A Socio-Economic Assessment of the System of Rice Intensification (SRI):
A Case Study from Xinsheng Village, Jianyang County, Sichuan Province

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Abstract: It is important to understand the performance of any new technology in the context of farmers' realities, which are always more complicated and more diversified than on any research station. This paper considers the effects of SRI compared with conventional practice in a village setting in China, where uptake of SRI was very impressive. It was found that SRI demonstrated many merits, such as higher yield and lower cost of production, along with saving of water and saving of labor. It also showed some positive features in terms of impacts on the environment and resilience to drought. It also has potential to release some labor from rice production. Some issues to be further examined are pointed out in conclusion.

Key Words: SRI Socio-economic Assessment Household Level

China's rice production has been declining since 2000 (State Statistic Bureau, 2004), so raising the growth of productivity in the rice sector is of great concern to the central government. SRI (System of Rice Intensification) is of interest because it has shown various merits in many places around China such as higher yield and lower costs of production along with saving of water and even with some saving of labor possible.

However, no socio-economic assessment of SRI at the household level has been carried out until now. It is important to understand the performance of any new technology in the context of farmers' realities, which are always more complicated and more diversified than on any research station (Chambers and Thrupp, 1989; Röling, 1991; Uphoff et al., 2002; Li, 1993, 2002).

This paper therefore focuses on the effects of SRI compared with conventional practice in an actual village setting. The points to be considered include: (1) the adoption and the diffusion of SRI in a rural setting; (2) farmers' impressions of SRI; for example, what are the advantages and disadvantages of SRI? and what is the ranking of the advantages they find with SRI as well as of any disadvantages? (3) the impacts of SRI on farmers' livelihood, especially on their gross incomes, on different kinds of production costs, as well as on their gross and net returns; and (4) the impacts of SRI on the division of labor by gender, and any impacts on the environment.

1. Methodology of the Research

This study was carried out in Xinsheng Village, Dongxi Township, Jianyang County, which lies to the east of Chengdu, during the period 18-25 August 2004. The data were collected by two researchers from the College of Humanities and Development, CAU, with assistance from four local farmers, three of whom undertook the questionnaire surveys, while the other organized group discussions. In total, 82 households were interviewed through questionnaire surveys, and two groups of farmers, with 11 in each group, were

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convened. The results of the group discussions and the findings of the questionnaires were cross-checked, with questionnaires supplying quantitative data for more detailed understanding. More about the research methodology is given in Table 1.

Table 1: Methodology of the research

Approaches	Methods and Tools	Output (information collected)
Contact with Li Shihua in Sichuan Academy of Agricultural Sciences (SAAS)	- Key informant interviews - Second-hand data collection	- The process of development of SRI in Sichuan - The relationships between different research institutions - Selection of Xinsheng Village as the case study site
Visit to Dongxi Township and Xinsheng Village	- Key informant interviews - Second-hand data collection - Field observations	- Township profile and village profile - General information about SRI in the village, such as its advantages, disadvantages, and the extension process
Living in Xinsheng Village	- Group Discussions (one group of SRI farmers, one group of non-SRI farmers)	- Advantages/disadvantages of SRI - Ranking of the advantages and also of the disadvantages of SRI - Comparison between SRI and conventional practice in terms of kinds of production costs - Any impacts of SRI on the division of labor by gender, as well as on the environment
Living in Xinsheng Village	- Questionnaires (82 SRI households)	Quantitative data on SRI during the process of adoption and adaptation
Report back to SAAS		

The introduction of SRI development in Sichuan Province was led by the Sichuan Agricultural University, which set up a research team on SRI for Sichuan in 2001.[2] In 2002, after attendance of an international conference on SRI held in Sanya, Hainan Province, Sichuan Academy of Agricultural Sciences (SAAS) began supporting an adaptation of SRI known as the 'Big Triangular Method' of planting. This methodology for crop establishment involves planting 3 young seedlings per hill (not just 1, as is standard SRI practice) but in a triangular pattern with 10-12 cm spacing between the plants; the hills are planted in a staggered 50x50cm grid, rather than 25x25 or 30x30 cm as is usually done with SRI.[3]

Due to the great success of trials in Wenjiang County, where the yield reached 800kg/mu, equal to 12 tons per hectare, the 'Big Triangular Method' of SRI began to be extended, though not yet on a large scale. In 2004, the extension process was accelerated by SAAS in collaboration with local governments, and more and more farmers have begun to know about and adopt the 'Big Triangular Method' of SRI.

There are 612 households in Xinsheng Village, and 398 of them were SRI farmers in 2004, up from just 7 in 2003.[4] Since 2004 was the first year of SRI adoption for most farmers in Xinsheng Village,[5] the

[2] The member institutions in this team included the Rice Research Institute of Sichuan Agricultural University, the Soil and Fertilizer Research Institute as well as the Rice Research Institute of SAAS, the Demonstration Center of Agricultural Technology of Sichuan, and the Meishan Institute of Science and Technology.

[3] This has the effect of increasing plant density by about 50% over standard SRI practice while still keeping wide spacing. Originally this triangular method placed 3 plants 5-7 cm from each other with staggered hills in a 30x30 cm grid, alternating rows by 15 cm. Although this alternative spacing reduces the number of hills by half, compared to planting at the intersection of every grid line, there are 50% more plants/m^2 since each remaining hill has 3 plants.

[4] In this paper, 'SRI farmers' are considered as the same as 'SRI households'.

impact of SRI on livelihoods cannot not be very evident yet. A more in-depth socio-economic assessment should be undertaken in a few years. However, the merits of SRI, such as saving of labor, saving of water and higher yield, can already be seen from both the group discussions and the questionnaire survey that provided the data for this analysis.

2. Findings

2.1 The adoption and diffusion of SRI

SRI is rather new to most farmers in Xinsheng Village. Among the 82 interviewees, 53.7% (44 SRI farmers) heard of it for the first time only in 2003, while 46.3% first learned of it in 2004. Most of the 7 households who used SRI in the first year were members of the village committee, or relatives of the head of the village committee. This number increased to 398 in 2004. The 75 farmers included in our sample were selected at random from this larger number. According to a wealth ranking of SRI farmers by the village committee,[6] poor farmers accounted for 8.5% of SRI users compared with being 10% of the total number of farmers in the village (Table 2). While the proportion of poor SRI farmers is a little bit lower than average for the village, the difference is not really significant. SRI adopters are roughly proportional to the distribution of farmers (households) according to wealth ranking in the village.

Table 2: Wealth ranking of SRI farmers

	Better-off	**Medium**	**Poor**	**Total**
Total households	184	367	61	612
Percent (%)	30	60	10	100.0
SRI farmers	128	236	34	398
Percent (%)	32.2	59.3	8.5	100.0

The average size of paddy field for households in the village is 1.1 Mu. This number has been fairly steady in recent years, although some holding sizes have been reduced by distribution of land to children or because of the SLCP.[7] According to the questionnaire data (Table 3), the average size of paddy field per household has been gradually increased from 2002 to 2004, probably because of the exploitation of 'wasteland,' although this requires confirmation. It can be seen that the average size of SRI plots per household has increased dramatically, from 0.07Mu/HH in 2003 to 0.99Mu/HH in 2004 (Figure 1).

Table 3: Size of paddy fields (Mu/HH)

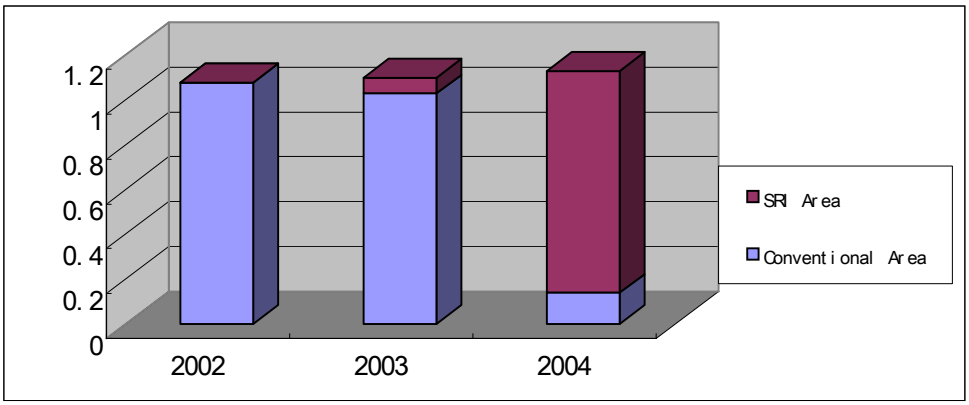
	2002 (before SRI)	**2003**	**2004**
Conventional rice (Mu/HH)	1.08	1.03	0.14
SRI (Mu/HH)	0	0.07	0.99
Total size (Mu/HH)	**1.08**	**1.10**	**1.13**

[5] We could not get data on the exact yield for 2004 while in the field as data were gathered before the harvest time. Estimates of 2004 yield as reported by the head of the village committee after the harvest in October have been used in this paper.

[6] The criterion adopted was the farm household's income per capita per year: better-off = over 2000 RMB; medium = 1000 RMB-2000 RMB; poor = under 1000 RMB.

[7] SLCP stands for the Sloped Land Conversion Program, promoting the conversion of sloping farms over 25 degrees back to tree or grass cover to reduce soil erosion, with subsidies of cash and food paid to farmers. It was initially carried out due to the major flood in 1998 in Yangtze River. Now it has expanded to 20 provinces.

Figure 1: Trends of SRI area in Xinsheng village (Mu/HH)



Most of the farmers (84.2%) said they got their SRI information from the village committee and the SAAS (Table 4). When asked "have you introduced SRI to others?" only 18.3% (15 farmers) gave the answer "yes." Further inquiry showed that those active in promoting SRI were mostly members of village committee or now of the farmers' association.[8] Most of the farmers (81.7%) had not spread the information partly because they themselves are not yet completely sure about the technology, this being their first year of adoption. Nevertheless, some expressed their wish to promote SRI to their friends and relatives in other villages in case the 2004 yield increased as expected. 86.6% of the SRI farmers said they are planning to expand their area under SRI, or to keep their full paddy area under SRI in the future, which reflects a favorable opinion to SRI.

Table 4: Where did you get information on SRI?

	Frequency	Percent (%)
Neighbors	3	3.7
Relatives	1	1.2
Extension personnel	8	9.8
Village committee	44	53.7
Others (SAAS)	25	30.5
No information	1	1.2
Total	**82**	**100.0**

2.2 Farmers' impressions of SRI

2.2.1 SRI farmers

As mentioned above, rapid progress has been made in the diffusion of SRI since 2003, in terms of both the number of households and the area of SRI fields. This can be ascribed mostly to the advantages that SRI offers, most prominently for saving labor and for saving water. According to the group discussion, SRI farmers unanimously (100%) considered saving labor as its greatest merit. Slightly over half, 54.5% of

[8] Attention should be given in the case of Xinsheng Village to the influence of the Farmers' Association on the adoption and the diffusion of SRI. This organization was set up in March 2004, according to the model of "Experts + Association." The "experts" are mainly scientists and researchers from SAAS or from their cooperating research institutions. The "association" made up of farmer-members provides services such as seed and fertilizer purchase and weed and pest control to its members. Member-households in Xinsheng Village and other villages each pay 10 RMB per household per year. The number of association members has increased up to 1000 in Dongxi Township by now.

farmers argued that the mulching/no weeding practice associated with SRI should be second on the list, while the other 45.5% of farmers insisted that "saving water" should be ranked after the advantage of "saving labor" (Table 5). Considering the fact that the time saved from weeding is ultimately part of the advantage of "saving labor," probably "saving water" should be considered as the second major advantage of SRI. This conclusion is supported by responses to the questionnaire survey (Table 6). Higher yield, saving labor, and saving water are listed as the first three main advantages of SRI, with some other benefits also mentioned, such as saving seed (18.3%) and less diseases and pests (15.9%).

Table 5: Ranking of the advantages of SRI, according to group discussion*

Farmers	Saving labor	Saving water	Use of plastic mulch/ No weeding
A	1	3	2
B	1	3	2
C	1	3	2
D	1	3	2
E	1	2	3
F	1	2	3
G	1	2	3
H	1	3	2
I	1	3	2
J	1	2	3
K	1	2	3
Total	100%: 1st	45.5%: 2nd	54.5%: 2nd

*Note: * The data represent the rankings of farmers: 1 indicates that the farmer gave that particular advantage first priority; 2 indicates second rank in importance; 3 indicates third rank of importance.*

Table 6: Advantages of SRI, according to questionnaire survey

Advantages	No		Yes	
	Frequency	Percent (%)	Frequency	Percent (%)
Higher yield	25	30.5	57	69.5
Saving labor	34	41.5	48	58.5
Saving water	37	45.1	45	54.9
Saving seed	67	81.7	15	18.3
Less disease and pest	69	84.1	13	15.9
Less pesticide	72	87.8	10	12.2
Lower production costs	75	91.5	7	8.5
Less fertilizer	80	97.6	2	2.4
More milling output	81	98.8	1	1.2
Others	73	89.0	9	11.0

As for disadvantages of SRI, need for "more pesticide" was mentioned in the group discussion, while "more efforts in the management of water," "more fertilizer," and "more weeds" were also put forward by 29.3% of the interviewees in the questionnaire surveys. It should be observed that more intensive and more uniform cultivation of rice has been carried out in Xinsheng Village since the association was organized in

2004. Increased agricultural technological information has come from the experts in SAAS and this information was delivered to members.

2.2.2 Non-SRI farmers

There are still 214 non-SRI households in Xinsheng Village, accounting for 35% of the total. A majority of them are medium or poor farmers. According to the results of group discussion (Table 7), the main reason for non-adoption is difficulties with water management. A second set of reasons seen in Table 7 relates to lack of knowledge about SRI.

More attention and effort for water management is needed when young seedlings with just 2-3 tillers are transplanted into the paddy field, to keep them from being flooded; this is not a problem in conventional practice with older and stronger seedlings. The water management constraint can be a real one. Some farmers do not have the possibility of controlling their water supply because they have field-to-field irrigation with no independent source of control. In some cases also, water management problems arise because the paddies are not well-leveled[9].

Other disadvantages mentioned by just a few non-SRI farmers were "more weeds" and "more seeds."

Table 7: Reasons for not adopting SRI

	1st reason	2nd reason	3rd reason	4th reason
More effort needed in water management	7	0	0	0
Do not know how to do it	2	5	1	0
Do not know the merits of SRI	2	2	5	0
More weeds to deal with	0	1	1	0
More seeds needed	0	0	0	2

Note: There were 11 non-SRI farmers in the group discussion. The number in each cell is the number of farmers who chose that reason.

2.3 Impacts on farmer livelihoods

2.3.1 Yield and gross income

SRI yield/Mu was 47.7% higher than that from conventional practice in 2003, and 12.1% higher in 2004 (Table 8). The higher SRI yield in 2003 was particularly important because that was a drought year. Farmers using conventional methods suffered a 26.2% decline in yield, while those using SRI got 9% higher yield than the previous normal year. This encouraged quick and widespread adoption of SRI in 2004.

The price of rice in 2004 was 60% higher than in 2002, and was raised by 20% in 2003. In Table 8 we show the value of rice production both in constant prices (1.5 RMB/kg) and current market price (2.4RMB/Kg). Actually, since farmers in Xinsheng Village do not sell much or any of the rice in the market, their increased yield with SRI and the higher market price have not led to any actual improvement of their cash income, which is very important for Chinese farmers, especially those with children at school or old parents in hospital. This village is still poor enough that it is using its rice mostly for home consumption.

Gross income per mu in 2003, at constant 2002 prices, went down 26.2% for farmers using conventional methods, because of the drought while SRI gross income/mu went up 9.0% despite the water shortage.

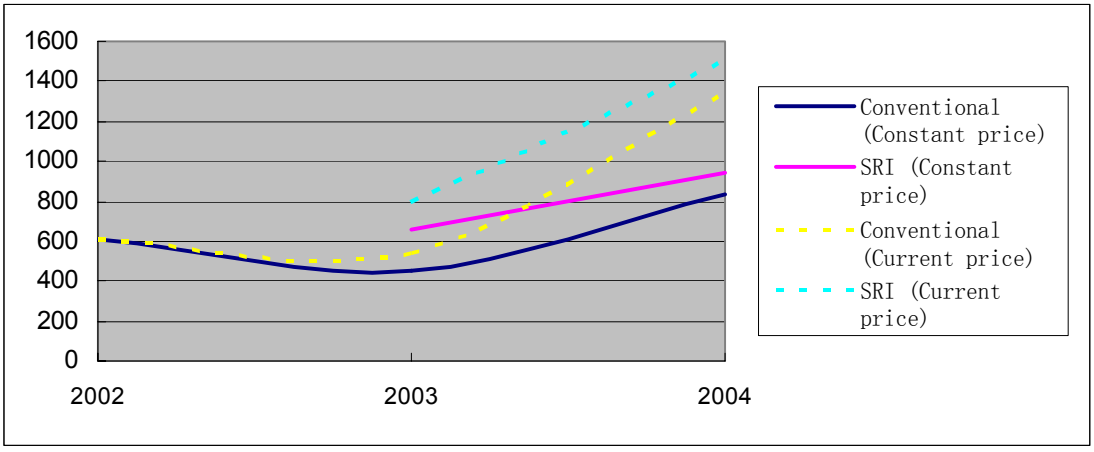
[9] This is a matter of investing labor to get paddies level enough that small amounts of water can be applied to wet the whole field in a quick and regular way without any part of the field getting and staying inundated.

At the current higher prices, income/mu was only 11.5% reduced for conventional farmers while it was 30.7% higher for those using SRI methods. This past year, 2004, a more normal year, the gross income/mu for farmers still using conventional methods was 38.1% higher at earlier 2002 prices and 120.9% increased at current, much higher, 2004 prices. Farmers using SRI methods, by comparison, earned a gross income/mu of 54.8% more at 2002 prices and 147.7% higher than 2002 income at current prices (Table 8; Figure 2).

Table 8: Yield and gross income using SRI in 2003 and 2004, with constant price and current price

		2002 (before SRI)	2003		2004	
Total size (Mu/HH)		1.08	1.1		1.13	
Conventional yield (Kg/Mu)		403.73	297.88		557.5	
SRI yield (Kg/Mu)		——	439.87		625	
Rice price (RMB/Kg)		2002 price	2002 price	2003 price	2002 price	2004 price
		1.5	1.5	1.8	1.5	2.4
Gross income (RMB/Mu)	Conventional	605.60	446.82	536.18	836.25	1338.00
	SRI	——	659.81	791.77	937.50	1500.00

Figure 2: Income respectively from SRI per Mu and conventional rice per Mu, with constant price and current price



2.3.2 Production costs

(1) Seed, fertilizer and pesticides

According to the questionnaire survey, farmers who used SRI and conventional practices in the same year (e.g., in 2003), found that the use of seed, fertilizer and pesticides with the two different practices was almost the same. From Tables 9, 10 and 11, we see that the expenditure on seed, fertilizer and pesticides all increased, rather than decreased after the introduction of SRI in Xinsheng village.[10] The total increment was 28.56 RMB/Mu or 34.29 RMB/HH.

SRI in Xinsheng involves not simply the 'Big Triangular Method' of planting rice, but a number of

[10] In a survey of 120 Cambodian farmers who have used SRI for three years (2001-2003), the use of chemical fertilizer per household went from 116 kg to 67kg per hectare. With healthier plants usually resulting from SRI practices, the use of pesticides also usually declines. In the Cambodian study, 80% of SRI-using households had given up the use of chemical protection altogether (Tech, 2004).

other changes including a change of seed variety, use of balanced chemical fertilizer, and more aggressive pest and weed control, which resulted in the overall increase of the costs in terms of seeds, fertilizers and pesticides. Total fertilizer use in volume terms (kg/Mu) declined about 11% after the introduction of SRI, as seen in Table 10[11]. These innovations were all carried out with the help of the Association and involved more purchases for farmers.

Table 9: Amount of seed used

	2002 (before SRI)	2003 (serious drought)	2004
Seed used (kg/HH)	1.24	1.28	1.7
Seed used (kg/Mu)	1.17	1.18	1.56
Price (RMB/kg)	8	8	20
Cost of seed (RMB/HH)	9.92	10.24	34
Cost of seed (RMB/Mu)	9.36	9.44	31.2

Table 10: Fertilizer used

	Price (RMB/Kg)	2002 (before SRI)	2003	2004
Carbolic ammonia (kg/Mu)	0.5	17.37	16.93	6.77
Carbamide (kg/Mu)	1.7	21.98	23.14	25.91
Phosphoric fertilizer (Kg/Mu)	0.34	42.91	42.94	38.36
Potassium fertilizer (kg/Mu)	1.8	0	0	1.97
Cost of fertilizer (RMB/Mu)		60.64	62.4	64.02
Cost of fertilizer (RMB/HH)		69.51	72.14	75.09

Table 11: Pesticide used

	2002 (before SRI)	2003	2004
Number of applications	2.88	2.94	3.3
Cost of pesticide (RMB/HH)	16.68	17.17	21.31
Cost of pesticide (RMB/Mu)	15.81	15.88	19.15

(2) Labor

Saving labor is the greatest advantage of SRI in farmers' opinion, as seen from both the findings of the group discussions and the results of the questionnaire survey. According to Table 12, labor saving amounted to 1.89 *gong/* Mu, or 1.35 *gong/*HH with SRI in 2004, compared with the conventional practice in 2002.[12] These savings amount to 11.1% and 7.3%, respectively. Interestingly, this saving was much less than what farmers communicated in group discussion, in which they estimated labor savings to be 9-11 *gong/*Mu. This big difference may result from the manner of accounting. Most farmers complained during the questionnaire survey that it was difficult for them to account for the labor used as they are not used to keeping accounts this way. Six to eight *gong* may be more correct figure for labor saving than 1-2 *gong*/mu. Some farmers suggested that even more labor could be saved with SRI in the future since this was their first year of trial, and they were still engaged in learning. The number of units of labor saved per

[11] In 2004, 24 households began to use nitrogenous fertilizer according to the suggestion of the SAAS experts. There was, however, no difference seen in the usage of compost before and after SRI: 21 households used organic manure in 2002, and 20 households in 2003 and in 2004.

[12] A *gong* is the standard unit of comparison for labor inputs in rural areas, equivalent to a person-day.

Mu during each step in the cycle of rice cultivation is listed in Table 13.[13]

Table 12: Labor investment, from questionnaire data

	2002 (before SRI)	2003	2004
Labor investment (*gong*/Mu)	17.17	16.95	15.28
Labor investment (*gong*/HH)	18.57	18.55	17.22
Labor costs (RMB/Mu)	257.55	254.25	229.2
Labor cost (RMB/HH)	278.55	278.25	258.3

Table 13: Labor saved in different steps (per Mu), from group discussion

	Conventional requirement	SRI requirement
5 *gong* saved in seedling management		
Gong needed in seedbed preparation	1.5	2
G*ong* for land leveling, fertilization, and drainage preparation	3	0
G*ong* needed in transplanting, watering, and weeding	2.5	0
5-7 *gong* saved in transplanting		
Gong needed to plough the paddy field	4	2 *gong* for drainage preparation
Gong needed in land leveling and fertilization	1	0.5 *gong* for land leveling
Gong in uprooting seedlings, transporting and transplanting them	5	2.5 *gong*
Gong in weeding	2	2 *gong* or 0 if land is mulched
1 *gong* increase in harvesting		
Gong in harvesting	3	4 *gong* in harvesting
In total: 9-11 *gong* saved		

(3) Pumping water

Another prominent advantage of SRI is saving water, confirmed by both the group discussion and questionnaire survey. As seen in Table 14, 33.67 RMB/Mu or 34.5 RMB/HH was saved with SRI in 2004, compared with that needed in the conventional practices in 2002, i.e., savings of 46.0% and 43.2%.

Table 14: Cost of pumping water

	2002 (before SRI)	2003	2004
Pumping water (RMB/Mu)	73.43	68.95	39.76
Pumping water (RMB/HH)	80.45	78.4	45.95

(4) Calculation of total costs

Total costs of production per Mu in 2004 decreased by 33.46 RMB (8.0%) compared with those of 2002, and by 27.59 RMB (6.7%) compared with 2003. This is a conservative comparison because the reduction in labor costs was probably much greater than shown in Table 15, for reasons discussed in section (2). This trend can be seen in Figure 3.

Table 15: Total costs of production (RMB/Mu)

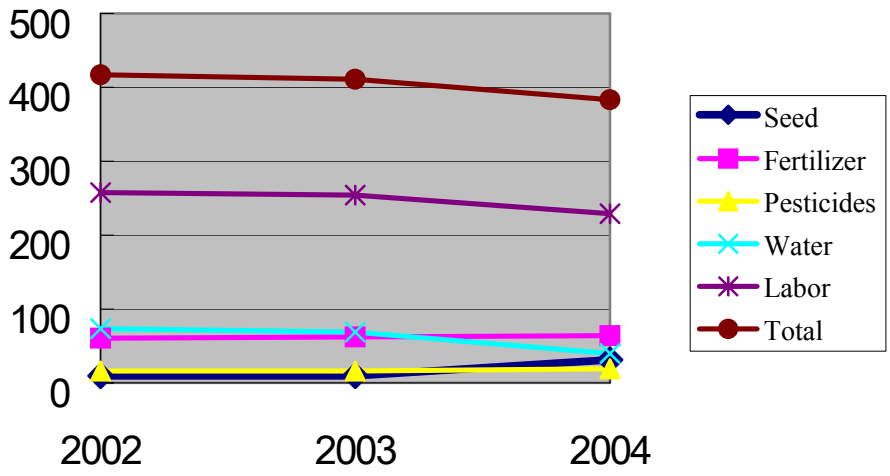
[13] The price of hired labor used for calculations in Table 12 is 15 RMB/*gong*, the wage for a laborer working a full day. Comparisons in terms of *gong* do not reflect differences in the capability or quality of the labor, or the different working hours of a day. It is not a common practice in Xinsheng to hire laborers when more hands are needed. Instead, farmers usually get help from their relatives, who will have meals with them, but not receive payment.

	2002	2003	2004
Seed	9.36	9.44	31.2
Fertilizer	60.64	62.4	64.02
Pesticides	15.81	15.88	19.15
Water pumping	73.43	68.95	39.76
Labor	257.55	254.25	229.20
Total	416.79	410.92	383.33

Table 16: Comparisons of total costs (RMB/Mu)

	2003 compared with 2002	2004 compared with 2003	2004 compared with 2002
Seed	0.85%	230.51%	233.33%
Fertilizer	2.90%	2.60%	5.57%
Pesticides	0.44%	20.59%	21.13%
Water pumping	-6.10%	-42.34%	-45.85%
Labor	-1.28%	-9.84%	-11.01%
Total	-1.41%	-6.71%	-8.03%

Figure 3: Production Costs of Rice (RMB/Mu)



2.3.3 Gross margin calculations

Considering the fact that farmers usually calculate their gross margin (net income) without deducting the costs of their own labor, two ways of calculation have been used, including an imputed cost of labor and then not including it. Also because there was a change in the price paid in the market for rice, thanks to the price increases in 2003 (from 1.5 to 1.8 RMB/kg) and again in 2004 (to 2.4 RMB/kg), we have calculated gross margins both at constant prices (all 1.5 RMB/kg) and current market prices. We see in Table 17 that with constant prices, the gross margin per Mu for rice production with SRI in 2003 was 6.93 times that in 2002 with conventional methods when including all imputed labor costs, and 2.11 times that when the costs of labor are not considered; with current prices, the ratios were respectively 3.04 and 1.91. These numbers are higher than those in 2004, which confirms the value of SRI to farmers in a bad year.

The value of water saving, compared with saving labor, contributes more to the reduction of the total costs according to Table 16, although as also discussed above, the questionnaire data used to make this calculation probably understate significantly the savings that are being made by farmers on cost of labor when using SRI. Labor savings are probably greater than water savings.

Table 17: Gross margin of rice respectively with conventional practice and SRI (RMB/Mu)

Year		2002	2003		2004	
Price adopted		2002 price	2002 price	2003 price	2002 price	2004 price
		1.5	1.5	1.8	1.5	2.4
Conventional	Cost of labor included	188.81	35.9	125.26	452.92	954.67
	Cost of labor not included	446.36	192.57	281.93	607.05	1108.80
SRI	Cost of labor included	—	248.89	380.85	554.17	1116.67
	Cost of labor not included	—	405.56	537.52	708.30	1270.80
Ratio of SRI margin compared with conventional one	Cost of labor included	—	6.93	3.04	1.22	1.17
	Cost of labor not included	—	2.11	1.91	1.17	1.15

2.4 Impacts on the gender division of labor and on the environment

In the questionnaire responses, 72% of the interviewees thought there were no impacts on the division of labor between men and women, and 96.3% identified no impacts on the environment. This may be partly a result of the short time of trial, or less importance may be attached to these issues than to the livelihoods of the interviewees. Also, the question regarding the environment may have been misunderstood. Usually it is asked with reference to negative impacts, and the response that there were no impacts on the environment could have meant they perceived no *adverse* effects for soil or water quality. Had the question been worded explicitly in terms of positive impacts and negative impacts, some distinction might have been made. But this remains to be studied further. Of the interviewees, 37.8% said that the SRI practice reduced the labor burden of male farmers (Table 20), while only 22% reported that it reduced the labor investment of female farmers (Table 21).

In the group discussion, it was generally accepted that SRI has more flexible labor requirements during the seedbed preparation. This usually requires young and strong labor during that period with conventional practice, whereas females and the old can also undertake nursery preparation with SRI since it is smaller in scale and with less heavy work. In the group discussion, the head of the village committee put forward an important point, accepted later by others, that SRI is more environmentally friendly because in conventional practice, drainage is necessary after transplanting with deep water and fertilization. This would lead to water pollution, whereas such drainage is not necessary in SRI practice because the young seedlings are transplanted with the shallow layer of water.

Table 18: Impacts on male labor

	Number of respondents	Percent (%)
Increase	4	4.9
Decrease	31	37.8
No change	28	34.1
No information	19	23.2

Total	82	100.0

Table 19: Impacts on female labor

	Number of respondents	Percent (%)
Increase	14	17.1
Decrease	18	22.0
No change	29	35.4
No information	21	25.6
Total	82	100.0

3. Issues to be Examined Further

There are several issues to be examined further in the following research. First and foremost, what is SRI? Is it a kind of technology, a set of technologies, a set of flexible practices, a methodology? Proponents insist that it should not be considered as a technology but rather as a set of principles for enhancing plant growth and performance, to be embodied in specific practices that are empirically adjusted and adapted to local conditions. Already in China, a number of modifications have been introduced to the set of practices that were developed in Madagascar for effectiveness under the agroecological conditions there. It seems that SRI should be regarded in a different light than usual 'technologies' for rice improvement, including an extension approach that involves farmers actively in the evolution and improvement of the methodology and also in its dissemination. How does this affect the methods used for dissemination? Is this a realistic approach and is it effective?

Second, what is the relationship between SRI spread and local institutional arrangements, such as the role and impacts of the Farmers' Association in Xinsheng Village? It is rather difficult to separate them. Possibly SRI's spread will depend on having such active support as the Association has given in this village. Alternatively, it may be possible once the principles and practices are more widely known and understood among farmers, there will be some natural diffusion, since SRI does not require purchase of certain inputs such as new seeds of fertilizer. It is a matter of changing how the plants, soil, water and nutrients are managed, using existing resources more productively. Maybe SRI will spread better when supported by certain kinds of local institutions -- local government, farmer association, cooperative, private business, NGO, schools, etc. Technology diffusion should always be understood in connection with corresponding institutional arrangements. SRI was developed in a farmer-centered mode in Madagascar. Can/should/must this be utilized in China for best results with SRI?

Third, SRI is 'not yet finished' but instead is still being improved by scientists and farmers alike (and hopefully, together). How can such a collaborative process be supported and promoted? Can this provide a basis for collaborative improvement of crops in sectors beyond rice? What are the respective roles of researchers, extension personnel, farmer-demonstrators, and other farmers? How could the process and institutions of technology development and dissemination be strengthened overall from this experience? SRI looks like a purely biophysical innovation, but it is embedded in social relationships.

Fourth, from this study, we see evidence that SRI offers benefits to farmers, but are these just short-run benefits? An important socio-economic issue to be explored is how the agricultural sector can

best absorb, accommodate and benefit from the gains in productivity of land, labor, capital and water that SRI offers. One response could be simply to let the price of rice decline as productivity rises and as supply moves ahead of demand. Another would be to try to capitalize on this increase in productivity to diversify the agricultural sector, redeploying the land, labor, capital and water no longer necessary to meet the country's basic food needs into other kinds of production, e.g., of fruits and vegetables that have higher nutritional and economic value and even export potential. How could intensification in rice production lead to diversification and modernization of agricultural production more generally? What market mechanisms, policy changes or other initiatives would be needed to make the most of the productivity gains that SRI offers?

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