Revisiting the Confounding Adoption Dynamics of the System of Rice Intensification (SRI) in Madagascar

Msc Thesis in International Development Studies (DEC-80433)

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Abstract

The System of Rice Intensification (SRI) has courted controversy as an alternative to traditional rice cultivation methods ever since its development in Madagascar in the 1980s. It is claimed by some proponents to drastically increase yields, but such claims have been met with doubt by critics. As this debate has continued, however, SRI has continued to expand throughout the world as the result of investment and extension efforts of governments, NGOs, and other organizations. Nonetheless, very few studies have actually been conducted on the extent to which farmers adopt the method after initial extension efforts. The purpose of the research effort outlined in this paper is therefore to follow up on one such adoption study conducted in Madagascar in 2000 in order to better determine how the practice of individual SRI components has evolved over time but also what factors may influence farmer adoption of these techniques. Specific attention is paid towards evaluating what influence access to information, particularly social learning, and plot-level conditions, such as soil quality, may play in SRI component adoption dynamics. Access to information is found to be potentially influential while the significance of plot-level conditions is rather more limited. At the same time, access to credit or cash appears to be significant across all components. Although additional research is warranted into overall SRI adoption dynamics, such findings can help to shape future SRI extension efforts in Madagascar.

Keywords: SRI, technology adoption, rice cultivation, social learning, Madagascar

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Acronyms

ATS	Association Tefy Saina
CIIFAD	Cornell International Institute for Food, Agriculture, and Development
FOFIFA	Le Centre National de Recherche Appliquée au Développement Rural
GSRI	Groupement SRI
LEIT	low external input technology
NGO	non-governmental organization
SRI	the System of Rice Intensification
USAID	United States Agency for International Development

1. Introduction

The System of Rice Intensification (SRI) is a rice cultivation method originally developed by Father Henrie de Laulanié, a French priest, in Madagascar during the early 1980s. It has come to be associated with various components but principally the transplanting of young seedlings one at a time and in a squared pattern, wide spacing between plants, and alternate wetting and drying of plots (de Laulanié, 1992). The employment of such techniques is said by proponents of SRI to lead to significantly higher yields in comparison to other methods. However, given that clear and convincing field-level proof of this is hard to come by, many rice scientists remain skeptical of SRI and there is certainly a need for additional research into the true yield potential of SRI versus other methods (Stoop et al. 2009; Berkhout and Glover 2011).

Despite this debate, however, SRI has reportedly spread from Madagascar to almost 50 countries around the world. This spread has taken place with the support of major developmental organizations, NGOs, and governments across Africa, Asia, and South America. Particularly notable investments in SRI-based agricultural development programs have been made in India and Indonesia but there has also been significant interest in SRI in major rice-producing countries such as China, the Philippines, and Vietnam (Berkhout and Glover, 2011).

Notwithstanding the spread of SRI around the world, there have been strikingly few studies conducted on adoption patterns associated with the technique. These studies have taken place in a limited number of countries and have been fairly small in scope (Anthofer, 2004; Namara et al., 2004; Noltze et al., 2012; Sita Devi et al., 2009). Therefore, there remains much to be learned about the dynamics of SRI adoption.

With this being the case, the purpose of this research effort is to follow-up on one of the more notable efforts, conducted in Madagascar by Christine Moser and Chris Barrett of Cornell University in 2000, in order to gain an understanding of longer-term SRI adoption dynamics in Madagascar. In doing so, the aims are to address the following principal questions:

- How has farmer practice of individual SRI components evolved over time?

- What are key factors that influence farmer practice of individual SRI components?
- How is farmer practice of individual SRI component influenced by access to information with specific attention to extension presence and social learning?
- How influential are plot-specific conditions within the context of farmer practice of individual SRI components?

The focus of the research, therefore, is on the factors that determine the adoption of individual components of SRI rather than the package as a whole. This approach is taken given the fact that in many cases not all parts of the package are adopted. Therefore, there is difficulty in defining and identifying an "adopter" of SRI. For instance, how do we label a farmer who chooses to practice several of the components but decides not to adopt the total package due to household or plot-specific circumstances? There is no real consensus as to how to answer that question, especially since SRI is widely seen not as a set of rigid guidelines but rather as a system of agronomic principles that can be adapted to one's particular environment (Stoop et al, 2002; Glover, 2011). Having stated that, in identifying factors that appear to be significant in the adoption of multiple components, we can certainly draw important conclusions about SRI adoption dynamics on the whole.

In taking this approach and seeking to address the above questions, this research effort can help to fill several knowledge gaps with respect to SRI adoption. First of all, there are no other known studies that have looked at longer-term SRI adoption dynamics. With this research effort, it is possible to combine data from 2012 with that from Moser and Barrett's data from 2000 to gain greater insight into what type of changes in farmer practice may occur over time. Secondly, no other known studies have examined the factors underlying individual SRI component adoption. Therefore, there is no detailed body of knowledge that explains why farmers choose to practice certain components and not others. Thirdly, few studies have examined the part that plot-level characteristics- such as soil quality and distance of plots from a farmer's home- may play in the adoption story. In providing these additional insights, this research effort can perhaps ultimately help to better shape future SRI extension efforts.

Towards that purpose, Chapter 2 proceeds to detail insights from relevant previous literature and how this research effort addresses the limitations of previous studies. Chapter 3 then continues with the methodology underlying the research while Chapter 4 covers the analysis of the data and results. Finally, Chapter 5 concludes the report in detailing the ultimate relevance and policy implications of the insights gleaned from the research.

2. Literature Review

2.1. Theoretical Perspective

In theory, superior agricultural technologies- amongst which SRI is purported to be- are expected to have considerable poverty-alleviating effects in developing countries as smallholders increase their yields and subsequently their incomes. However, in reality, the adoption of such technologies is not automatic and therefore the potential benefits associated are either delayed, quite reduced, or nonexistent depending on the extent to which the technology is adopted. Given the poverty-related implications, gaining a greater understanding into the dynamics involved with technological adoption in developing countries represents a major goal within Development Economics (Feder et al., 1985; Feder and Umani, 1993).

Before beginning a theoretical discussion, however, it is necessary to define what we mean by adoption. Whereas Rogers (2003) defines it simply as "a decision to make full use of an innovation", Feder et al. (1985) insist on a more economically rigorous definition. At the individual level, they define adoption as "the degree of use of a new technology in long-run equilibrium when the farmer has full information about the new technology and its potential." This definition reflects the assumption that the introduction of a new technology leads to a period of disequilibrium during which learning and experimenting drive the farmer to new levels of equilibrium (Feder et al., 1985).

Rogers (2003) separates adopters into five categories according to the rate at which they adopt: innovators, early adopters, early majority, late majority, and laggards. Innovators are, of course, those that bring about new ideas and systems. Early adopters are the most proactive parties in adopting these new ideas and tend to hold leadership roles within their societies. They play an important role in supporting the innovation from its initiation, and their early adoption paves the way for more widespread adoption within their communities. The early majority represents a third of the society not in leadership roles but who have well-developed networks within their communities. They adopt somewhat later than early adopters but ahead of most of their peers. The late majority represents a third of the society that is more reluctant and skeptical about the innovation. They are more likely to depend on the feedback of their peers. Finally, there are the laggards, who are the most skeptical members of the society and most steeped in local traditions. They also tend to have the fewest resources and be the most risk-averse (Rogers, 2003). Therefore, for Rogers, social learning in terms of

feedback and sharing of experiences with a technology clearly plays a large part in the adoption story. It is the flow of information from the early adopters that facilitates greater overall adoption.

Typical constraints to the timely adoption of agricultural technologies include lack of credit and information, aversion to risk, and inadequate supply of necessary inputs such as seeds, water and chemicals. These are, of course, issues that tend to affect poorer farmers, who are thus more likely to be laggards. Wealthier farmers, more likely to be early adopters, tend to be more concerned with issues relating to increased labor demands of a technology and related opportunity costs (Feder et al., 1985).

In giving these categories it must be mentioned, however, that Rogers's approach has been criticized as overly simplistic in that it does not account, for instance, for possible social and structural implications of innovations. According to this criticism, it must be recognized that technology adoption is not a one-dimensional process whereby a particular technology is developed and an individual chooses to adopt or not based on aversion to risk and feedback from others in society. Rather, it is a more complex process whereby a particular innovation may necessarily lead to changes in societal rules and relationships between different parties. In such a situation, there are many more stakeholders that are involved in the adoption process and therefore adoption should not be seen so much from an individual standpoint (Leeuwis and Aarts, 2011).

2.2. Empirical Perspective

Moving away from theory, it is worthwhile to look at the empirical challenges faced in technology adoption studies. A primary difficulty faced within these studies is defining what exactly constitutes adoption of a particular technology. This is especially the case when the technology is a system of techniques, such as SRI, that can be completely or partially adopted. In many studies, adoption is viewed as a discrete choice, with a household choosing either to adopt or not. As such, binary choice models such as Probit or Logit are often used, with the decision to adopt or not regressed upon a range of explanatory variables (Doss, 2006; Noltze et al., 2012). In many cases, though, a technology can be applied by a farmer over a certain area of his or her land but not the totality. In such instances, some studies look at the intensity of adoption, that is the total area over which a technology is practiced (Leathers and Small, 1991; Smale et al, 1995; Noltze et al. 2012). In such cases, continuous models are often used (Just and Zilberman, 1983; Sall et al., 2000; Moser and Barrett, 2006; Noltze et al., 2012).

Beyond the model that is chosen, though, the choice of explanatory variables is another area that requires care and attention. This is because endogeneity is an ever-present issue that is often difficult to overcome within technology adoption studies. Furthermore, it is often difficult to find adequate proxies for important factors- such as access to cash, credit, information, and labor- that may help to explain adoption dynamics (Doss, 2006).

Measuring access to credit or cash is particularly important as some technologies require initial outlays of funds to pay for additional labor, seeds, or other inputs. Thus, a lack of available funds can be a serious impediment to adoption. With that being the case, many studies add a variable that is intended to proxy access to credit (Doss, 2006). However, given the difficulty in devising a variable that directly and accurately measures a household's access to credit, some studies simply ask whether the household borrowed money during the course of the year (Boahene et al., 1999; Negatu and Parikh, 1999; Doss, 2006). This is a rather imperfect measure given that it does not distinguish between those who have no access to credit and those who do have access to credit but choose not to borrow. A range of alternate measures are often used, including total landholdings, which can be a prerequisite for obtaining credit. Similarly, it can be a challenge to directly measure income, which, in any case, can be considered as an endogenous variable. Therefore, information is often solicited about the source of a farmer's income (Doss, 2006). For instance, Moser and Barrett (2006) included in their analysis a dummy variable indicating whether the household had a stable income source throughout the year.

Access to information is another important factor that must be taken into account given that farmers need to be sufficiently informed of the specific techniques associated with a technology as well as the potential advantages and disadvantages. For this reason, many studies include variables measuring the presence of extension services, which are primary sources of such information. Some studies have looked at the number of visits paid to a household by extension services (Boahene et al., 1999; Herath and Takeya, 2003; Ouma et al., 2002) while others have looked at whether the farmer has received any visits within a certain period of time (Doss, 2006; Ransom et al., 2003)

At the same time, social learning, that is to say learning from one's neighbors, is another potentially important source of information. Several prominent studies have indeed confirmed the impact of social learning in technology adoption. Conley and Udry (2010) found that pineapple cultivators in Ghana were more likely to increase their level of fertilizer use if someone within their information network had

positive results with a higher quantity of fertilizer. This held true especially for less experienced farmers. Similarly, Bandiera and Rasul (2006) found in Northern Mozambique that farmer decisions as to whether or not to adopt sunflower as a new crop correlated within networks of family and friends. This was the case mostly with respect to disadvantaged farmers rather than advantaged farmers. Similar conclusions are presented in Foster and Rozenwieg (1995) and Munshi (2004).

Yet, devising variables that measure social learning can be tricky given the dangers of endogeneity. One potential issue is that an omitted unobserved variable rather than actual learning is responsible for a farmer choosing to adopt a technology after his or her neighbor has already done so (Bandiera and Rasul, 2006; Conley and Udry, 2010). Reverse causality could be another issue if farmers choose to form networks with other adopters of a technology after having already adopted themselves (Bandiera and Rasul, 2006). Overcoming such issues requires a rich data set that can specifically delineate an individual's network and the nature of the relations within that network (Conley and Udry, 2010). At the same time, it is important to be able to control for factors within a village- such as traditional institutions, market access, and soil quality- that can drive farmers to make similar adoption choices (Bandiera and Rasul, 2006).

Apart from cash, credit, and information, though, access to labor can be another influential factor within an adoption study. This is because certain technologies, such as SRI, may require relatively more labor. Therefore, those households that lack a sufficient level of household labor and that are unable to hire outside labor may be unable to adopt such technologies. As such, many studies include household size or adult household members as proxies for household labor availability. Some studies (e.g. Ouma et al., 2002) also include a dummy variable denoting whether hired labor was used on the farm. However, such a variable can be endogenous to the decision of which technologies to use. With this being the case, accurately measuring just how well labor markets in a particular location function and connecting such a variable to the adoption decision represents another challenge within adoption studies (Doss, 2006).

2.3. SRI Adoption Studies

Having established the theoretical and empirical underpinnings of this study, it is worthwhile to survey previous SRI adoption studies in order to review what is already known about SRI adoption dynamics. As outlined in Table 1, there have only been a handful of notable studies completed in countries such as

Madagascar, East Timor, India, Sri Lanka and Cambodia. These were mostly small-scale efforts done in a limited number of locations.

Table 1: SRI Adoption Studies

Study	Locations	Number of Farmers Surveyed
Moser and Barrett, 2003, 2006	Four villages and one rural commune in Madagascar	317
Namara et al., 2004	Two districts in Sri Lanka	120
Anthofer, 2004	Five provinces in Cambodia	500
Sita Devi and Ponnarasi, 2009	One district in Tamil Nadu, India	100
Palanisami, unpublished	10 districts in Tamil Nadu, India	600
Noltze et al., 2012	2 districts in East Timor	397

Source: partially taken from Berkhout and Glover (2011)

Some clear themes emerge from these efforts. For instance, to varying degrees across the studies, household characteristics such as access to cash and availability of labor are found to be significant in explaining adoption patterns. Given that most of the studies note that SRI demands more labor, at least initially, limited availability of family labor and the inability to hire outside labor can be impediments to adoption of the method. This greater demand for labor comes mostly with respect to weeding since weed growth in unflooded SRI plots is greater than in flooded plots (Noltze et al., 2012; Moser and Barrett, 2003; Namara et al., 2004; Sita Devi and Ponnarasi, 2009). Curiously, though, the study of Anthofer (2004) in Cambodia notes that the practice of SRI in the relevant provinces actually demands the same amount of family labor and even less in the way of hired labor. This notable difference within

the Cambodian context certainly highlights the need to take country-level context into account when examining SRI adoption dynamics.

Another commonality across most of the studies is that most farmers who choose to practice SRI only do so over a fraction of their rice plots. This can be partly explained by limited household resources but also due to varying plot characteristics such as the distance of a plot from a farmer's home- important with respect to one's ability to properly monitor SRI tasks- or access to permanent irrigation, which is important for the proper management of water (Noltze et al., 2012; Moser and Barrett, 2003; Namara et al., 2004). In any case, despite the fact that SRI is advanced by its proponents as a low external input technology (LEIT), it is clear that it is not a technology that is accessible for all farmers (Moser and Barrett, 2003).

2.4. Moser and Barrett's Adoption Study in Madagascar

Of the studies listed in Table 2.1, one of the most notable was carried out across five locations in Madagascar by Christine Moser and Chris Barrett (2003; 2006) of Cornell University. During the course of the research effort, 317 households were surveyed. Moser and Barrett found that adoption rates of SRI in these areas were very low, with only 15 percent of rice farmers practicing the technique five years after its introduction. At the same time, the dis-adoption rate was high with 40 percent of the farmers who had originally tried SRI having dis-adopted. This was a somewhat confounding finding given that SRI had been portrayed as a superior technique (Moser and Barrett, 2003)(Barrett et al., 2004).

However, in line with what has already been discussed above, Moser and Barrett found that a key factor potentially explaining the low adoption rate was the initial labor-intensity of the technology and the inability of poorer farmers to forego wage employment during the hungry season in order to meet these labor demands. In the absence of credit, these farmers could not afford to transfer labor from employment that provided wages needed for immediate consumption. These factors amongst others made it less likely for poorer farmers to adopt SRI in comparison to richer farmers with more land (Moser and Barrett, 2003).

Further, Moser and Barrett found that learning effects were influential throughout the adoption process. Differentiating between "learning by doing"- a farmer's experience with SRI- and "learning from others," - the knowledge of SRI gained from extension services or other farmers- they emphasized the latter as

particularly important in helping to explain the dis-adoption rate (Moser and Barrett, 2006). For example, in areas where there were interruptions in extension services, dis-adoption was found to be greater. This was seen as a possible indication of just how complex SRI is from the standpoint of the farmers and therefore how necessary continued support is for them. Given this complexity, social learning, the insights gained from the sharing of knowledge and experience amongst farmers, also plays a key role in determining whether and to what extent farmers continue to practice SRI (Moser and Barrett, 2006).

2.5. Limitations of Past Adoption Studies

Apart from the insights offered by these studies, though, it is important to note their limitations and opportunities for this research effort to build upon them. One of the most significant general shortcomings is a failure to define what exactly is meant by SRI adoption. Only the study of Noltze et al. (2012) gives a clear and explicit definition. Therefore, in the other studies it is not clear which individual components of SRI are considered essential and to what extent these components have to be practiced by farmers in order to be classified as adopters.

Also, none of the studies actually looked at the factors behind the adoption of individual SRI components. Given that in many cases not all components are adopted, it is instructive to note which of these might be more likely to be practiced and which are not. From there, one can understand what characteristics of the farm household may lead it away from the practice of certain components. Such insights could in turn be useful in shaping future extension efforts.

Further, most studies did not examine the part that plot-level differences play in the adoption story. Again, the study of Noltze et al. (2012) is an exception in this respect. Yet, as already noted, such differences can potentially help to explain adoption dynamics.

Finally, not much is really known about longer-term adoption dynamics given that there have not been studies that have tracked changes that may have occurred over 10 years. Therefore, our understanding of the overall SRI adoption story is necessarily incomplete. We do not know to what extent and why farmers may adopt, dis-adopt, re-adopt, or decide never to adopt SRI or its components over the longer-term.

With such limitations in mind, this research effort attempts to build upon previous studies in examining what changes may have occurred since the study of Moser and Barrett with a focus on the factors affecting adoption of individual components. In doing so, attention is given to social learning, plot-specific factors, and household factors. In this way, a more complete picture of SRI adoption dynamics in Madagascar can be gained.

3. Methodology

3.1. Madagascar and SRI

Agriculture makes up over a quarter of Madagascar's GDP with 80% of the population involved in agricultural activities (cia.gov). The vast majority of farmers are involved in rice production, which is the main staple in the country. As such, rice plays a very important part in the development and food security of the country.

With this being the case, SRI has been advanced by proponents as a means of improving the livelihoods of farmers since its development in Madagascar in the 1980s by a French Jesuit priest named Henrie de Laulanié. An NGO created by de Laulanié, Association Tefy Saina (ATS), was mostly responsible for the spread of SRI in various parts of the country during the 1990s and early 2000s. This was done in cooperation with foreign organizations such as the Cornell International Institute for Food, Agriculture, and Development (CIIFAD) and funding provided by organizations such as the United States Agency for International Development (USAID). It was within the framework of this cooperation that Moser and Barrett's research effort came about. In recent years, though, the demise of ATS has coincided with the growing influence of Groupement SRI (GSRI), an umbrella organization established in 2008 that encompasses various NGOs dedicated to the spread of SRI across the country. The activities of GSRI have been largely supported by the Better U Foundation, a charitable organization started by the American actor Jim Carrey to spread SRI worldwide (sri.ciifad.cornell.edu).

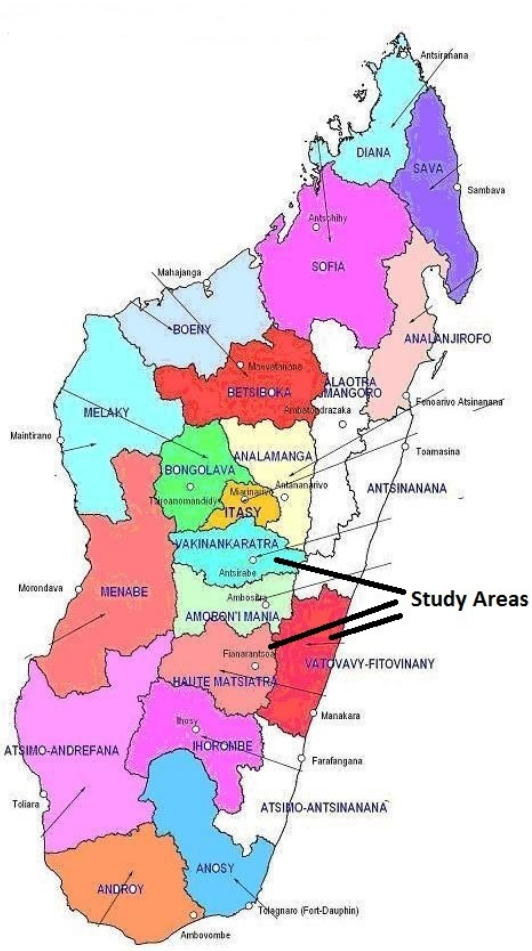
3.2. Study Area

The research was executed in five different locations, namely the fokontany (villages) of Ambatovaky, Tsaramandroso, Iambara, Anjazafotsy and the rural commune of Manandona. These were areas originally chosen by Moser and Barrett due to their having been introduced to SRI by ATS in the early 90s. It must be noted that these five locations are not of the small scale given that a rural commune is an administrative unit that encompasses multiple villages. This abnormality in study area selection reflects a misunderstanding of the administrative divisions of Madagascar at the time by Moser and Barrett.

Madagascar is made up of 22 different regions, which in turn are comprised of over 100 districts. These districts are then subdivided into communes and then finally into fokontany, the lowest administrative level. A fokontany can be understood as a village encompassing many hamlets of varying sizes.

Iambara and Ambatovaky are located in the region of Haute Matsiatra, close to the fourth largest city of Madagascar, Fianarantsoa. Tsaramandroso is in the region of Vatovavy-Fitovinany, near to Ranomafana National Park. Manandona and Anjazafotsy are located in the region of Vakinankaratra, near to the third largest city of Madagascar, Antsirabe. Whereas the commune of Manandona has an approximate population of 15000[1], the four villages range in population from around 1500 to 2000.

Figure 1: Map of Madagascar



Source: taken from Mappery.com

[1] population figures are according to latest census figures as communicated by local authorities

Significant differences between regions are also worth mentioning. Vakinankaratra is relatively more developed in comparison to the other two regions (Moser and Barrett, 2003; 2006). The Haute Matsiatra region is mainly populated by the Betsileo ethnic group while Vakinankaratra is dominated by the Merina and Vatovavy-Fitovinany by the Tanala ethnic groups. Whereas Haute Matisatra and Vakinankaratra are located in a geographical area known as the Central Highlands. Vatovavy-Fitovinany consists mainly of lowland rain forest. Flooding during the rainy season makes it a particularly difficult environment in which to practice SRI in general and the alternate wetting and drying component in particular. These aspects of Vatovavy-Fitovinany together with the relative isolation of Tsaramandroso in comparison to the other locations makes Tsaramandroso a true outlier, a fact that is made clear through the relative absence of SRI practice both currently and in the past.

3.3. Sampling and Data Collection

This research effort utilizes the same sample of 317 farmers across the five locations used by Moser and Barrett. Moser and Barrett utilized stratified random sampling in first conducting a census of the number of known adopters (those who were identified as practitioners of SRI), dis-adopters (those who had abandoned SRI after initial adoption), and non-adopters (those who had never tried the method), and then randomly selecting from the three strata for a total of 317 households. As mentioned previously, what is troublesome about these strata is that Moser and Barrett did not provide a clear definition of what constituted adoption. With this being the case, this thesis will largely avoid referring to adopters, dis-adopters, and non-adopters except when making reference to the work of Moser and Barrett.

In attempting to follow-up on their research, it was first necessary to gain access to the names and locations of all of the farmers. For that purpose, Christine Moser forwarded the first pages of all the surveys, which contained the relevant information. From there, a list of farmers was created for each location. These lists were shared with the heads of villages and hamlets in each location who in turn advised as to the exact whereabouts of each household. In total 251 households out of the original 317 were surveyed between January and April 2012. The 66 households not surveyed include those that have moved, no longer exist, and those that either refused to be surveyed or were not available. The locating of the households and the actual surveys were done with the cooperation and assistance of Le

Centre National de Recherche Appliquée au Développement Rural (FOFIFA), the primary research institution within the Ministry of Agriculture of Madagascar.

Table 2 shows the breakdown of strata across villages for Moser and Barrett's research effort while Table 3 directly below gives the attrition rates across strata and villages for the present study. Table 2 shows the breakdown of adopters, dis-adopters, and non-adopters across villages as labeled by Moser and Barrett in 2000 while Table 3 simply notes the number of these originally labeled adopters, dis-adopters, and non-adopters across villages that dropped out of the sample for the present study. Again, in this study we do not actually separate farmers out into these strata given the varying interpretations of how to actually define an adopter in the first place.

Table 2: Breakdown of strata surveyed by Moser and Barrett in 2000

Number of rice producing households surveyed and in population

Surveyed	Iambara	Ambatovaky	Tsaramandroso	Manandona	Anjazafotsy	Total
Adopters	8	21	0	34	17	80
Dis-adopters	9	20	20	13	21	83
Non-adopters	34	18	31	36	35	154
Total	51	59	51	83	73	317
Total among rice producing households						
Adopters	8	33	0	85	16	142
Dis-adopters	10	28	20	20	17	195
Non-adopters	87	69	55	398	91	700
Total	105	130	75	503	124	937

Source: partially taken from Moser and Barrett (2003)

Table 3: Attrition Rates Across Strata and Villages

	Iambara	Ambatovaky	Tsaramandroso	Manandona	Anjazafotsy	Total	Attrition rate
Adopters	1	3	0	5	6	15	18.80%
Dis-adopters	0	5	3	2	8	18	21.70%
Non-adopters	5	2	7	6	13	33	21.40%
Total	6	10	10	13	27	66	20.80%
Attrition rate	11.80%	16.90%	19.60%	15.70%	37%	20.80%	

As can be noted, the attrition rate across strata is relatively even. However, this is not so for the attrition rate across villages, as Anjazafotsy has a relatively high rate of 37%. This reflects the relatively greater number of farmers in this village who refused to be surveyed or who claimed to be too busy during the period of rice harvests. As such, we might expect a certain level of sample selection effect that reflects the attrition of relatively more farmers from Anjazafotsy. Indeed, when we use Moser and

Barrett's data from 2000 to compare the characteristics of households that dropped out and those who did not, there are significant differences. For instance, those who dropped out of the sample cultivated an average of 91.6 ares in 2000 while those who stayed in the sample cultivated an average of 125.2 ares, a difference that is significant at 5%. Also, those who dropped out knew around 4 other SRI cultivators in 2000 whereas those who stayed in the sample knew around 7 other SRI cultivators, a difference that is again significant at 5%. At the same time, those who stayed in the sample were significantly more likely to be members of a farmers association in 2000.

Although no adjustments are made in this thesis to deal with this effect, one way of handling it would be to run a two-stage Heckman selection regression. In the first stage, the odds of remaining in the sample for 2012 would be estimated based on the characteristics of households in the 2000 data. The second stage would then provide corrected parameter estimates for each SRI component.

The survey itself, which was pre-tested in order to refine the line of questioning, tended to last about an hour on average and was conducted in Malagasy with French translation by a translator from FOFIFA. It involved asking the head of the household- or other available household member- various questions about the household, rice-cultivating techniques, and experience with SRI. The various sections of the survey questionnaire[2] addressed plot-specific information, rice-cultivating history, individual techniques, social learning, household economics, and knowledge and experience with SRI. Some questions, especially with regard to household economics (including questions about livestock and materials available), rice-cultivating history (including total land cultivated and land cultivated using SRI techniques) and experience with SRI (including qualitative questions asking about advantages and challenges associated with SRI), were formulated in essentially the same way as those employed by Moser and Barrett in order to have direct comparability of respective data. Questions regarding individual cultivating techniques (including those asking about how long the household had practiced individual SRI components) were expanded from those asked by Moser and Barrett and plot-specific questions (including questions asking about soil quality of individual plots and distance of plots from the home) and social learning questions (including asking the names of trusted farmers and whether these farmers practiced SRI) were added towards answering the principal research questions regarding the influence of social learning and plot-level factors on individual SRI component practice.

[2] See Appendix 1 for full questionnaire (in French)

With regard to the data gleaned from the surveys, it is important to mention possible issues and limitations. For instance, in cases where it was not possible to survey the heads of household the data may be less reliable. With that said, in those cases efforts were made to gain access to the member of the household with the most complete knowledge of household affairs. Also, the limitations of certain variables meant to partially proxy access to cash or credit (e.g. total land cultivated, quantity of livestock owned) and social learning (e.g. membership in a farmer's association, total number of other SRI cultivators known) must be mentioned. The inability to precisely capture such factors may introduce measurement error.

3.4. Econometric Specification

In this thesis, adoption of an SRI component is viewed as a dichotomous choice and intensity of adoption is not examined. Therefore, a household is seen as either choosing to adopt or not adopt a particular component. As such, a binary choice model, specifically a Logit model, is used to estimate four equations representing the four principal components of SRI in the same way that binary choice models have been used in other adoption studies (Doss, 2006; Moser and Barrett, 2006; Noltze et al., 2012). These components are:

(1) the transplanting of seedlings 15 days after sowing or before
(2) the transplanting of seedlings one at a time (as opposed to transplanting in bundles)
(3) transplanting in a square pattern at a width of at least 25 x 25 centimeters
(4) alternate wetting and drying of the rice plot.

This narrowing of components is similar to the approach taken by Noltze et al. (2012) and the defining of each component is done in line not only with the recommendations set forth by Henri de Laulanié (1992) but also as understood by authorities such as ATS and CIIFAD (sri.ciifad.cornell.edu).

The four equations can be specified as follows:

$$T_Y = \alpha_1+\beta_X X + \beta_Z Z + \beta_H H + \beta_L L + \beta_K K + \varepsilon_y \quad (1)$$

$$N_Y = \alpha_2+\Pi_X X + \Pi_Z Z + \Pi_H H + \Pi_L L+ \Pi_K K + \varepsilon_y \quad (2)$$

$$P_Y = \alpha_3+\Omega_X X + \Omega_Z Z + \Omega_H H + \Omega_L L + \Omega_K K + \varepsilon_y \quad (3)$$

$$A_Y = \alpha_4+\delta_X X + \delta_Z Z + \delta_H H + \delta_L L+ \delta_K K + \varepsilon_y \quad (4)$$

Where dependent variables are defined as:

$\mathbf{T_y}$ = decision of household y to practice transplanting of seedlings 15 days after sowing or before (1=Yes 0=No)

$\mathbf{N_y}$ = decision of household y to practice transplanting of single seedlings (1=Yes 0=No)

$\mathbf{P_y}$ = decision of household y to practice square pattern at width of at least 25 x 25 (1=Yes 0=No)

$\mathbf{A_y}$ = decision of household y to practice alternate wetting and drying (1= Yes 0= No)

Independent variables are defined as:

X= group of variables measuring access to information

Including:

extension presence= dummy variable noting whether the household has been visited by an agricultural extension agent since 2000 (1=yes 0=no)

farmers association= dummy variable for membership of a farmer in a farmers association (1=yes 0=no)

Z= group of variables measuring plot-specific characteristics

Including:

soil quality= quality of soil as evaluated by farmers themselves (1=good 2=average 3=poor)

distance to plots= average walking time (in minutes) from farmer's home to rice plots

H= group of variables measuring access to cash or credit

Including:

land cultivated= total land cultivated (in ares)

fertilizer usage= total amount of fertilizer (in kg) per are of land cultivated

livestock= quantity of livestock owned measured in Tropical Livestock Units (TLU)[3]

children= number of family members aged less than 15 years of age

stable income= dummy variable noting if the household has a stable source of income throughout the year (1=yes 0=no)

[3] as outlined at: http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Mixed1/TLU.htm
conversion factors: cattle=.7, pigs= .2, poultry=.01

L= group of variables measuring access to labor

Including:

off-farm labor= dummy variable noting if off-farm labor represents a major source of income for the household (1=yes 0=no)

labor availability= number of family members aged 15 or older

K= group of control variables

Including:

age= age of the head of household

education= educational level (in years) of head of household

Iambara= dummy variable for farmers located in village of Iambara (1=yes 0=no)

Ambatovaky= dummy variable for farmers located in village of Ambatovaky (1=yes 0=no)

Tsaramandroso= dummy variable for farmers located in village of Tsaramandroso (1=yes 0=no)

Manandona= dummy variable for farmers located in the commune of Manandona (1=yes 0=no)

This grouping of variables is done in a similar way to that described in Doss (2006) and as outlined in Section 2.2. The variables measuring access to information (X) are included in order to take account of extension presence and social learning (in the form of membership in a farmers association) and their influence within the decision-making process of the farmer. Two other social learning variables, measuring the number of other SRI farmers known (SRI farmers known) by a farmer and whether the farmer has a confidant who practices SRI (SRI farmer trusted), are not included in the regression due to possible endogeneity issues. These possible issues are associated with omitted variable bias and reverse causality as referenced in Section 2.2. However, mean values for these two variables are presented and discussed in Chapter 4 as part of the overall analysis.

The variables measuring plot-specific characteristics (Z) are included in light of their potential explanatory value as outlined in previous SRI adoption literature (Section 2.3). The distance of plots to the home can be an important factor with respect to a farmer's ability to properly monitor SRI plots. Soil quality, on the other hand, can influence the farmer's decision-making process with respect to expectation of yields. Poorer soil quality might lead a farmer away from investing the resources

necessary to practice SRI, given that the yield potential might not be enough to justify such an investment.

The group of variables measuring access to cash or credit (H) are included in order to take account of the household's ability to provide the necessary inputs to practice SRI. Land cultivated can be seen as a very rough proxy for access to credit while fertilizer usage can be a proxy for access to necessary inputs. At the same time, livestock can act as a proxy for access to cash while the children variable is included as a possible negating factor with regard to cash availability. The stable income source is added as another proxy for access to cash in the same way that Moser and Barrett (2006) included it in their analysis. Two other variables in this category, which measure the hungry period of the household in months (hungry period) and denote whether the household practices off-season cultivation (off-season cultivation), are not included in the regression due to possible endogeneity and multicollinearity issues respectively. Mean values for these variables are included in Chapter 4 as part of the overall analysis.

The group of variables measuring access to labor (L) are included to take account of a household's ability to support the labor demands of SRI. Labor availability is self-explanatory as a possible proxy for the labor available within the household. The off-farm labor dummy is added given the influence of this variable within the study of Moser and Barrett (2003; 2006) in explaining why some farmers were unable to practice SRI. That is to say that the need to find off-farm labor during the planting season was seen as a draining effect on household labor and thus the ability to practice SRI.

Finally, the group of control variables (K) is included in order to control for village-level factors that could affect the adoption decision as well as for the characteristics of the head of household.

Apart from these variables, average yields for plots denoted as SRI by farmers are compared with those plots denoted as non-SRI in Chapter 4. Otherwise, it is worth noting that a possible correlation between soil quality and fertilizer was checked and found to be weak. Also, a cross term (labor x land) was created amongst other alternative variables in an attempt to add explanatory value to the models, but such variables did not prove to have much significance.

With the regional differences mentioned in Section 3.2 in mind, consideration was also given to running regressions at the regional level. This was considered especially in light of significant differences in the

mean values of some explanatory variables across regions. However, a Likelihood Ratio Test indicated that there was no significant improvement in model fit when the regressions were separated by region. Therefore, it was decided to simply do one regression per component and not allow the parameter estimates to vary by region.

4. Results and Analysis

This chapter begins with a comparison of individual SRI component adoption rates from Moser and Barrett's study and the present study. Afterwards, sample statistics from the present study are given in order to add context. From there, descriptive statistics and the results from the Logit regressions for each of the four SRI components are presented. Finally, the results and findings are discussed and examined within the context of previous SRI adoption literature.

4.1. Individual SRI Component Adoption Rates

Table 4 shows the adoption rates of individual SRI components for the surveys completed in 2000 alongside those for 2012. Given that in 2000 data was not collected on water management techniques, comparisons can only be made with regard to adoption of three of the four main SRI components.

Table 4: Individual Component Adoption Rate Comparison

Component	2000 overall adoption rate	2012 overall adoption rate	Dis-adoption rate	New Adopter rate
Transplanting before or at 15 days after sowing	23.70% (75 farmers out of 317 in total)	35.90% (90 farmers out of 251 surveyed)	40.7%	28.6%
One seedling at a time	29.30% (93 farmers out of 317 in total)	50.60% (127 farmers out of 251 surveyed)	28.8%	42.10%
Squared pattern at width of at least 25cm x 25cm	10.70% (34 farmers out of 317 in total)	9.50% (24 farmers out of 251 surveyed)	67.9%	6.70%
Alternate wetting and drying	no data collected	43.8% (110 farmers out of 251 surveyed)		

What can be observed is that both in 2000 and 2012 the component with the highest adoption rate is the transplanting of the single seedling. Furthermore, the overall adoption rate for that component has risen to 50%, an increase of 21 percentage points. On the other hand, the component with the lowest

rate in both years is the squared transplanting at a width of at least 25cm x 25cm. The rate of adoption has slightly decreased and is now practiced by less than 10% of farmers. At the same time, transplanting after 15 days or less is practiced currently by around 36% of farmers, an increase of about 12 percentage points from 2000, while the rate for alternate wetting and drying is 43.8%.

Therefore these numbers appear to show that the transplanting of single seedlings is the most accessible of the four components. Indeed, this is not surprising given that this component requires relatively less in the way of resources in comparison to the others. It mostly requires care with regard to the handling and transporting of a single seedling, which is more delicate, and possibly the embracing of a slight bit of risk given the greater vulnerability of a single seedling to environmental conditions.

On the other end of the spectrum, transplanting in a square pattern at a width of at least 25cm x 25cm appears to be the least accessible component. There are several possible reasons for this. First of all, this component requires relatively more time, expertise, and precision in order to ensure that the transplanting is in fact properly done in a square pattern at the desired width. Many farmers mentioned that this method of transplanting takes much more time, at least initially, and is much more complicated in their eyes in comparison to the traditional method of planting seedlings randomly. Secondly, transplanting in a squared pattern is principally done in order to facilitate the weeding of the rice plot with a rotary weeder. Of course, if a farmer neither owns nor has access to a weeder that can be borrowed then that eliminates the rationale for transplanting in a square pattern. For those that do have access to a weeder, the choice of transplanting width may have to do with the size of weeder available. Several farmers mentioned that they transplant at widths of 15cm or 20cm given the smaller size of weeders they have access to.

With regard to the actual days of transplanting, the second least practiced component, one of the obstacles can be a lack of time. That is to say that households may lack the time or human resources to ensure that seedlings are in fact transplanted within 15 days. This is especially the case for smaller households with less labor available, those that depend heavily on off-farm labor for additional income, as well as those households with rice plots located far away from the home.

Finally, with regard to alternate wetting and drying, the second most practiced component, obviously this is dependent on access to irrigation. Almost all of the households surveyed have access to some

form of irrigation, but the availability, quality, and level of control can vary greatly across a household's plots. Therefore, a household may lack the capacity to properly manage water over a certain number of its plots. This issue is indeed one of the main general problems mentioned by farmers in the survey areas. Apart from the capacity to manage the water, though, this component of SRI also takes additional time that may not be available. Whereas the traditional method of constant saturation requires relatively little in the way of supervision, alternate wetting and drying requires more consistent monitoring and manipulation of the water level of the rice plot.

4.2. Sample Statistics

Table 5 is presented below in order to first describe the average characteristics of the farmers in the sample.

Table 5: Sample Statistics (N=251)

Variable	Description	Mean	Std. Deviation
soil quality	quality of soil as evaluated by farmers themselves (1=good 2=average 3=poor)	2.013999	0.0404123
distance to plots	average walking time (in minutes) from home to rice plots	17.92712	0.8040307
SRI farmers known	How many other farmers who practice SRI does the farmer know?	11.47347	1.197948
SRI farmer trusted	Does the farmer have a friend/confidant who practices SRI? (1=yes 0=no)	0.5142857	0.0319962
farmers association	Is the farmer a member of a farmer's association? (1=yes 0=no)	0.4163265	0.0315578
labor availability	number of family members aged 15 or older	3.742857	0.1356989
Children	number of family members aged less than 15 years of age	2.831325	0.1497567
off-season cultivation	Does farmer practice off-season cultivation (1=yes 0=no)	0.6	0.0313625
fertilizer usage	Total amount of fertilizer (in kg) used per are of land cultivated	27.02291	2.025958
extension presence	Has the farmer been visited by an extension organization since 2000 (1=yes 0=no)	0.3387755	0.0302995
Livestock	quantity of livestock owned measured in Tropical Livestock Units (TLU)	1.85551	0.1373431
off-farm labor	Does off-farm labor represent a major source of income? (1=yes 0=no)	0.4081633	0.0314647
land cultivated	Total land cultivated (in ares)	161.1745	9.260552
Education	years of education for head of household	4.436735	0.193758
hungry period	how long is the household's hungry period (in months)	3.476	0.1434994
Age	age of the head of household	52.43825	0.7611879
stable income	Is there a stable source of income throughout the year? (1=yes 0=no)	0.1713147	0.0238299
SRI yield	average yield for plots denoted as SRI by farmers (in tonnes per hectare)	4.440477	0.5164672
non-SRI yield	average yield for plots not denoted as SRI by farmers (in tonnes per hectare)	2.71359	0.1349862

On examination of the table, one can note that the average head of household has between four and five years of education, which is to say that he or she did not complete primary school. The average household cultivates 1.6 hectares (ha) of land in total, including .76 ha in rice plots. The mean number of household members aged 15 years or older, a rough proxy for household labor availability, is 3.74.

Otherwise, on average each farmer surveyed knew about 11 other SRI farmers. The average yield for plots that were denoted as "SRI plots" by farmers was 4.44 tonnes per hectare while the average yield for "non-SRI plots" was 2.71 tonnes per hectare. Of course, this is not presented as clear proof of the superiority of SRI as a method, but these numbers fall in line with the fact that the farmers themselves appeared to be convinced of the superiority of SRI in terms of production. Of the 238 farmers who were familiar with SRI, all but one of them mentioned production as an advantage of SRI relative to other methods.

4.3. Statistics and Results for Component 1: Transplanting of seedlings 15 days after sowing or before

Table 6 outlines mean characteristics for farmers that practice transplanting of seedlings at 15 days after sowing or before, along with t-scores measuring the significance of variances between those that practice and those that do not.

Table 6: Descriptive Statistics for transplanting of seedlings 15 days after sowing or before

		Practicing farmers=90			Non-practicing farmers=161		
Type of Variable	**Variable**	**Mean**	**Std. Deviation**		**Mean**	**Std. Deviation**	**T score**
plot-level	soil quality	1.958981	0.6740778		2.036986	0.5487476	0.9376
plot-level	distance to plots	17.45169	10.72167		17.9382	13.51911	0.2921
information	SRI farmers known	19.71111	23.27667		6.714286	13.37088	-5.6219***
information	SRI farmer trusted	0.7777778	0.4180688		0.3726708	0.4850242	-6.6593***
information	farmers association	0.6222222	0.4875478		0.2981366	0.4588671	-5.2467***
information	extension presence	0.5	0.5028011		0.2546584	0.4370284	-4.0382***
labor	labor availability	3.755556	0.2484967		3.754717	0.1651793	-0.0029
labor	off-farm labor	0.3555556	0.481363		0.4409938	0.4980552	1.319
cash/credit	stable income	0.2555556	0.0462342		0.1242236	0.0260759	-2.6754***
cash/credit	children	2.788889	0.21463		2.855346	0.2010712	0.2128
cash/credit	off-season cultivation	0.8	0.4022409		0.5031056	0.5015504	-4.8152***
cash/credit	fertilizer usage	39.09814	4.189921		27.77127	8.095976	-1.0068
cash/credit	livestock	1.932667	2.102927		1.82205	2.175375	-0.391
cash/credit	land cultivated	202.7083	227.8705		143.177	108.6832	-2.7971***
cash/credit	hungry period	3.314607	0.2694647		3.565217	0.1659676	0.8357
control	age	52.18889	11.56117		52.57764	12.36256	0.2445
control	education	5.370787	3.358781		4.074534	2.931622	-3.176***

*significant at 10%

**significant at 5%

***significant at 1%

It can be noted that the mean differences for all of the information variables are significant at 1%. At the same time, the mean differences for the off-season and stable income source dummies are also significant at 1% together with the education and land cultivated variables. Mean differences for the plot-level variables turn out not to be significant together with the labor variables.

Table 7 then gives the results for the accompanying Logit regression. The 13 households that claimed complete ignorance of SRI are not included in the regressions.

Table 7: Logit regression results for transplanting of seedlings 15 days after sowing or before

N=238 farmers

Type of variable	**Variable**	**Coefficient**	**Standard Error**
plot-level	soil quality	-0.2403972	0.3443761
plot-level	distance to plots	-0.0056607	0.0151523
information	farmers association	0.8041133**	0.3877877
information	extension presence	0.6617638*	0.3925216
labor	labor availability	0.0786366	0.0893771
labor	off-farm labor	-0.0261661	0.4046622
cash/credit	fertilizer usage	0.0256858***	0.0066017
cash/credit	livestock	0.0283326	0.0936503
cash/credit	children	-0.2147658**	0.0915421
cash/credit	stable income source	0.9526627**	0.4759012
cash/credit	land cultivated	0.0046288***	0.0015335
control	age	-0.0177201	0.016272
control	education	0.0038702	0.0682783
control	iambara	0.1352852	0.6583044
control	ambatovaky	0.3943085	0.6163379
control	tsaramandroso	-3.453038***	1.192066
control	manandona	-1.403893***	0.5133836
constant	constant	-0.4888292	1.36844

Pseudo R2= .3069

VIF= 1.58

*significant at 10%

**significant at 5%

***significant at 1%

We can note that the coefficients for the plot-level variables are not significant while the coefficients for the information variables are positive and significant at 5% (for farmers association) and 10% (for extension presence). The fertilizer usage and land cultivated coefficients are positive and significant at 1% while the stable income source coefficient is positive and significant at 5%. The coefficient for the children variable is negative and significant at 5%.

4.4. Statistics and Results for Component 2: Transplanting of seedlings one at a time

Table 8 presents descriptive statistics for farmers that practice transplanting of single seedlings.

Table 8: Descriptive Statistics for transplanting of seedlings one at a time

		Practicing farmers=127			Non-practicing farmers=124		
Type of Variable	**Variable**	**Mean**	**Std. Deviation**		**Mean**	**Std. Deviation**	**T score**
plot-level	soil quality	1.979499	0.5686925		2.039247	0.6918717	0.7482
plot-level	distance to plots	17.8697	12.86027		17.65806	12.3231	-0.1326
information	SRI farmers known	16.89764	21.88963		5.717742	12.21791	-4.98***
information	SRI farmer trusted	0.6929134	0.4631125		0.3387097	0.475191	-5.9806***
information	farmers association	0.5590551	0.4984666		0.266129	0.4437254	-4.9135***
information	extension presence	0.4094488	0.4936796		0.2741935	0.4479168	-2.2716**
labor	labor availability	3.825397	0.215017		3.682927	0.1732924	-0.5145
labor	off-farm labor	0.3937008	0.4905048		0.4274194	0.4967109	0.5411
cash/credit	children	3.02381	0.2252235		2.634146	0.1960112	-1.3027
cash/credit	stable income	0.2047244	0.0359466		0.1370968	0.0310129	-1.4218
cash/credit	off-season cultivation	0.7322835	0.4445226		0.483871	0.5017671	-4.1541***
cash/credit	fertilizer usage	44.6981	10.44246		18.79254	1.917346	-2.4217**
cash/credit	livestock	2.07063	2.243138		1.647742	2.02874	-1.5653
cash/credit	land cultivated	191.2461	204.3447		137.1532	101.6492	-2.6454***
cash/credit	hungry period	3.210317	0.2147241		3.745968	0.1877699	1.8757*
control	education	5.214286	3.273181		3.846774	2.862838	-3.514***
control	age	51.86614	10.94674		53.02419	13.12074	0.76

*significant at 10%

**significant at 5%

***significant at 1%

As was the case for the previous component, mean differences for all the information variables significant at at least the 5% level. Similarly, mean differences for off-season cultivation (at 1%), land cultivated (at 1%), and education (at 1%) are significant once again. Otherwise, mean differences for fertilizer usage (at 5%) and for the hungry period variable are (at 10%) are significant whereas they were not for the previous component.

Table 9 presents the results for the accompanying Logit regression.

Table 9: Logit regression results for transplanting of seedlings one at a time

N=238 farmers

Type of variable	Variable	Coefficient	Standard Error
plot-level	soil quality	-0.0939142	0.3146132
plot-level	distance to plots	0.0006067	0.0131414
information	farmers association	0.8096838**	0.3600791
information	extension presence	0.1069905	0.3703001
labor	labor availability	0.0593868	0.0800887
labor	off-farm labor	0.1702373	0.3687816
cash/credit	fertilizer usage	0.0269446***	0.0074429
cash/credit	livestock	0.0909971	0.0827701
cash/credit	stable income source	0.6333397	0.4679557
cash/credit	land cultivated	0.0036531**	0.0016433
cash/credit	children	-0.056227	0.0885422
control	age	-0.012941	0.0151528
control	education	0.0827767	0.0636858
control	iambara	-0.0017707	0.6355475
control	ambatovaky	1.160535*	0.6244992
control	tsaramandroso	-1.156256*	0.6750188
control	manandona	-0.7641038	0.4784248
constant	constant	-1.370763	1.319221

Pseudo R2= .2407

VIF= 1.56

*significant at 10%

**significant at 5%

***significant at 1%

Relatively fewer variables are significant for this component in comparison to the previous one. With that said, we can note that the variables that are significant (farmers association dummy at 5%, fertilizer usage at 1%, and land cultivated at 5%) for this regression were also significant for the previous one.

4.5. Statistics and Results for Component 3: Transplanting in a square pattern at a width of at least 25 x 25 centimeters

Table 10 presents descriptive statistics for the third component, transplanting in a square pattern at a width of at least 25cm x 25cm.

Table 10: Descriptive Statistics for transplanting in a square pattern at width of at least 25cm x 25cm

		Practicing farmers=24			Non-practicing farmers=227		
Type of Variable	**Variable**	**Mean**	**Std. Deviation**		**Mean**	**Std. Deviation**	**T score**
plot-level	soil quality	1.731944	0.5848101		2.03831	0.6308756	2.2773**
plot-level	distance to plots	20.28478	15.35208		17.5078	12.26436	-1.0094
information	SRI farmers known	23.58333	26.62447		10.0837	17.13009	-3.4527***
information	SRI farmer trusted	0.8333333	0.3806935		0.4845815	0.5008667	-3.3091***
information	farmers association	0.5833333	0.5036102		0.3964758	0.4902464	-1.7712*
information	extension presence	0.375	0.4945354		0.339207	0.4744865	-0.3501
labor	labor availability	4.416667	0.5209964		3.684444	0.1421627	-1.5678
labor	off-farm labor	0.3333333	0.4815434		0.4185022	0.4944036	0.8045
cash/credit	children	2.5	0.4382111		2.866667	0.1591146	0.7219
cash/credit	stable income	0.2916667	0.094776		0.1585903	0.024299	-1.6478
cash/credit	off-season cultivation	0.7916667	0.4148511		0.5903084	0.4928636	-1.9295*
cash/credit	fertilizer usage	22.36012	3.066346		32.85661	5.962665	0.5718
cash/credit	livestock	2.015	2.516619		1.845507	2.108937	-0.3673
cash/credit	land cultivated	242.5417	322.7148		156.2742	135.656	-2.4772**
cash/credit	hungry period	3.021739	0.5053843		3.522026	0.1495507	1.0077
control	education	5.125	2.938685		4.473451	3.16673	-0.9646
control	age	52.66667	13.33732		52.4141	11.94847	-0.0974

*significant at 10%

**significant at 5%

***significant at 1%

Once again, mean differences for three of the information variables (notably the social learning variables) are significant, although the difference for the farmers association variable is significant only at 10% for this component. Mean differences for off-season cultivation and land cultivated continue to be significant (at 10% and 5% respectively) as well. Otherwise, the mean difference for soil quality is significant at 5% whereas it has not been significant for either of the previous two components.

Table 11 presents the results for the accompanying Logit regression.

Table 11: Logit regression results for squared transplanting at a width of at least 25cm x 25 cm

N=238 farmers

Type of variable	Variable	Coefficient	Standard Error
plot-level	soil quality	-1.908332***	0.5961502
plot-level	distance to plots	0.0132437	0.023777
information	farmers association	-0.2608403	0.6373681
information	extension presence	0.3223968	0.6066197
labor	labor availability	0.1650564	0.1337255
labor	off-farm labor	-0.1960957	0.5978739
cash/credit	fertilizer usage	-0.0086848	0.0126129
cash/credit	livestock	-0.0302479	0.1350036
cash/credit	stable income source	1.608956**	0.6717272
cash/credit	land cultivated	0.0003739	0.001974
cash/credit	children	-0.3088358*	0.162548
control	age	-0.0296276	0.0259072
control	education	-0.0749076	0.1052694
control	iambara	2.375871**	1.189846
control	ambatovaky	3.858451***	1.080257
control	manandona	0.5771667	0.942251
constant	constant	1.261314	2.304335

Pseudo R2= .2437

VIF= 1.56

Note: the dummy variable for Tsaramandroso is dropped as no farmers from this village practice this particular component

*significant at 10%

**significant at 5%

***significant at 1%

For this regression, the coefficient for soil quality is negative and significant at 1%. At the same time, the coefficient for stable income is positive and significant at 5% while the coefficient for children is negative and significant at 10%. Both of these coefficients were significant for the first component, transplanting of seedlings at 15 days.

4.6. Statistics and Results for Component 4: Alternate Wetting and Drying

Table 12 presents descriptive statistics for the fourth SRI component, alternate wetting and drying.

Table 12: Descriptive Statistics for alternate wetting and drying

		Practicing farmers=110			Non-practicing farmers=141		
Type of Variable	**Variable**	**Mean**	**Std. Deviation**		**Mean**	**Std. Deviation**	**T score**
plot-level	soil quality	1.975043	0.5526122		2.035952	0.6892322	0.7577
plot-level	distance to plots	18.63571	13.04611		17.0747	12.18452	-0.973
information	SRI farmers known	17.55856	22.91632		6.471429	12.34949	-4.8988***
information	SRI farmer trusted	0.7027027	0.4591414		0.3714286	0.4849217	-5.5026***
information	farmers association	0.5585586	0.498811		0.3	0.459903	-4.2608***
information	extension presence	0.4144144	0.4948548		0.2857143	0.4533761	-2.1448**
labor	labor availability	3.836364	0.2369275		3.690647	0.1623673	-0.5227
labor	off-farm labor	0.3693694	0.4848229		0.4428571	0.4985075	1.1741
cash/credit	children	3.045455	0.2525554		2.661871	0.1784892	-1.2736
cash/credit	stable income	0.2090909	0.0389509		0.141844	0.0294866	-1.4029
cash/credit	off-season cultivation	0.7207207	0.4506797		0.5214286	0.5013343	-3.2695***
cash/credit	fertilizer usage	35.95797	3.740595		28.62042	9.192439	-0.6737
cash/credit	livestock	2.068649	2.34802		1.697643	1.964575	-1.3626
cash/credit	land cultivated	205.5923	218.3827		131.9607	90.32957	-3.6194***
cash/credit	hungry period	3.224771	0.2138278		3.670213	0.1924901	1.5436
control	education	5.227273	3.238697		3.992857	2.971075	-3.1338***
control	age	51.56757	11.56847		53.12857	12.43275	1.0186

*significant at 10%

**significant at 5%

***significant at 1%

As with all of the other components, mean differences for the social learning variables as well as those for land cultivated and off-season cultivation are significant. Otherwise, mean differences for the other information variable, extension presence, and education are significant, as they have been for all of the other components except Component 3 (squared pattern).

Table 13 shows the results for the accompanying Logit regression. Apart from the 13 farmers who claimed ignorance of SRI, three additional farmers that lack access to irrigation are excluded from this regression.

Table 13: Logit regression results for alternate wetting and drying

N=235 farmers

Type of variable	Variable	Coefficient	Standard Error
plot-level	soil quality	-0.7022446**	0.3307522
plot-level	distance to plots	0.0080434	0.0130739
information	farmers association	0.3083776	0.3700673
information	extension presence	0.3999782	0.3865503
labor	labor availability	0.0611973	0.0790018
labor	off-farm labor	0.0507145	0.3831092
cash/credit	fertilizer usage	0.0320667***	0.007971
cash/credit	livestock	0.1480622*	0.0839657
cash/credit	stable income source	0.6413243	0.5054322
cash/credit	land cultivated	0.0032571**	0.0015957
cash/credit	children	-0.0630311	0.0895651
control	age	-0.0228281	0.0155878
control	education	0.0732247	0.0695803
control	iambara	0.8126844	0.6690659
control	ambatovaky	1.080234*	0.6478645
control	tsaramandroso	-.3872424	0.6516918
control	manandona	-0.3872424	0.6516918
constant	constant	-2.286924***	0.5485225

Pseudo R2= .2772
VIF=1.56
*significant at 10%

**significant at 5%

***significant at 1%

The coefficient for soil quality is negative and significant at 5%. Coefficients for fertilizer usage and land cultivated are positive and significant at 1% and 5% respectively. The coefficient for livestock is positive and significant (at 10%) for the first time in this regression.

4.7. Discussion of Results

Given the results from the regressions, then, what can we deduce about individual SRI component adoption dynamics? How can we best summarize the differences in significance of variables across components? To assist with this task, Tables 14 and 15 provide summaries of the descriptive statistics and Logit results respectively across regions.

Table 14: Summary of descriptive statistics across components

Type of Variable	Variable	Comp 1	Comp 2	Comp 3	Comp 4
plot-level	soil quality			5%	
plot-level	distance to plots				
information	SRI farmers known	1%	1%	1%	1%
information	SRI farmer trusted	1%	1%	1%	1%
information	farmers association	1%	1%	10%	1%
information	extension presence	1%	5%		5%
labor	labor availability				
labor	off-farm labor				
cash/credit	children				
cash/credit	stable income	1%			
cash/credit	off-season cultivation	1%	1%	10%	1%
cash/credit	fertilizer usage		5%		
cash/credit	livestock				
cash/credit	land cultivated	1%	1%	5%	1%
cash/credit	hungry period		10%		
control	education	1%	1%		1%
control	age				

Table 15: Summary of Logit results across components

Type of variable	Variable	Comp 1	Comp 2	Comp 3	Comp 4
plot-level	soil quality			1%	5%
plot-level	distance to plots				
information	farmers association	5%	5%		
information	extension presence	10%			
labor	labor availability				
labor	off-farm labor				
cash/credit	fertilizer usage	1%	1%		1%
cash/credit	Livestock				10%
cash/credit	stable income source	5%		5%	
cash/credit	land cultivated	1%	1%		5%
cash/credit	Children	5%		10%	
Control	Age				
Control	Education				

Generally speaking, we can note a closer synergy between components 1,2, and 4 given that these are the most practiced components. We can see that many of the same variables for which mean differences are significant are similar across these components. It is also notable that the coefficients for fertilizer usage and land cultivated are significant for all three of these components. Given that the third component, squared transplanting, is by far the least practiced of all of the components, it is no surprise to see somewhat less synergy of this component with respect to the others.

We can also note that a greater number of variable coefficients are significant for the regression of the first component, transplanting at 15 days or before, compared to the other components. This reflects the fact that farmers associate this particular component the closest with SRI. Around 98% of farmers in the survey who practiced this component identified themselves as SRI farmers. Amongst the practitioners of the other components, the next highest percentage is 79% for squared transplanting. Therefore, it makes sense that a greater number of variables that are typically identified as being influential for SRI adoption in general turn out to be significant for the first component.

At the same time, we can also note that the same variables coefficients that are significant for the second component, transplanting of single seedlings, are also significant for the first component at the exact same level of significance. This reflects the fact that these two components are the two that are most practiced together. Of the 90 adopters of the first component, 89 of them also practice the transplanting of single seedlings. At the same time, not as many variables show up as significant for the transplanting of single seedlings, which could be explained by the fact that only around 71% of farmers who practice this component, the lowest percentage of all, identify themselves as SRI farmers.

Having discussed some of the differences across components, what can we say about the respective groups of variables and the extent to which they are influential? Certainly, we can observe that the variables proxying access to labor seem to have no influence at all either in the descriptive statistics or in the regressions. This is a somewhat surprising result given that the labor-intensity of SRI in general is typically identified is the greatest impediment to farmer adoption. With that said, it could be that these variables turn out to be influential in explaining intensity of adoption, which has not been examined in this thesis.

It also appears that the plot-level variables are not particularly influential when we look at the two tables. Soil quality seems to be the only one of the two variables with explanatory power and that is only with respect to the third and fourth components. This could indicate that soil quality is not as much of a factor for partial practice of SRI, that is for the practice of the two components (transplanting at or before 15 days and single seedlings) most typically adopted in combination. However, for full adoption, the adding of components 3 and 4, it would appear that soil quality is a concern. Again, this makes sense given that a farmer wants to be assured of a yield level that justifies his or her investment of resources.

On the other hand, the access to information variables seem to be influential especially for practice of the first two components. We can note that the farmers association variable coefficient is significant for these components while extension presence is also significant for the first component. This makes sense given that transplanting at or before 15 days is the signature component in the eyes of farmers. Above all, then, a farmer that is convinced to practice SRI by an extension agent or through the experiences of farmers would be expected to practice transplanting at or before 15 days and perhaps also transplanting of single seedlings given that there appears to be a close synergy between these components. We can also note in the descriptive statistics that the mean differences for the two information variables (more specifically social learning variables) not included in the regression (number of SRI farmers known and the dummy variable indicating whether a farmer has a trusted friend/confident who practices SRI) are significant at 1% across all components. This suggests the potentially strong influence that social learning may exert across all components and for SRI in general. Of course, though, given that these variables were not included in the regression due to possible endogeneity issues, we must be cautious in extrapolating too far.

For the access to cash or credit variables, we can say this group of variables was generally influential across the components. In particular, the coefficients for land cultivated and fertilizer usage were significant across components 1,2, and 4. This is very much in line with previous SRI adoption literature which has emphasized liquidity as an important factor in a farmer's ability to mobilize the resources necessary to practice SRI.

Otherwise, neither age nor education appeared as significant within any of the regressions, although mean differences for education in the descriptive statistics were significant at 1% for three of the four components. This suggests that education plays a role in adoption dynamics but not necessarily a large one.

Having thus discussed the differences in the significance of variables across components, how can we compare the overall insights and conclusions from this study with those of past adoption studies mentioned in Section 2.3? Above all, it is the examination of factors that are specific to individual components of SRI or combinations of components- as opposed to the method as a whole- that sets this study apart from others. Having examining the apparent synergies between certain components, we can get a better idea as to why so many farmers choose to practice a certain combination of SRI

techniques but not necessarily all of the prescribed components. Amongst other contrasts with previous SRI adoption studies, we can also point to the insignificance of access to labor in explaining the adoption of individual components. Again, this appears somewhat surprising, but it is quite possible that access to labor would turn out to be significant in explaining intensity of individual component adoption. Similarly, plot-level conditions appeared only somewhat influential in this study but may well be much more significant within the context of intensity of adoption.

As was the case with other studies, though, this thesis has found that access to cash or credit is an influential factor across components but also that access to information can also potentially play a key role. Given that none of the other studies looked at longer-term dynamics, such a finding within this study could possibly be used to draw a general conclusion about the increased importance of social learning amongst farmers in the long term. Given the absence of any extended extension presence in the study areas currently and given that the constant presence of extension agents over the longer term is in any case unrealistic and unviable, it would appear that the extent to which SRI farmers themselves can substitute for extension agents may be an important factor in determining whether SRI can truly take hold within a location over a longer period. In any case, it has been emphasized not only in this study but essentially all of the adoption studies that, despite all of its purported benefits, SRI is not an easily accessible technology from the standpoint of many cultivators. Therefore, there appears to be a constant need over time for some sort of information and support channel- whether this is provided by extension agents or other SRI farmers- to provide clear confirmation of the advantages of the system and support to overcome the disadvantages. This is especially so for communities that have been tied to traditional techniques for generations and that in some cases may even consider a change of cultivation method as religious taboo. Therefore, the extent to which social learning can be fostered within a village in order to overcome obstacles to adoption may be a key factor in the long term.

With that being the case, it is worth pondering what conditions within a village may influence the level of social cohesion necessary to bring about widespread social learning. This is not necessarily something that is easy to pin down, but we can offer possible anecdotal explanations. On a general level, it appeared during the surveys that those households located in the relatively more isolated hamlets within the villages tended to be more tied to traditional techniques and less engaged with those from other hamlets. Areas with greater population densities appeared to foster greater social cohesion and in turn sharing of information about SRI, which seems quite logical of course. At the same time, though,

one must also look at the history of social relations within a particular village and the extent to which conflicts have existed or continue to exist between certain groups of farmers. In this respect, we are not referring necessarily to tensions between ethnic groups- since this did not appear to be an issue in any of the locations- but more so the volume and intensity of land disputes which may have existed in the past. Such issues were noted especially by the head of the village of Anjazafotsy and reflected during the surveys in this location by the number of farmers who claimed to trust no one outside of their family. Therefore, a range of factors, some of which may be difficult to discern, may play a part in the social cohesion of a location.

Given these findings, though, what can we point to as the ultimate policy implications? Most importantly, it is necessary for extension agents to recognize clearly the difficulties associated with SRI from the standpoint of farmers and the need for constant support. As such, it is necessary for agents to ensure that a channel of information and support remains even after they have left. In this respect, a recommendation would be to expend more efforts to create SRI farmer groups that can to some degree themselves function as extension agents. To some extent this is already being done by Groupement SRI in Madagascar, but it should be recognized as a priority within the context of extension campaigns. In doing so, agents should assure that farmers in more remote hamlets are somehow connected to such information channels. Otherwise, one can expect adoption in these areas to be spotty. Along the same lines, it is also important to get the buy-in of key individuals who command respect and influence in each location. This requires contextual awareness because these individuals are not always necessarily the heads of villages. For example, in the village of Iambara, it was made extremely clear during the surveys that the most prominent and respected individual was the son of a preacher. As such, it is important to tailor extension efforts to the individual realities, social and otherwise, of each location to ensure the long term success of these efforts.

5. Conclusion

This thesis, then, has attempted to answer various questions relating to individual SRI component adoption dynamics. In Section 4.1, we looked at how component practice has evolved over time. We noted that the single seedling component remains the most practiced component while the squared transplanting at a width of at least 25 cm by 25 cm component remains the least practiced. Whereas, the overall rate of adoption for the former component increased by 21 percentage points, the adoption rate for the latter decreased slightly. In Sections 4.2 through 4.7, we examined which factors are influential in the practice of each individual SRI component. We found that variables that proxy access to cash or credit are generally significant across components while access to information may also play an important role. Otherwise variables proxying access to labor were found to be insignificant across components while plot-level conditions, especially soil quality, appear partially influential.

In conducting this research and attempting to shed more light on individual component practice, the most notable policy implication that comes to light has to do with the importance of establishing the social infrastructure necessary to foster social learning. Given that it is relatively more difficult for extension agents to significantly improve a household's access to credit or cash, it would appear a good idea to focus on improving access to information amongst farmers. As such, the long-term success of extension efforts might be better assured if a reliable channel for information and support amongst SRI farmers is established in each target area such that other farmers can have clearer confirmation of the advantages of SRI as well as support in order to overcome the disadvantages long after extension agents have left the area. At the same time, extension efforts should be tailored to the realities of a farmer's particular environment, because location can clearly play a part in these dynamics. Therefore, contextual awareness is important.

In offering these insights, though, it is also important to recognize the limitations of this research effort. For instance, in this thesis, we did not look at the intensity of adoption, that is the total area over which a farmer may practice a component. Therefore, we did not attempt to explain what factors may play a part in a farmer choosing to practice a component in one or several plots but not others. It could be that other variables that were not necessarily as influential in this thesis turn out to be important in explaining the intensity of adoption. Also, again we must recognize the limitations of the actual variables used in this research. For instance, even though plot-level data was collected for this research

effort, it was not possible to actually visit all the plots and collect the kind of specific, detailed, information for each plot that might better explain differences in adoption patterns.

Given what has been stated here then, further research on individual SRI component practice across countries that addresses the limitations of this research effort and others is warranted. In this way, the large gaps that still exist with regard to our understanding of overall SRI adoption dynamics can be gradually filled.

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Appendix

Survey Questionnaire

Enquête pour mieux comprendre les caractéristiques des rizicultivateurs malgaches

---

Date: _____ *Ménage Numéro* _____

*Enquêteur:*_____ *Classification en 2000 :* □ Adoptant □ Dis-adoptant □ Non-Adoptant

*Commune:*_____

*Fokontany:*_____

*Hameau:*_____

Information démographique du chef de ménage

Nom et Prénom: _____

Sexe: M □ *F* □

Age: _____

Niveau d'éducation atteint: _____

Taille *du ménage:* ___ (incluant ___ personnes de 15 ans ou plus et ___ jeunes de moins de 15 ans)

Personne enquêtée (si pas le chef de ménage): _____

Est-ce que le chef de ménage a changé depuis le début de l'année 2000? □ oui □ non

Si oui, pourquoi?

□ *La personne a déménagé* □ *La personne est décédée* □ *Autre raison*

Quelle est la relation de l'actuel chef de ménage á l'ancien chef de ménage? _____

---

1. Expérience et Connaissance du SRI

1.1 Combien d'années d'expérience avez-vous dans la riziculture? ___ ans

1.2 Connaissance du SRI

1.2.1 Connaissez-vous le SRI? □oui □non

Si oui,

1.2.2 À votre avis, quels sont les composants essentiels du SRI?

1. _____

2. _____

3. _____

4. _____

5. _____

1.2.3 Quelles sont ses avantages?

□ production □ moins de semence □ moins d'eau □ autre (préciser) _____

1.2.4 Quels sont ses désavantages?

□ trop de travail □ plus de risque □ trop compliqué □ autre (préciser) _____

1.2.5 Comment avez-vous appris les techniques du SRI?

□ formation de _____ (nom de l'organisation) **□ voisin/famille**

□ vulgarisateur de _____ (nom de l'organisation) **□ journal**

□ autre (expliquer) _____

1.2.6 (Le cas échéant) Nombre de visites par vulgarisateur: __ 1ère année, __maintenant

---

2. Information générale sur les rizières

2.1 Combien de rizières (ensemble de parcelles) avez-vous ? _____

2.2 Variété de semence _____

2.3 <u>Méthodes</u>

2.3.1 Quelle(s) méthode(s) est-ce que vous utilisez dans vos rizières? SRI □ Autres Méthodes □

2.3.2 Si vous pratiquez le SRI avec autre(s) méthode(s), spécifier le nombre de rizières par méthode?

SRI ____ Autres Méthodes ____

2.4 <u>Distances</u>

2.4.1 Est-ce que vos rizières sont contiguës (ensembles) ? □oui □non

2.4.2 Si non, quelle est la durée du trajet de l'un à l'autre ? _____minutes

2.5 Est-ce que vous cultivez une autre culture dans les rizières pendant la contre saison? □ oui □ non

Si oui, préciser. _____

3. Information par rizière

	Rizière 1 (ou autre classification _____)	Rizière 2 (ou autre classification _____)	Rizière 3 (ou autre classification _____)	Rizière 4 (ou autre classification _____)	Rizière 5 (ou autre classification _____)	Rizière 6 (ou autre classification _____)
3.1 Superficie	___ ares	___ ares	___ ares	___ ares	___ ares	___ ares
3.2.1 Méthode(s) Utilisée(s)	□ SRI □ autre	□ SRI □ autre	□ SRI □ autre	□ SRI □ autre	□ SRI □ autre	□ SRI □ autre
3.2.2 Si vous pratiquez plus qu'une méthode dans la rizière, pourquoi ?						
3.3 Où se situe la rizière?	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____	□ en plaine □ en hautes terres □ en terrasse □ autre (préciser) _____
3.4. Quelle est la durée du trajet de la maison jusqu'à la rizière?	___ minutes	___ minutes	___ minutes	___ minutes	___ minutes	___ minutes
3.5.1 Classer la qualité du sol dans la rizière.	□ bon □ moyen □ pauvre	□ bon □ moyen □ pauvre	□ bon □ moyen □ pauvre	□ bon □ moyen □ pauvre	□ bon □ moyen □ pauvre	□ bon □ moyen □ pauvre
3.5.2 Expliquer et donner plus de détails sur la qualité et type du sol.						
3.6 Quelle est la principale source d'irrigation pour la rizière?	□ source permanente (préciser) _____ □ barrage □ eau de pluie	□ source permanente (préciser) _____ □ barrage □ eau de pluie	□ source permanente (préciser) _____ □ barrage □ eau de pluie	□ source permanente (préciser) _____ □ barrage □ eau de pluie	□ source permanente (préciser) _____ □ barrage □ eau de pluie	□ source permanente (préciser) _____ □ barrage □ eau de pluie

4. Superficie cultivée (en ares)

Année	**2011-2012**	**2010-2011**	**2009-2010**	**2008-2009**	**2007-2008**	**2006-2007**	**2005-2006**	**2004-2005**	**2003-2004**	**2002-2003**	**2001-2002**	**2000-2001**
en SRI												
Autres Méthodes												
Total												

Si la superficie totale a changé entre 2000 et 2012, pourquoi?_____

2011-2012	**Rizières en SRI**	**Autres Rizières**	**Depuis**
Propriétaire			
Locataire			
Métayer			

5. Rendement pour 2010-2011 (si l'information est disponible)

	Semences (en grammes)	Superficie (en Ares)	Talles Fertiles (Min-Max)	Récolte (en KG)	Rendement (Tonnes/Ha)
Rizières en SRI			-		
Autres Rizières			-		
Total			-		

---

6. Techniques rizicoles

Tâche	Rizières en SRI (Maintenant)	Rizières en SRI (Technique Précédente)	Autres Rizières (Maintenant)	Autres Rizières (Technique Précédente)
6.1 Comment préparez-vous la pépinière?	□ á sec □ inondée □ pas de pépinière Depuis _____	□ á sec □ inondée □ pas de pépinière Depuis _____	□ á sec □ inondée □ pas de pépinière Depuis _____	□ á sec □ inondée □ pas de pépinière Depuis _____
6.2 Après combien de jours repiquez-vous les plants?	_____ jours Depuis _____	_____ jours Depuis _____	_____ jours Depuis _____	_____ jours Depuis _____
6.3 Comment repiquez-vous les plants?	□brin par brin □ensemble en touffe de ___ plants Depuis _____	□ brin par brin □ensemble en touffe de ___ plants Depuis _____	□ brin par brin □ensemble en touffe de ___ plants Depuis _____	□ brin par brin □ensemble en touffe de ___ plants Depuis _____
6.4 Est-ce que vous faites le repiquage en ligne?	□ oui □ non Depuis _____	□ oui □ non Depuis _____	□ oui □ non Depuis _____	□ oui □ non Depuis _____
6.5 Quel est l'écartement en centimètres entre les plants?	___ cm X ___ cm Depuis _____	___ cm X ___ cm Depuis _____	___ cm X ___ cm Depuis _____	___ cm X ___ cm Depuis _____
6.6 Comment se fait la maîtrise de l'eau dans les rizières?	□saturation constante des rizières □assèchement périodique des rizières □ Autre méthode (préciser)_____ Depuis _____	□saturation constante des rizières □assèchement périodique des rizières □ Autre méthode (préciser)_____ Depuis _____	□saturation constante des rizières □assèchement périodique des rizières □ Autre méthode (préciser)_____ Depuis _____	□saturation constante des rizières □assèchement périodique des rizières □ Autre méthode (préciser)_____ Depuis _____

6.7 Comment se fait le sarclage des rizières? Combien de fois?	□à la main, _____ fois par an □avec une sarcleuse, _____ fois par an Depuis _____	□à la main, _____ fois par an □avec une sarcleuse, _____ fois par an Depuis _____	□à la main, _____ fois par an □avec une sarcleuse, _____ fois par an Depuis _____	□à la main, _____ fois par an □avec une sarcleuse, _____ fois par an Depuis _____
6.8 Quel type de fertilisant utilisez-vous? Dans quelles quantités?	□ compost, ___ kg □ fumier, ___ kg □ engrais chimique, ___kg Depuis _____	□ compost, ___ kg □ fumier, ___ kg □ engrais chimique, ___kg Depuis _____	□ compost, ___ kg □ fumier, ___ kg □ engrais chimique, ___kg Depuis _____	□ compost, ___ kg □ fumier, ___ kg □ engrais chimique, ___kg Depuis _____

6.9 D'où vient le compost ou le fumier que vous utilisez? _____

6.10 Quelles tâches est-ce que vous faites vous-même et lesquelles sont faites par salariés?

_____

_____

7. Apprentissage

7.1 Est-ce que vous êtes membre d'une organisation paysanne? □ oui □ non

Si oui, donner le nom de cette organisation? _____

7.2 Contacts avec autres paysans

7.2.1 En quels autres paysans est-ce que vous avez le plus confiance? Donner les noms de deux de ces paysans si possible.

1. _____
2. _____

7.2.2 Pourquoi est-ce que vous estimez les conseils de ces paysans?

_____

_____

7.2.3 Ces paysans pratiquent quelle(s) méthode(s)?

Paysan 1 □ SRI □ autres méthodes
Paysan 2 □ SRI □ autres méthodes

7.3 Contacts avec cultivateurs du SRI

7.3.1 Combien de cultivateurs qui font le SRI connaissez-vous? ____

7.3.2 Donner les noms de deux de ces paysans (si différent de question 3.2.1)

1. _____

2. _____

7.3.3 Est-ce que vous discutez le SRI avec eux? □oui □non

7.3.4 Est-ce que vous avez visité leurs rizières? □oui □non

---

8. Défis

8.1 Quelles sont les problèmes qui diminuent votre production du riz ? Quelles sont les plus inquiétantes ?

Risques (marquer le rang)	Période (le cas échéant)	Les rizières en SRI sont : plus / moins / aussi susceptible que les autres rizières.
□		
□		
□		
□		
□		

8.2 ***Est-ce que les rizières sont susceptibles á l'inondation ou la sécheresse?***

□ pas susceptible □ susceptible á l'inondation

□ susceptible á la sécheresse □ susceptible á tous les deux

---

9. Economie du ménage

9.1 <u>Autres Parcelles</u>

9.1.1 Avez-vous d'autres parcelles (ou ensembles de parcelles) dans lesquelles vous cultivez d'autres cultures (á l'exception du riz)? □oui □non

Si oui,

9.1.2 Préciser les cultures? _____

9.1.3 Combien de parcelles (ensembles de parcelles)? ____

9.1.4 Superficie totale de ces parcelles? _____

9.2 Combien et quels types d'actifs avez-vous?

Animaux	**Nombre**
bœuf (zébu)	
porcs	
vache laitière	
volaille	
autres	
Matériaux Agricoles	**Nombre**
angady	
charrette	
sarcleuse	
faucille	
fourche à fumier	
bêche	

9.3 Crédit

9.3.1 Est-ce que vous empruntez de l'argent au cours de l'année? □oui □non

Si oui,

9.3.2 Pour faire quoi? _____

9.3.3 Quand? _____

9.3.4 D'où? _____

9.4 Sources de revenu monétaire régulières (rentrées d'argent) pour la famille

LIEU : L'activité se passe (1) au Village (2) Ailleurs

PERIODE : Les mois de l'activité. 1=janvier, 2=fevrier, etc. Mettre « tous » pour les activités qui dure toute l'année et « périodique » pour les sources périodiques

TYPE : (1) Salarie (fonctionnaire, ONG, etc.) *(2) Main d'œuvre agricole*
(3) Main d'œuvre non-agricole *(4) Artisinat*
(5)Commerce *(6) Vente de produits agricoles autre le riz*
(7) Vente du riz *(8) Vente de produits de l'elevage*

Source (en Rang)	Lieu	Période	Type
9.4.1			
9.4.2			
9.4.3			
9.4.4			

9.5 Normalement, combien de mois de soudure avez-vous? _____

---

10. Questions supplémentaires pour les non-adoptants de 2000 qui actuellement pratiquent les composants du SRI

10.1 Pourquoi est-ce que vous avez décidé de pratiquer les techniques du SRI? Est-ce qu'il ya des conditions qui ont changé depuis 2000 de telle façon que vous puissiez les pratiquer?

_____

_____

10.2 Est-ce que vous avez vu des cultivateurs qui faisaient le SRI avant vous? □ oui □ non

10.3 Est-ce que leur succès vous a encouragé d'essayer le SRI? □ oui □ non

10.4 En général, est-ce que vous êtes content avec la méthode du SRI? □ oui □ non

Pourquoi ou pourquoi pas?

_____

10.5 Est-ce vous avez reçu de l'aide avec les travaux ou des matériaux d'un projet ou d'un ONG pour le SRI au début ? □ oui □ non

Si oui, expliquer _____

10.6 Quels sont les travaux supplémentaires que vous avez fait pour avoir une bonne maîtrise d'eau pour SRI la première année (travail sur le planage, les canaux, les draines, etc.) ? Avez-vous beaucoup dépensé pour ces travaux?

_____

10.7Expansion (Pour ceux qui ont des rizières non-SRI)

10.7.1 Pourquoi n'avez–vous pas toutes vos rizières en SRI maintenant?

- □ trop de travail pour l'irrigation ou le planage
- □ maîtrise d'eau impossible
- □ manque d'argent pour les salariés
- □ manque d'expérience avec la méthode
- □ manque de temps
- □ retard de la pluie
- □ autre (préciser)_____

10.7.2 Qu'est qui peut vous permettre d'augmenter la superficie en SRI?

- □ aide avec le planage ou irrigation
- □ crédit pour payer les salariés
- □ autre (préciser) _____

---

11. Questions supplémentaires pour les non-adoptants et dis-adoptants de 2000 qui actuellement ne pratiquent pas les composants du SRI

11.1Pourquoi ne faites-vous pas le SRI?

- □ trop de travail pour l'irrigation ou le planage
- □ maîtrise d'eau impossible
- □ manque d'argent pour les salariés
- □ manque d'expérience avec la méthode
- □ manque de temps
- □ manque de techniciens
- □ retard de la pluie
- □ autre (préciser)_____

11.2 **Est-ce qu'il y a des techniciens, vulgarisateurs, ou experts qui peuvent vous aider avec les techniques du SRI?** □ oui □ non

11.3**Est-ce que vous voulez faire le SRI? □ oui □ non**

11.4Si non, pourquoi pas? _____

11.5Si oui, qu'est qui peut vous permettre de le faire?

- □ aide avec le planage ou irrigation
- □ crédit pour payer les salariés
- □ vulgarisation
- □ autre (préciser)_____

---

12. *Questions supplémentaires pour les dis-adoptants de 2000 qui actuellement pratiquent les composants du SRI*

12.1Pourquoi est-ce que vous avez décidé de pratiquer encore les techniques du SRI? Est-ce qu'il ya des conditions qui ont changé depuis 2000 de telle façon que vous puissiez les pratiquer?

_____

_____

---

13. Questions supplémentaires pour les adoptants de 2000 qui actuellement ne pratiquent pas les composants du SRI?

13.1Pourquoi ne faites-vous plus le SRI?

- □ trop de travail pour l'irrigation ou le planage
- □ maîtrise d'eau impossible
- □ manque d'argent pour les salariés
- □ manque d'expérience avec la méthode
- □ manque de temps
- □ manque de techniciens
- □ retard de la pluie
- □ autre (préciser)_____

13.2**Est-ce que vous voulez faire le SRI? □ oui □ non**

13.3Si non, pourquoi pas? _____

13.4Si oui, qu'est qui peut vous permettre de le faire encore?

- □ aide avec le planage ou irrigation
- □ crédit pour payer les salariés
- □ autre (préciser)_____

---

14. *Questions supplémentaires pour les adoptants de 2000 qui actuellement pratiquent les composants du SRI*

14.1*Pourquoi est-ce que vous continuez de pratiquer les techniques du SRI?*

_____

14.2Quels types de problèmes est-ce vous rencontrez actuellement à propos du SRI?

_____

14.3(Pour ceux qui ont augmenté la superficie en SRI depuis 2000)Pourquoi est-ce que vous avez décidé d'augmenter la superficie en SRI? Est-ce qu'il ya des conditions qui ont changé depuis 2000 de telle façon que vous pouviez l'augmenter?

_____

_____

---

15. Autres Notes/ Commentaires

Autres organisations/ONGs/vulgarisateurs qui ont visité le ménage? (Qui, quand, pour faire quoi?)

_____

_____

_____

_____

_____

_____