SUMMARY OF GTZ EVALUATION OF THE SYSTEM OF RICE INTENSIFICATION (SRI) IN CAMBODIA, FEBRUARY-APRIL, 2004, BY JÜRGEN ANTHOFER & TEAM

This note summarizes a 51-page report commissioned by the German aid agency GTZ to evaluate the results, performance and limitations of the System of Rice Intensification (SRI) that is being used increasingly by thousands of farmers in Cambodia since its introduction in 2000. The report itself, which has an even longer appendix, is available from the SRI home page (http://ciifad.cornell.edu/sri/) but is too large a file to be sent over the internet without being 'zipped.' This summary gives the basic findings. Reading the whole report is recommended for a fuller understanding of what was learned from this very thorough study. --Norman Uphoff

DATA BASE: A survey was conducted in five provinces (Kandal, Kampong Thom, Kampong, Takeo, and Prey Veng), selected to represent a diversity of farming environments. In each of these provinces, 80 SRI farmers were interviewed, 20 being randomly selected within each of four villages that were identified as ones where SRI was in use (N=400). In addition, 20 non-SRI farmers were randomly selected in each province, 10 from each of two villages (N=100). This gave a representative sampling of experience with and without SRI. To verify information obtained from the individual interviews, two farmer group discussions were held in each province with both SRI and non-SRI farmers to get an understanding of the specific advantages and problems that they were finding with SRI.

Unlike many other on-farm evaluations, fields that were affected by either flooding or drought were purposely not excluded from the analysis, to take the effects of natural disasters into account. Further, because the data showed an inverse relationship between plot size and yield [something not necessarily seen in other countries -- NTU], only SRI fields of at least 30 ares were included in the quantitative analyses of yield, man-days of labor, profitability, etc. For qualitative assessments, all farmers were included in the analyses. A number of different quantitative analyses were done with the data, with statistical tests of significance, adaptability analysis, risk assessment, and economic evaluations.

FINDINGS:

1. Education: SRI farmers were somewhat more educated: 21.9% had no formal education vs. 29.3% for non-SRI farmers. 26.9% had lower secondary school vs. 15.7% for non-SRI; but only 7.5% of SRI farmers had secondary schooling or higher vs. 7.1% for non-SRI farmers.

2. Households: There were slightly fewer female-headed households among SRI farmers (16.5% vs. 20.0%). More SRI farmers were members of a farmer association (58.1% vs. 41.9%). Rice area per household member was slightly more for SRI farmers (27.6 ares vs. 21.3 ares).

3. Crop Management: Not all SRI recommended practices were being used by 'SRI farmers' though the extent of change in management practices was quite remarkable:

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<th>Conventional</th>
<th>SRI</th>
<th>% Change</th>
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<tbody>
<tr>
<td>Seed rate (kg/ha)</td>
<td>90.3</td>
<td>29.8</td>
<td>-67%</td>
</tr>
<tr>
<td>Seedling age (days)</td>
<td>45.2</td>
<td>16.8</td>
<td>-63%</td>
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4. On average there was a 67% change in these quantifiable practices. The percent selecting only strong seedlings for transplanting went from zero to 86% among SRI farmers. Row planting went from 0.5% to 68.3%. Flooding during transplanting fell from 96.3% to 2.5%, and keeping the soil 'just moist' went from 3.5% to 92.3% (some did both). During the vegetative growth phase, permanent flooding came down from 64.3% to 22.4%, while alternating flooding and drying went from 35.7% to 77.6%. Weeding once went from 39.4% up to 66.8%, and twice up from 0.7% to 19.2%. 7.2% of SRI farmers did even three weedicings.

5. It should be kept in mind that the SRI farmers evaluated are not yet doing all of the practices as recommended, but even so have had some remarkable improvements in yield and profitability. This shows that the practices are to a large extent adaptable under Cambodian conditions, while also showing that there still further productivity gains to be made, as detailed factorial trials in Madagascar, as well as experience elsewhere, has shown the still greater potential with full use. Careful water management, to apply minimum amounts of water, is the practice still least fully used, in large part because of physical difficulties. If irrigation systems were modified to permit more water control, a demonstrably profitable investment with SRI, there could be better and more profitable water management.

6. **Nutrient Management:** SRI farmers have understood and accepted the advantages of applying nutrients in organic form. The application of NPK, DAP and urea diminished by 14 to 39%, while application of compost and/or animal manure went up 23-52%. The report raises concerns about the sustainability of SRI without additional nutrient amendments but recognizes that this is a matter to be monitored and evaluated over time.

7. **Yield Results:** The average yields recorded for SRI farmers were lower than previously reported from CEDAC surveys, but this can be due in part to the inclusion of fields affected by drought or flood and exclusion of fields under 30 ares. The average increase was 660 kg/ha, or 41% (from 1629 kg/ha to 2289 kg/ha), "achieved on a wide range of different agro-ecological environments, individual management practices, and varieties." It held up across all five provinces and was seen in all four years for which data were obtained. Thus, even with incomplete use of SRI practices, increases were consistent and significant (and cost-effective as seen below).

8. "It is often claimed that SRI is a promising technology for poor farming environments, while at locations with better resource endowments, other technological options are superior over SRI (Doberman, 2004). Results of the adaptability analysis conducted separately for each province demonstrate the opposite (Fig. 13)." Regression lines showed clearly ($R^2 = 0.9758$ and 0.9554, significant at the .001 level) that 'with SRI' yield went up proportionally to 'before SRI' yield. SRI performed better in all environments, but better where underlying endowments were better.
9. **Risk:** A separate risk analysis found that with SRI methods, farmers' risk of getting a lower yield after changing from conventional practices was only 15%, while the chances of getting an increase were many times greater (Fig. 14). At low initial yield levels, the risk of not achieving a low yield target (e.g., 800 kg/ha) is the same for both SRI and conventional methods; for higher targets "the risk not to achieve these levels is much higher for conventional practices than for SRI."

10. **Labor Demand and Distribution:** SRI has been generally characterized as 'labor-intensive' or as requiring more labor per hectare. Certainly in its initial use, when farmers are learning how to use the practices, this will be true. This Cambodian evaluation, however, found no consistent effect. "While many farmers mentioned the additional labor requirement caused by the increased weeding operations, lots of farmers expressed their appreciation about the overall labor-saving effect during uprooting and transplanting. **A quantification of the overall labor demand for SRI showed that it is rather labor neutral with respect to family labor. However, it reduced the need for hired labor significantly, although at a fairly low level (Fig. 16).**" (p. 32, emphasis in original)

11. I calculated from Fig. 17 that SRI requires 105 man-days of family labor (numbers adjusted by gender and age) vs. 102 man-days for conventional cultivation, no significant difference. In fact, for Cambodian farmers, the peak demand time for labor comes at transplanting time. Being able to accomplish transplanting with less labor at that time, up to 10 man-days/ha, cuts down on the most critical labor bottleneck by 26% (p. 32). "**Besides the reduction of inputs like seeds and fertilizers and the increase of yields, labor reduction during transplanting might be an important criterion for Cambodian farmers to adopt SRI.**" (p. 32, emphasis in original) There is an increase in labor required for weeding, but this is well distributed throughout the season, so farmers did not regard as a particular problem with SRI.

12. **Gender Effects:** In Cambodia, there is often significant specialization of agricultural tasks according to gender and age. A detailed analysis of rice management activities broken down among women, men and children, comparing common practice before using SRI with practices under SRI found no significant changes. If anything, "**the reduced labor demand during transplanting particularly benefits the female household members.**" (p. 35, emphasis in original)

13. **Gross Economic Margins:** There was a clear advantage of SRI over conventional practices when gross profits/ha were calculated. These went from $120/ha with conventional methods to $209/ha with SRI, an increase of $89, or 74%. Farmers saved $23/ha in variable costs like seeds and mineral fertilizer while SRI increased the value of yields by $66.

14. "Gross margin calculations do not consider the timing effect...saving costs for inputs might be even more valuable to the farmers than increasing yields because costs for purchased inputs are saved at a time of year when financial resources in small-scale farming households are particularly scarce. Hence, the farmers presumably value this economic advantage even higher
than it already appears. Moreover, saving monetary inputs reduces the economic risk of investing money for purchased inputs and (then) losing everything in case of flooding or drought." (p. 36)

15. More on Risk: An economic risk assessment revealed lower risk with SRI to achieve a desired gross margin per hectare compared with conventional practices. For example, the probability of not achieving a gross margin of $100/ha was 42% with conventional practices and only 17% with SRI (Fig. 20). "Moreover, the risk for SRI to be economically outperformed by other methods was only 12%, 16%, 13%, 2% and 12% in Kandal, Kampong Thom, Kampot, Takeo and Prey Veng [Provinces], respectively…It was concluded that SRI is an economically very attractive methodology for rice cultivation with a lower economic risk compared to other cultivation practices." (p. 37, emphasis in original).

16. Rice Self-Sufficiency: The study looked at how many months out of each year the household was able to meet its rice and other food needs. Even with SRI being practiced on only a portion of farmers' total rice area, the proportion of farmers facing rice insecurity had declined from 34% to 28%, while the proportion able to produce a surplus increased from 20% to 33%. First-time farmers were using SRI on 21% of their total farm area, while those with more experience applied it on 42% of their area. "As many as 17% of all SRI farmers had converted their total rice area to SRI. These figures alone document that SRI works well at least for a substantial part of farmers." (p. 39, emphasis in original)

17. Labor Constraints at the Household Level: It appears that labor time for weeding is the main constraint to more extensive use of SRI. Losing out to weed competition could wipe out possible gains from the new methods. The labor bottleneck does not appear to be at the stage of transplanting, for which farmers find SRI to be labor-saving. [Note: farmers in other countries are working on this particular labor bottleneck; a farmer in Sri Lanka, Ariyaratna Subasinghe, has motorized a two-row weeder, costing about $800, which enables him to weed 2 ha in one day by himself; another farmer in India, Gopal Swaminathan, has designed and built a four-row hand weeder (rotating hoe) which cuts labor time for weeding practically by half to three-quarters; such implements if introduced in Cambodia could break this particular labor bottleneck -- NTU]

18. Adoption and Potential Economic Benefit at National Level: The analysis concluded that if just 10% of Cambodian rice farmers would convert 42% of their rice area to SRI, the economic benefit to the nation would be $36 million, more than enough to justify an extensive program of training for SRI within the agricultural extension system (p. 42).

19. "Despite many open questions still to be investigated by researchers, SRI has proven to be a worthwhile practice to be promoted and should be included in any rice intensification program. Although some of the constraints limit its use on larger proportions within a farm and certain farming households might not be able or willing to apply it, its potential should not be missed." (p. 45)

20. Research-Extension Linkage: "The fact that thousands of farmers have started to use SRI, with a considerable number applying SRI on all of their rice area, clearly documents that SRI works very well under the conditions small-scale farmers are facing in Cambodia. SRI is already a reality in Cambodia. If researchers reject to get on the boat, it will depart
without them. **Researchers should view SRI as a great opportunity to work on. There are many knowledge gaps, and researchers are urgently needed**, especially for the investigation of the long-term sustainability of such a system." (p. 46)

21. **Implication of the Extension Approach:** The report documents the farmer-centered approach of CEDAC, the NGO that has been leading efforts to introduce and disseminate SRI in Cambodia. CEDAC field staff begin by working with individual farmers, but once SRI results have been demonstrated, it gets them to choose 'key farmers' from among themselves who can get further training and who disseminate SRI to other farmers, facilitate groups meeting, and conduct training. "Although during the initial stages, much training, coaching and follow-up is necessary, enabling farmers to play a more active role in their own development is presumably much more sustainable in the long-term than approaches where farmers have few choices other than to accept or reject a technology developed elsewhere." (p. 47)

22. "...SRI is particularly useful to serve as an important entry point for any further development intervention intended by a project. This chance should not be missed, and the focus should go beyond SRI...it is important that farmers have the feeling that they have ownership over the demonstration in question. Heavily subsidized demonstrations do not fulfil this requirement... In conclusion, SRI is a worthwhile rice management practice to be promoted with a substantial demand for financial and human resources. However, the possible long-term gains achievable through SRI and a more farmer-centered extension approach easily justify the costs involved." (pp. 47-48, emphasis in original)

23. This conclusion is well supported by the data and analysis from this evaluation of SRI, the most extensive and detailed to date. The International Water Management Institute (IWMI) has recently published its own evaluation of **SRI in Sri Lanka**, by Namara, Weligamage and Barker (Research Report No. 75), available from IWMI's home page on the internet.

- The IWMI research team surveyed 60 SRI farmers and 60 non-SRI farmers, chosen at random in two provinces. The **average increase in yield** with SRI methods was 50%, even though the SRI farmers were not using the full set of recommended practices. The increase in **water productivity** was 90%; and in **labor productivity**, 50% in the dry season and 62% in the wet season.
- **Costs of production** were reduced 17-27%, depending on how family labor was accounted for. **Net profit per hectare** increased by 83%, if family labor was imputed a wage equal to the prevailing agriculture wage, and by 206%, if family labor was not counted, so this represented the return on capital invested in production.
- The risk of having a **net economic loss** with conventional methods was calculated to be 28% of seasons, but only 4% of seasons with SRI, given the higher yield and revenue and the lower production costs.
- Several recent evaluations of **SRI in Bangladesh**, supported by a DFID-funded project managed by IRRI/Bangladesh, reached similar conclusions from detailed studies comparing SRI and conventional methods of rice growing. So these Cambodian results are quite in line with what is being found in other countries.