conditions are not ideal [3,5,15,16]. 'Improved' varieties that have been optimized for the particular growing conditions present on an agricultural research station may not meet farmers' needs for a range of different varieties that can grow well on their own soils or on different portions or pockets of their land [3]. Financial, time or other considerations will condition a farmer's willingness to try new technologies, especially if these involve external inputs that are expensive or difficult to obtain.

2.3. New technologies rarely displace existing technologies in a simple one-for-one exchange

It is often assumed that successful new technologies will simply displace old ones, eliminating the existing ways of doing things by substituting for their functions more effectively or efficiently. In fact, 'old' technologies may well persist alongside new ones for extended periods of time. 'Old' and new practices may continue in parallel, each better adapted to a particular niche. Rather than being pushed out, the demand for established technologies may even be increased by the advent of new ones [17–19]. Innovation, in any case, very typically involves recombination or reconfiguration of existing tools and technologies rather than radical invention. Thus, in so far as 'adoption' occurs at all, it may well be partial and contingent on local conditions; frequently the story is not of adoption but adaptation, during which the technology is transformed into something distinct. Especially when technologies travel from one setting to another, they also change through processes for which 'hybridization' or 'creolization' are better names than 'technology transfer' [17]. On small farms, new practices are often incorporated gradually, experimentally at first, and the process of incorporation may include mistakes and steps 'backward' to tried-and-tested practice as well as 'forward' to the new practice [3,9]. Sometimes the advantages of a new technology package or improved variety may not be sufficiently visible or obvious to enable a farmer to recognize it or give him a compelling reason to adopt it. In such cases, new technologies cannot be expected to smoothly displace older ones unless an external intervention encourages that outcome [7,20,21].

Drawing on these well-established insights, it should be evident that any model of technology 'diffusion', which implies that existing practices are static, new technologies are fixed packages and farmers can be assigned to discrete and mutually exclusive categories of 'adopters' and 'non-adopters' [e.g., 22], will be insufficient to explain processes of technological change in peasant agriculture. Much more appropriate is the analytical concept first proposed by Richards [8,13], who suggested that peasant farming should be thought of as a spatially and temporally situated and contingent 'performance' – a skilful and iterative response to the uncertain and risky situations that poor farmers typically face. Although a farmer may set out with general intentions and even quite specific plans, contingency and uncertainty make it likely that she will have to adjust her course as she goes along [12]. Thus, the planting schemes the farmer arrives at in a given season are better understood as the outcome of this performance than the fulfilment of a detailed plan conceived in advance. So in the context of peasant agriculture, too great a fixation with measuring how closely or loosely a recommended technology package is applied misconstrues the nature of the predicament small farmers are in. The scientific debates surrounding SRI serve to illustrate the pitfalls of such an approach.

3. The System of Rice Intensification represents a categorical problem for science

The System of Rice Intensification (SRI) is depicted as a farming system that overturns the conventional norms of rice cultivation. The system is said to have been developed in the field by a French Jesuit missionary working with peasant farmers in Madagascar during the 1980s and 1990s [23,24]. It comprises a number of distinctive practices concerning the transplanting of seedlings, water management, weed control and soil aeration, together with the use of organic nutrients [23,25]. These methods have been claimed to produce higher yields while consuming less water, without the need to adopt improved rice varieties. It has also been claimed that SRI methods produce more robust rice plants that resist pests and diseases. There are said to be synergies among the component practices of SRI, so that the benefits of the system as a whole are greater than those of the individual parts [23–26]. SRI has been depicted as a sustainable, low external-input production system based on agro-ecological principles, in an explicit contrast with fossil fuel-dependent Green Revolution methods [24,27]. Since SRI involves changed management practices rather than expensive inputs, it is also said to be particularly appropriate for poor, small-scale rice farmers [28]. The system is reported to have spread widely and rapidly to dozens of rice-growing countries.[1] It has garnered support from some heavyweight NGOs, such as Africare, Oxfam and WWF [28] as well as government agencies (e.g., in Vietnam and India) and the World Bank.[2]

Father Henri de Laulanié, the Catholic missionary–agronomist who is credited with inventing SRI, insisted that he had learned how to optimize the conditions rice requires by closely observing the performance of rice plants themselves [29]. This representation, which is echoed by many of SRI's enthusiasts, implies that SRI comprises the precise set of cultivation practices specifically required to satisfy the biophysical needs of the rice plant. In this perspective, SRI represents the exact combination of methods that would inevitably be adopted by any discerning farmer if she were to be guided solely by the demands of rice itself. The argument implies that a singular optimal strategy exists for coaxing the best performance from rice. It appeals to rice itself to provide an irresistible endorsement for SRI.

The claims made on behalf of SRI have provoked a heated row in the pages of international scientific journals [30]. The controversy hinges partly on questions of scientific rigour and measurement accuracy. An important difficulty is that the constituent practices or principles of SRI have been defined in a number of different ways. In this respect, SRI appears to present something of a categorical problem for agricultural science, especially if one thinks of agricultural methods in terms of discrete technical packages. De Laulanié himself asserted that there were only two fundamental principles underlying the system, but he defined these two key components in significantly different ways at different times. On each occasion, he described a number of other practices that should also accompany the two essential features [29,31]. Today, the system is typically said to comprise six basic practices, as in this example by Stoop et al.: '(1) raising seedlings in a carefully managed, garden-like nursery; (2) early transplanting of eight to 15 days old seedlings; (3) single, widely spaced transplants; (4) early and regular weeding; (5) carefully controlled water management; and (6) application of compost to the extent possible.' [23: p. 252].

However, not all of these specific practices are always identified as essential. For example, the use of compost is usually identified as a desirable but optional practice [e.g., 25] – although the importance of organic fertilizer for improving the chemical, physical and biological properties of the soil is also heavily stressed [e.g., 32]. Raising seedlings in a nursery is rarely mentioned as a key practice in its own right, since transplanting is not unique to SRI. Transplanting a single seedling per hill and wider spacing of seedlings are sometimes portrayed as two independent practices [e.g., 33] but sometimes as a single practice – producing a list of just five core practices [e.g., 25]. Mishra et al. [32] proposed a different classification scheme, producing a list of four basic practices, whereas Uphoff [27] boiled the system down to three fundamental principles from which various specific practices may be derived.

Even if a concise list of two or three underlying 'principles' or five or six specific 'practices' is agreed – the distinction between principles and practices in these accounts is debatable – a good deal remains to be said. Associated practices and refinements that are often mentioned include careful handling and quick transplanting of seedlings, in order to avoid causing trauma to the young plants, and the use of mechanical rotary weeders to control weeds while also aerating the soil [e.g., 23]. However, hand weeding is also recognized as SRI practice in many cases. Planting seedlings in systematic patterns, which may be rows or grids ('square' or 'rectangular' planting), is also often mentioned, although this is only really necessary if mechanical weeders are to be used. Stoop et al.'s [23] reference to 'carefully controlled water management' also needs to be elaborated, but although most accounts agree on the absence of continuous flooding (a feature that clearly distinguishes SRI from conventional practice in many parts of the world), in specific instances this may entail regular (though sparing) irrigation or alternate wetting and drying (AWD) of the soil [e.g., 25].

The imprecision reflected in these definitions of SRI has provided fertile ground for critics to attack the system. They have

[1] See http://sri.ciifad.cornell.edu/countries/index.html (accessed 10.12.2010).

[2] See http://info.worldbank.org/etools/docs/library/245848/index.html (accessed 1.11.2010).

complained about the field-oriented empiricism of some SRI studies, few of which have observed formal scientific protocols or been published in peer reviewed journals. For instance, Dobermann [34] pointed out that few SRI evaluation studies had involved rigorously controlled experiments with respect to the application of compost. This could be important, the critics argue, because improving soils by adding compost is a rather conventional good agronomic practice that might by itself explain significant improvements in rice yields, compared with existing farmer practice [e.g., 35].

SRI's critics are particularly keen to point out that some of the case studies cited as successful examples of SRI have involved only a loose implementation of the system or a subset of the supposed core practices, yet still reported dramatic improvements in yield [e.g., 36]. For their part, SRI advocates argue that the system should be regarded as a suite of flexible principles to be adapted to local conditions rather than a fixed technology package [e.g., 23,33]. Therefore, they say, one should expect to encounter partial implementations of the full suite of ideal SRI practices, depending on local agronomic or institutional opportunities and constraints. Despite such variations, they argue, the farmers concerned could still be said to be applying the principles of SRI and could be expected to derive some benefits from adopting individual SRI practices, even though they might be missing out on the full scope of the postulated synergies between them.

However, when defending SRI against its critics, the system's supporters often resort to language that strongly implies that SRI does represent a specific 'package' or 'technology' that consists of certain 'recommended practices' and 'essential elements' [e.g., 37,38]. For example, Stoop and Kassam [37], defending SRI, strongly criticized an experiment conducted by the sceptical Sheehy et al. [39] because the SRI treatment used in the experiment deviated from SRI recommendations. Unless agronomic experiments faithfully replicate all of the recommended SRI treatments, the supporters argue, the results cannot be taken as a proper evaluation of the system's full potential [38]. Nevertheless, studies undertaken by researchers who are sympathetic to SRI have also sought to evaluate the effect of adopting discrete components of the system, singly and in combination – a step that would seem to be vital if the postulated synergies between different SRI practices are to be investigated [e.g., 26]. The critics accuse SRI advocates of adopting loose and ambiguous definitions when it suits their argument [e.g., 36]. However, in their own defence of orthodox 'best management practices' (BMPs) against the accusation that these suit only well-endowed farmers in favourable locations and are too rigid or too expensive to be applied in less-favoured areas, the critics also point out that recommended BMPs vary from place to place, taking local conditions into account [e.g., 40].

De Laulanié himself could be quite dogmatic about the practices that should be considered incompatible with SRI, writing for instance that "If there are . . . two seedlings transplanted together, it is no longer SRI" [31, p. 3], but he apparently vacillated over this very point. In a draft technical note, in which he stressed the importance of planting just one seedling at a time, he added: 'as a concession to the official doctrine I will add between parentheses "two [seedlings] at the most"' – but later he deleted this compromise with the conventional wisdom, probably because it seems to conflict directly with his thinking on the wider spacing of seedlings [29: p. 17]. De Laulanié also insisted that SRI was a system for irrigated rice farming and seemed to doubt whether it might be successfully adapted for rainfed systems [31]. Nonetheless, there are self-identified SRI practitioners today who seek to apply the system's principles in non-irrigated rice.

In short, both sides in the SRI debate display some degree of anxiety over the need to clearly identify the technical practices (or underlying principles) that define SRI and distinguish or exclude those that are incompatible with it. In this and other respects, there is a curious symmetry between the arguments of protagonists on either side of the argument. As they attempt to draw clear distinctions between two alternative approaches to rice science and rice cultivation, the two sides can be seen to be engaged in a kind of 'boundary work' [41]. Both sides appeal to science, or Nature, to endorse their claim to have identified the ideal management practices for rice. The polarizing dynamic of the controversy itself further reinforces the idea that SRI and BMPs are two discrete, mutually exclusive and competing systems of rice cultivation (alongside a third, implicit category of unimproved 'traditional' or 'conventional' farmer practices). But both sides struggle equally to resolve the inherent tension between the notion of a standardized package of practices on the one hand – a universal package determined by scientific analysis of the biophysical needs and potential of rice – and the knowledge that agricultural practices necessarily have to be locally adapted on the other. Indeed, the translation of validated scientific knowledge into workable practices at field level is a general and long-standing challenge for agronomic science [42; this issue].

Practically speaking, a clear definition of what SRI consists of would appear to be vital if the specific biophysical mechanisms said to underlie the system are to be tested experimentally, particularly if we want to examine whether the posited synergies are at work among the constituent practices [26,32]. Similarly, agreeing on a technical definition would also be important if one were determined to go looking for 'adopters' of SRI. One would have to decide which are the essential practices that make an SRI farmer, and/or how many of the component practices an individual has to adopt before one can label her an SRI farmer. Indeed, ongoing disputes over how SRI should be defined are probably one reason why it is currently far from clear how many farmers are actually practising what its advocates or opponents would recognize as its core components. However, focusing too narrowly on the technical practices involved in (or excluded from) SRI poses the risk of obscuring the important human and social dimensions of whatever may be going on in this seemingly distinct cultivation system. A resolution of the scientific dispute would not necessarily help us to understand why SRI seems to have attracted so much attention from farmers and NGOs. This is not to say that the technical practices are unimportant. On the contrary, a technographic approach brings farmers' practices and the agro-ecological contexts in which they are performed into sharp focus. Nonetheless, a focus on farmers' practices does tend to dissolve the categorical simplicity that a purely technical definition imposes on rice farming systems that are intrinsically diverse, dynamic and contingent.

4. In practice, SRI 'adopters' and 'non-adopters' are hard to identify

If SRI is regarded as a distinct and integrated technical system of linked practices, it makes sense to look for mutually exclusive categories of 'adopters' and 'non-adopters'. When one starts searching for such farmers, however, the categorical clarity of both BMPs and SRI seems increasingly contrived and the boundary between them begins to dissolve. The system's general principles can accommodate a range of specific practices, as discussed in the previous section. Field observations and discussions with farmers and other stakeholders very quickly confirm that the label 'SRI' encompasses a range of different implementations that depend heavily on the contingencies of farmers' attitudes, household capacities, socio-economic contexts and local institutional factors, as well as agro-ecological constraints.

Watching farming operations, observing rice fields and talking to farmers, one quickly learns how locally and temporally varied cultivation practices can be. For instance, during a recent field visit to Indrapur district in eastern Nepal, I met a farmer who was considered to be 'an SRI farmer' and apparently acknowledged that label himself. I knew that the field where we stood had been used at the beginning of the growing season as the location for a training and demonstration exercise on SRI transplanting methods. The rice harvest having been completed not long before, the stubble of harvested rice plants was now clearly visible, spread out across the field like the bristles of a worn-out scrubbing brush. Where we stood near the field edge, the fat clumps were widely spaced and arranged in a neat square pattern – a textbook example of SRI planting. Within a short distance, however, the neat lines had become wavy and the clumps much closer together. A few metres away there was no longer any clear sign that an SRI planting technique had been used. Was this still an 'SRI field'? Would it be correct to label this farmer an 'SRI farmer'?

I was curious to know what set of circumstances or chain of events could have produced the peculiar planting pattern that was visible in this field. Perhaps the labourers hired to carry out the transplanting had faltered once the demonstrators and supervisors had turned their attention elsewhere. Perhaps they had found the new precision transplanting method and its tiny, delicate seedlings too fiddly and difficult. Or perhaps it had simply been getting late that day when the training took place, and everyone had agreed it was important to finish planting the seedlings before dark, without worrying too much about applying the newly learned techniques. Through my companion – who was known to the farmer as an extension officer and SRI trainer – I asked the farmer if he could shed some light. However, he seemed embarrassed, as if he was reluctant to discuss this evidence of his failure to comply with SRI norms.

Evidently, we were not likely to find the explanation by asking sensitive questions so long after the event. Technographic observation, applied at the time of transplanting, could have offered real insights. Equipped with camera, video recorder and notebook, and observing the transplanting operation from beginning to end, the technographer could have gained valuable insights into the specific steps through which SRI was translated from a concept into a specific performance. For example, close observation, taking key measurements (e.g., of time, stooping frequency, age of seedlings, depth of transplanting), and recording the discussions taking place among labourers, farmers and trainers, could have helped to identify the specific (mis)understandings, obstacles and habits that led the transplanting to be done in a particular way. Some of these factors might be highly idiosyncratic and locally contingent; other ones might be observed more commonly across sites. In either case, useful insights could be gained into how and why SRI may come to be implemented in particular ways in different contexts, and how these implementations may differ from one another.

A short walk further on, my companion and I met another 'SRI farmer'. Her fields, also recently harvested, were choked with weeds. There was no evidence of careful weed management or soil aeration here. The farmer had good reason to neglect these activities: as the sole breadwinner in a household with school-age children, she was too busy to keep on top of weeding operations herself and she lacked the money to pay for hired help. If and when she had time and money to do so, she tried to tackle the weed problem using a selective herbicide. Did her use of herbicides – instead of a mechanical weeder – make her a 'conventional' farmer? Or was her planting technique enough to make her an 'SRI farmer'?

Again, asking retrospective questions might not be the most powerful technique for learning how and why this farmer's performance had produced fields in the condition I observed at the end of the season. To fully understand why she had prioritized tasks other than weeding and how weeds had flourished in her fields, technographic observations could have been used to reveal which tasks she and her family members had performed in the fields, in the home and elsewhere during the season; to measure and compare the relative demands in time, money and physical effort demanded by different methods of weed control; and to monitor the weather, the emergence of weeds and the growth and condition of the rice crop, week by week. With such data, a technographer would be in a position to describe and analyse the specific confluence of factors and events that had led to this particular variation in the concrete form of SRI.

A few kilometres away, farmers in Jhorahat district had been having a more difficult time during the rice season. Their rice crop was mostly still standing in the fields, although the harvest was underway. The crop was later here than in Indrapur primarily because the rains had been late at planting time. As a result, very few of the local farmers were applying SRI principles. The late rains had meant that they had been unable to transplant their young seedlings in suitably 'puddled' fields. Still, we met several people who identified themselves as 'SRI farmers'. They thought the system was a good one, having been satisfied with its performance the previous season. If all went well, they intended to apply SRI methods the following season. In the meantime they had coped well with the late rains by double transplanting some of their rice seedlings. By transplanting young seedlings in clumps of 10–12 plants and a short while later re-transplanting them in clumps of 4–5 seedlings per hill, they felt they had obtained a satisfactory harvest. But double transplanting could be said to infringe, or at least significantly modify, two of the key principles of SRI, namely avoiding the trauma involved in transplanting older rice plants and planting single seedlings. Should these farmers still be termed 'SRI adopters'?

The dilemma as posed above implicitly frames SRI as a norm and double transplanting as a deviation. A technographic perspective suggests that it would be more meaningful to pose a new question in a more open-ended way. One is more likely to grasp the process through which formal principles are translated into practice by appreciating the farmers' performance in a more dispassionate manner. A foundational question would be to ask exactly how, how much and in what respects the double transplanting method used by these farmers differed, in fact, from what they had done the previous season, or from 'conventional' rice cultivation methods, the practices of neighbouring 'non-SRI farmers,' the formal prescriptions of SRI trainers or the farmers' own perceptions of SRI. In this way, a technographic approach could shed light on the extent to which SRI is actually evident in real practice. Direct observations of farmers' practice and key measurements taken in rice fields could reveal whether and to what degree differences in rice cultivation methods are actually discernible in the landscape. Correlations among agro-ecological and socio-economic characteristics, farmers' own classifications of 'SRI farmers' and 'non-SRI farmers,' and observed farming practices could reveal whether clear patterns exist in the distribution or frequency of such different methods. If so, it might be possible to draw up a typology of distinct rice farming methods, distinguished by different combinations of agro-ecological, socio-economic and institutional characteristics. Would any of these correspond to a formal definition of SRI? If yes, it would be particularly fascinating to examine how closely this category would coincide with that of the individuals and households identifying themselves as 'SRI adopters.'

Alternatively, observations might point to a more random scattering or continuous range in farming practices; or they might reveal that a considerable range of variation often occurs in individual farmers' practice from one season to the next (even if such changes might occur in patterned ways across a community of farmers). Such findings would indicate that clearly distinct or very stable types or classes of rice farming may not exist in real practice. Richards' [8,13] concept of smallholder farming as a spatially and temporally shaped performance invites us to consider that possibility seriously. Technographic 'thin descriptions' [1; this issue] of farmers' activities during the course of a season or year might be among the most effective tools available for uncovering and understanding how specific sequences of situated and contingent steps, mistakes, corrections and improvisations could result in a set of unique observations that resist typology. As Almekinders [11; this issue] describes in her analysis of participatory bean breeding in Nicaragua, the explanation could be that micro-climatic or topographical variations may lead individual farmers to make highly personal or local choices. Similarly, it might be that agro-ecological factors – like the late rains experienced by farmers in Jhorahat during the season I visited – might play at least as powerful a role as farmer's knowledge or intentions in determining what specific practices end up being applied (or performed) in a given season.

A final example. After spending some time in Nepal's Terai region, my companion and I travelled into the hills near Dhankuta, where we met some more 'SRI farmers'. However, these upland rice farmers were following practices that differed from those applied by farmers in Indrapur and Jhorahat. The leading farmer in a women's self-help group had received training in SRI as it was practised in the plain. Returning home, she and her neighbours quickly realized that some of the SRI principles would have to be modified to suit the small terraces and steep hillsides where they grew their rice. Abandoning the idea of trying to plant their seedlings in straight lines or a grid pattern, their rows followed the contours of the hillside. The distance between the rows, which was generally a little wider than on conventional rice terraces but judged by eye rather than precisely measured, fluctuated gently in harmony with the tapering shapes of the terraces. These farmers also used little compost on their fields. Hiking up and down the steep paths that ran between the rice terraces, I was impressed by the physical exertion that would be involved in delivering loads of compost (or inorganic fertilizer) to the fields.

Technographic observation could help a researcher to understand the specific learning and adaptation process that led to the translation of orthodox 'lowland SRI' methods into a system that could be practical for these farmers, cultivating their rice on small hillside terraces. Evidently, the trained farmer's instruction was not the sole factor that determined the particular suite of modified practices that ended up being applied. Confronted with the practical realities of their upland rice system, she and her neighbours had to work out for themselves what kinds of adjustments they would make. To understand the learning processes going on, a technographer could use close empirical observation of the farmers' efforts to grapple with the SRI planting system, both in their practice and in their discussion. Such a method could help to clarify the general degree to which SRI methods are determined, in specific instances, by the biophysical needs of rice on the one hand and by the farmers' and labourers' capacities in time, energy and ingenuity on the other.

5. Discussion

From the observations and testimonies presented above, it should be apparent how important it is not to make firm assumptions in advance about the likely existence of distinct and separate groups of 'SRI farmers' and 'non-SRI farmers'. The point of describing these examples is to bring into sharper focus the process by which a formal system of agricultural knowledge is translated from a standard recipe into a set of practical methods that can be applied on diverse farms [42; this issue]. In this respect, SRI is not categorically different from the officially recommended BMPs for rice. Both systems undergo conversion when they are put into practice by farmers. Moreover, real rice farmers evidently compile their farming strategies from the range of options available to them, which may include a mixture of familiar and newly learned methods. During a recent visit to Madagascar, for example, I met numerous 'SRI farmers' who were notably undogmatic about their SRI practice. They showed no hesitation or embarrassment in explaining that they applied SRI to the extent possible on some of their rice plots but used alternative methods on other fields. Their reasons for opting for one method or another included both the nature of the plot – SRI seemed to be preferred on level and irrigated land in valley bottoms – and the constraints on their time and money.

Evidently, SRI methods, once encountered, may be regarded pragmatically by farmers as just one additional resource on which to draw. This implies that their approach to farming is indeed akin to Richards' notion of a performance, situated in a particular place and time, in which the farmer draws on a repertoire of skills and a library of knowledge and experience in order to balance priorities, trade off risks and hedge against uncertainty [8,13]. A technographic methodology to investigate SRI as a 'process of making' [1; this issue] may therefore be highly appropriate.

A technographic approach could enable researchers to problematize SRI in a fresh, more disengaged way. A focus on farmers' actual practices enforces a healthy agnosticism on the technographer. Instead of starting with a theoretical model or norm (a 'package of practices') and measuring the extent to which a farmer's activities conform to or deviate from it, she sets out empirically to discover and appreciate the motivations, opportunities and constraints that shape the farmer's agricultural performance. Empirical observation and thin description would be the initial set of tools, though this does not mean that the appropriate set of methodologies would be purely ethnographic or purely qualitative. An integrated analysis of both the social and technical components of an agricultural system inevitably requires various suitable disciplinary approaches or research styles to be combined [1; this issue; 43; 44; this issue]. Soil samples, temperatures, water consumption and crop yields could be important data, depending on the specific questions being asked, alongside observations of farmers and labourers interacting with seeds, plants, soils and tools.

In particular, it is important to note that this empirical stance in relation to farmer's practice is not being portrayed as a way of resolving the remaining uncertainties surrounding the technical efficacy of SRI methods. Agronomically speaking, it may still be reasonable to argue that one or another package of practices is technically optimal for a particular parcel of land, although such prescriptions should certainly be tempered by recognition that perfection is highly unlikely in the context of peasant farming. Scientific research is certainly needed to understand why such dramatic yield and productivity advantages have been claimed for SRI and to explore the underlying biophysical mechanisms that might be at work [23,32]. However, answering these questions will not necessarily help development agencies and policy makers to understand what SRI is and why it may be spreading.

Equally, though this paper raises questions about whether a distinct agricultural system resembling SRI can be seen in practice, this should not be interpreted as questioning whether SRI exists. Instead, the aim is to suggest that we can learn more about what kind of phenomenon SRI is, and how it works, by beginning with a set of rather open questions about what happens when SRI *as a system of knowledge* flows into rice farming *as a system of practice*. Poor rice farmers have to adapt their practices to suit their constrained circumstances. Few have complete freedom to farm precisely according to a prescribed system of recommended practices, whether it be BMPs or SRI. Nevertheless, the fact that farmers within a few kilometres of one another can be found to follow different methods does not necessarily preclude the possibility that they may still be said to be practising variants of a common system. A lot depends on how the system is conceived – as a strict blueprint to be followed precisely or a looser portfolio of improved practices that leaves a lot to the farmer's capabilities, preferences and priorities.

A variety of useful research hypotheses can be suggested. For example, farmers who have been exposed to SRI may adopt only some of the system's core components at a given time. They may experiment with SRI on part of their land to begin with and perhaps continue to implement SRI practices on only some of their fields in the following seasons. Perhaps they might choose to apply SRI practices on their best fields, land that they own, irrigated plots or plots close to the homestead, rather than on poorer soils, rainfed land, fields that they cannot visit so often, or rented plots. In any given season, economic constraints, illness or the vagaries of the weather may make it difficult for individual farmers or households to carry out some or all of the recommended practices, even if they wish to do so. The socio-technical and institutional setting may be crucial; for example, a farmer's ability to transplant seedlings of the recommended age may depend on the way labour is organized in her village. Similarly, a farmer who relies on canal or tank irrigation is unlikely to be able to apply SRI irrigation methods unless his neighbours co-operate; a farmer with a bore well is likely to have more freedom in that respect. These kinds of community-level and institutional arrangements – linked to agro-ecological and technical factors – would be especially important if one wanted to explore the possibility that part of SRI's appeal for some farmers might lie in social payoffs, such as a greater sense of involvement in the community, rather than technical payoffs alone, such as improved yield or higher profits. Furthermore, what if the methods and channels through which SRI is being promoted are the key factors driving its spread, rather than its technical effectiveness alone? Is it possible that social factors like mutual support, better knowledge sharing and farmer enthusiasm are key mechanisms helping to improve rice cultivation practices, and so contributing indirectly to obtaining higher yields or greater productivity? These kinds of effects might legitimately be attributed to the phenomenon of SRI, if it is properly construed in a broad socio-technical perspective and not just as a list of cultivation practices. A narrow technical focus is likely to miss these possibilities.

6. Conclusions

Although the technical aspects of SRI have been contested, it clearly exists as a real social phenomenon. Could it have features that make it superior to conventional or best management practices, at least for some types of farmers in some kinds of circumstances? So far, academic efforts to grapple with SRI have been dominated by agronomic studies and theoretical analyses published in scientific (rather than social science) journals. The debate has generated a good deal of heat but perhaps less light. From a technographic point of view, the scientific controversy surrounding SRI comes to appear as an artefact of a dualistic worldview that detaches science from practice, in which science construes systems and categories within farming practices that, in reality and for good reasons, are fluid, diverse and contingent. A technographic approach offers a useful alternative way of exploring what is going on in SRI because it is a method that focuses on human activity while also adopting a realist perspective that takes the materiality of tools, plants and biophysical processes seriously. Recognizing that technology has intrinsic social and institutional dimensions, the technographer goes into the field without rigid preconceptions about the technical components of farming systems or trying to identify adopters and non-adopters of fixed technological packages. Instead, she observes the spatially and temporally situated performance of farmers in order to understand how farming is carried out in practice and how it may be changing under the influence of new ideas or information.

Investigating how SRI works as an institutionally and historically embedded socio-technical phenomenon represents a powerful complement to controlled technical experiments, designed to evaluate the agronomic performance of a fixed package of technical practices that can only partially replicate how rice farming is performed in the real world. With its focus on practices embedded within social institutions and networks, a technographic perspective recognizes that it is a specific combination of social, technical and institutional components that makes SRI a distinctive phenomenon, which could amount to a coherent, functional and perhaps advantageous system for rice cultivation – at least for some farmers under some types of circumstances. The challenge should be to understand whether, and if so why, how, and for whom, that might be the case.

Acknowledgements

I thank Paul Richards for continually opening my eyes to new ways of thinking about knowledge, practice and society. I also wish to thank the farmers I met in Indrapur, Jhorahat and Dhankuta for welcoming me and answering my questions, and Kees Jansen, Conny Almekinders, Harro Maat, Sietze Vellema, Edwin Nuijten and Todd Crane and two anonymous reviewers for helping me to develop the ideas contained in this paper.

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