Sunari Morang Irrigation Project, Nepal:
Experience with SRI – Monsoon Season 2002

INTRODUCTION

The responsibilities of NEDECO/DHV with its Nepali associates SILT, CMS and MASINA are for detailed design and assistance to SMIP for construction supervision, institutional development and water management, and to the DoA (through Regional and District offices) for agriculture and agriculture extension. We work with WUOs that were formed, with our assistance, before detailed design of irrigation infrastructure was started, so that they could take part in the laying out of the field-level works.

You will see from the following that SMIP/DoA's involvement with SRI is only one of many components of an integrated crop and water management extension programme. The way in which SRI fits into the overall picture becomes clearer on page 4 of this note.

We feel that a lengthy background section is essential to set the context for understanding the SRI work, particularly for readers not familiar with SMIP. Potentially, if further work shows SRI to be a viable option for increasing paddy yields in SMIP, the impact on national production would be very great. However, we must emphasize that much has still to be done before the part that SRI could play can be properly established. Government, through SMIP-DoI and DoA, will have the main part to play in such an effort.

THE SUNSARI MORANG IRRIGATION PROJECT (SMIP)

Location

SMIP operates in the *terai* of southeastern Nepal, and has about 65,000 ha under command of the Chatra Main Canal (CMC), which is fed from the Koshi River. The CMC, running generally from west to east, has a maximum capacity of 60 m^3/sec, giving a gross water duty of about 0.90 l/sec/ha, or rather less than 0.50 l/sec/ha at the plant root. This is because it was designed for "preventive irrigation", i.e. to supply enough water to supplement (by 80%) the monsoon rainfall, so guaranteeing one crop of rice a year over the entire area. Therefore, effective water management at all levels is vital. A series of secondary canals, running north to south, take the water from the CMC into the command area, which extends almost to the Nepal/India border some 20 km to the south. There is considerable conjunctive use of groundwater (STWs) and low lift pumping from drainage lines to supplement supplies from CMC – particularly towards the tail end of the system. Farmers obviously find the use of this more expensive water profitable, as they pay for it themselves – it is also, of course, completely under their control!

Development History

DATES	DEVELOPMENT STAGE	SOFTWARE ACTIVITIES
1954	Agreement between HMG Nepal/GoIndia to implement Chatra Irrigation Project	
1965-1975	Construction + two year O&M period Handover to HMGN 1975	None
1978-1986	Implementation of *Stage I* CAD (9,750 ha)	None
1988-1994	Implementation of *Stage II* CAD (16,600 ha)	Starting 1991, comprising: • Organisation of WUOs • Training of junior DoA staff & farmers • Demonstration of fertiliser dosages • Introduction of rice trials & upland crops

DATES	DEVELOPMENT STAGE	SOFTWARE ACTIVITIES
1993-1996	Sunsari Morang Headworks Project (SMHP)	Starting 1994 took over Stage II ID&T activities
1996-1997	[Note: IDA has financed all the works from Stage I onwards]	*Pilot Areas* (two) only now set up, with: • Demonstration of water management & agriculture • DoA start trials & training in Pilot Areas
Thus, there was minimal software input (though much appreciated by farmers) until the mid/late 1990s		

SMIP Stage III-Phase I Activities (1998 to 2003)

Background
SMIP-III/I comprises 11,200 ha of Command Area Development (CAD = overall system rehabilitation, and provision of field level infrastructure for the first time) on two secondary canals. Genuine efforts were made during project preparation to learn from Stages I and II, and to restructure the TOR accordingly. We have tried to continue the learning and adaptation process.

Original Scope of Software Activities (1999 to 2002)
In the first three years, management resources were concentrated on construction, and software activities were restricted to WUO establishment, participative design of field-level irrigation works, and agricultural extension. In the project documentation, a "traditional" approach was envisaged: agricultural demonstrations with *ad hoc* and transitory groups of farmers, and OFWM based on classroom training with a minimum of practical work. There is no logic to traditional agricultural extension in an irrigated farming system, particularly where the institutional framework is very weak. When the consultants' software staff were fielded in January 1999, the implementation of the water management, agriculture and agricultural extension programmes was reviewed with a view to improving on the implicit specification of the TOR. Attempts were made to introduce some integration. However, these were not successful, largely because SMIP and DoA had not yet become used to working closely together. Also inter-departmental responsibilities for OFWM training were not clear.

Participation in Construction & Feasibility Study Phases
The full involvement of WUOs in the layout and design of the tertiary and field level irrigation infrastructure reduced subsequent disputes. However, during the 2001-2002 construction season, it was also demonstrated that full involvement of the WUOs/farmers from an early stage, with the contractor and with SMIP, very much improved the progress and quality of construction, and made any necessary redesign easier. (Bulldozers did not appear over the horizon with no warning, 18 months after the joint design process, when the farmers' situation may well have changed!)

From trial work carried out on feasibility level design for command area development, with farmers in a 2,000 ha secondary canal, it is clear that the participatory principle is equally applicable at this stage of the project cycle. With the introduction of participative M&E WUOs would become full partners in project cycle management – maybe with beneficial results!

Current (Integrated) Approach (2002 to 2003)
In early 2002 we reviewed, in an All-Parties Workshop, the approach the project was taking to software generally. Since then training has been based on an Integrated Crop and Water

Management Programme (IP, for short). This “participative” method is a departure from the previous, more formal agriculture and water management training. It is not a fundamental change, but a re-orientation of the “separated” original approach (with some additions) to focus on strengthening WUOs through technical as well as institutional means. It is based on the contention that, in an irrigated farming system, where there are no other existing farmers' groups of any permanence or strength, it is logical to use the WUOs as the basis for training and extension activities. Most importantly, the medium used is “learning by doing and discussion” through Farmers’ Field Schools (FFS).

Objectives of the IP Approach

Recognising the shortcomings in the software foundations for irrigated agriculture in SMIP (and throughout Nepal), the objectives were set (ambitiously) as:

- Extending practical knowledge of irrigated farming systems within the network of WUOs.
- Strengthening the WUOs in all respects.
- Embedding long-term training and development capability into the farming community itself.

FFSs are run by Farmer Trainers, who were trained during the spring paddy season 2002 by a parallel training-of-trainers (ToT) programme within the project; and Lead Farmers, senior community members who have built up a solid reputation for practical extension work over the years in working with DADOs and VDCs. These men and women are supported by DoA and SMIP-DoI staff, and are seen as the core of long-term interventions to encourage self-reliance in the farming community. The main components of the IP are tabulated below.

Continued activities:

- Crop and irrigation planning, including seasonal Water Operation Plans
- Preparation of irrigation area boundary maps and farmers' inventories
- Various WUG training on admin and finance

Adapted from the “traditional” approach:

- ID strengthening as necessary
- Crop variety demonstrations/trials
- Fertiliser and micro-nutrient demonstrations/trials
- Agri-chemical demonstrations/trials
- Multiplication of improved seed – for own use and commercial sale
- Seed production and post-harvest technology
- Technical extension bulletins
- Extra rotational water supply training [(1)]

Additional activities, made possible by reallocating two excellent young engineers from construction supervision to different aspects of water management:

- Mobilisation of WUGs for watercourse and tertiary canal maintenance
- Encouragement of Irrigation Service Fee collection, by working out with WUOs the actual cost of routine maintenance [At the moment they have no understanding and, naturally, are reluctant to pay the ISF]
- OFWM and response of rice and wheat to different water applications
- Review of CMC hydraulics and water management
- Strengthening/training for CMC WM, through training of SMIP and WUO gate operators

(1) Because of the low available water duty, only CMC and secondary canals run at full flow. Lower-order canals are divided into two groups (for monsoon season), each of which is of more or less equal area. Each group gets water for an equal length of time.

SRI in MONSOON SEASON 2002

Background

The opportunity was taken to fit an SRI plot into the monsoon season FFSs. These FFSs, which are run in close liaison with RAD and DADOs, are designed to use agricultural extension and on-farm water management training to support institutional strengthening at WUG (watercourse) level. FFSs are a form of non-formal education based on learning by experimenting and discovering. The programme provides hands-on knowledge of a complete package of crop cultivation practices.

Co-ordination meetings were held at all levels with WUOs, SMIP, RADO and DADOs. The Farmer-Trainers were mobilised in the field to organise programme implementation. All those involved remained very enthusiastic, and co-ordination between SMIP and DoA training staff improved.

FFSs were located in the command areas of so-called Nucleus Tertiary Canals (NTs). The initial objective was to select, through the WUOs, from WUCCC (all of SMIP) down to WUC (Sub-Secondary/Tertiary Canals), a total of twelve NTs, three in each of Stages I and II, and six in Stage III/I. However, WUCC (Secondary Canal) Chairmen in Stage II were not interested in taking part, and so an additional three NTs were added to Stage III/I. NTs were evenly divided between head, middle and tail reaches in order to cover the full range of farm sizes and water distribution issues. The 1,019 ha covered by the NTs in Stage III/I were about 9% of the total 11,500 ha CAD.

Selection and Details of FFS Participants

Meetings were organised with WUCs to select the participants for FFS. It was agreed to select the participants from all watercourses of the nucleus tertiary and almost in equal numbers as far as possible and practicable. A summary of the details of participants is presented in Table 2.1 and the landholding situation (owned, rented in, rented out and cultivated area) of participants is presented in Table 2.2.

FFS Activities

FFS were conducted once a week, and each schooling day was divided into two sessions. In the first session, participants were involved in field activities (sowing, transplanting, weeding, top-dressing, data collection for agro-ecosystem analysis), and preparation and presentation of agro-ecosystem analysis and group discussion. In the second session, theory classes on special topics were organised. Farmer-Trainers were the main field-level programme-implementing agents. Plant Protection Specialists were the main facilitators and other Subject Matter specialists and Innovator Farmers were also utilised as resource persons. It was observed that farmer participants were very enthusiastic, and they showed keen interest to learn through FFS. They were found to be regular in attending FFS though there was no provision for participants' allowances.

Treatments of the different factors were finalised based on the problems experienced by the farmers. The treatments were related to integrated crop management with special reference to integrated pest management and water management. SRI method of paddy cultivation was also included in the experiment as discussed with the Directors of Regional Agriculture Directorate and the Regional Agriculture Research Station. The System de Riziculture Intensive (SRI) in Madagascar has been showing that <u>yields can be doubled or more just by changing certain common management practices</u>.

SRI Methodology

The following are the SRI practices that were followed as much as possible under field conditions:

- Seedlings were raised on a dry seedbed.
- Young seedlings, 10 days old, were transplanted.
- One seedling per hill.
- Transplanting done in a square pattern (30cm x 30cm).
- Seedlings were transferred from the nursery into the field within 30 minutes.
- Roots were slipped horizontally into the moist (not flooded) soil with tips laid in gently.
- Soil well-aerated and well-pulverized.
- Irrigation water was managed to keep the soil moist but never flooded.
- During plants' reproductive phase, a thin layer of water (1-3 cm) was maintained.
- Weeding was done for the first time 10 days after transplanting.
- Second weeding was done 14 days after 1st weeding.
- Third weeding was done 14 days after 2nd weeding.
- Fourth weeding 14 days after 3rd weeding (as needed).

FFS Results

Background

A format was developed to record the data of the experiments. The Farmer-Trainers were oriented on recording the data. Data were collected, compiled, analysed and interpreted. The data were presented in two separate formats. In one format yield data of treatments of different experiments (excluding SRI method) conducted at 12 NTs were presented (Table 4.1). In the second format, data on different characteristics (plant height, number of tillers, root length, number of filled grains, 1000 grain weight, and yield) of (a) SRI methods, (b) improved practice, and (c) farmers' practice were recorded (Table 4.2) in order to compare the performance of those three methods of cultivation. The results of the experiments are summarised below. The rice variety used in all the trials, except the varietal trials, was Mansuli, the variety used most commonly in the area

Water Management

Each FFS had its own irrigation schedule which was adjusted to coincide with the schooling. In all FFS the first two or three irrigations were not given due to sufficient rainfall. Six plots had their own outlet system, which were adjusted to the required depth of water, so that excess water simply drained away. The plot under rainfed condition did not have a drainpipe. On the day of school, the participant farmers, who were also the water users of the watercourses within the IP area, gave canal water to the plots to the required depth as per irrigation schedule. The Farmer-Trainer explained that different irrigation treatments were given to find out the proper level of irrigation for monsoon paddy. Also, other resource persons, usually experienced farmers, gave talks on their experience regarding irrigation to paddy. The participants were shown how a field channel facilitates to apply canal water to an individual plot without disturbing another plots. In SRI plots, water management was involved, to maintain saturation level of irrigation

At the end of the FFS, yield samples from each demonstration plots involving different irrigation treatments were taken, shown in Table 4.3. The table shows that there is not significant difference in paddy yield in ponded or saturated non-SRI fields.

Lessons

- There is no need to pond a paddy field
- Saturation of the field is enough for paddy - though more weeding is needed
- Field channels facilitate individual plot irrigation

Farmers' Practice/Improved Practice

At all locations, the yield from what we evaluated as "improved practice" was higher than farmers' practice. The difference in yield between improved and farmers' practice varied from 200 kg to 2,000 kg/ha. On an average the yield of improved practice (5,810 kg/ha) is about 32% higher than the yield of farmers' practice (4,380 kg/ha).

Fertiliser Trial

The average highest yield was obtained under recommended dose of fertiliser (6,402 kg/ha) followed by full dose of nitrogen and phosphorous and no potash (5,656 kg/ha), full dose of nitrogen and potash and no phosphorous (4,908 kg/ha), full dose of phosphorous and potash and no nitrogen (4,844 kg/ha), farmers' practice (4,348 kg/ha), and control (3,629 kg/ha). This programme demonstrated the impact of fertiliser on crop yield.

Number of Seedlings/Hill

The highest yield was obtained from two seedlings/hill (6,031 kg/ha). This was followed by three seedlings/hill (5,813 kg/ha), and one seedling/hill (5,725 kg/ha). The yields of other treatments were lower than these. The results showed that there is no need to transplant more seedlings. The optimum number of seedling/hill was one to three per hill. This experiment demonstrated that farmers could save the cost of seed without any decrease in the yield.

Micro-Nutrient Use

The result revealed that use of a micro-nutrient (zinc) added value in paddy production. The highest yield was obtained in case of soil application (5,923 kg/ha) followed by foliar application (5,323 kg/ha). The contribution of zinc in yield was 1,246 kg/ha in soil application and 646 kg in foliar application.

Weedicide Use

Two manual weedings gave the highest yield (5,625 kg/ha) followed by use of butaclore weedicide (5,142 kg/ha), one manual weeding (5,017 kg/ha), and control (4,081 kg/ha). This experiment demonstrated that weedicide can be used in case of labour shortage with a yield at par with one manual weeding.

Varietal Performance

Kanchhi Mansuli variety was included as a check variety. The yields of Kanchhi Mansuli (5,250 kg/ha) and Mansuli (5,318 ha/kg) were almost the same. The highest yield was Radha-12 (6,582 kg/ha) followed by Rampur Mansuli (5,805 kg/ha) and RP-1017 (5,639 kg/ha).

Simulation of Stem Borer

The yield data showed that 10% to 20% stem cutting from 14 to 28 days after transplanting had no significant differences in yield. This experiment demonstrated that there is no need of the use of insecticide up to certain level of attack of insect (stem borer). This type of experiment should be conducted in the following years for the confirmation of result.

Simulation of Defoliation

The yield data showed that 25% to 100% leaf cuttings at the early stage of plant growth had no significant different in yield. This type of experiments should be conducted in the following years for the confirmation of results.

Comparison of Cultivation Methods

Overall Results

Data on different characters of these three methods of cultivation were recorded as presented in Table 4.2. The results showed that (a) the average yield of SRI method was highest (8.07 t/ha) followed by (b) improved practice (5.81 t/ha) and (c) farmers' practice (4.38 t/ha). The range of yield in SRI method was 5.45 to 11.1 t/ha, and those in improved practice and farmers' practice were 4.85 to 7.5 t/ha, and 2.5 to 6.5 t/ha, respectively.

The average yield of SRI method is around 39% more than the average yield of improved practice, and about 85% higher than average yield of farmers' practice. At one location (Manikchauri-Head), the yield of SRI method (11.1 t/ha) is more than double that of improved method (5.40 t/ha). The plant height was 8% more in SRI, compared to improved practice. Similarly the number of productive tillers was 35% more, root length 23 % longer, and number of filled grains 35% more. There were no significant differences in length of panicle and 1000 grain weight. The increase in yield in SRI method was contributed mainly by more productive tillers and more grains per panicle.

SRI Method

With SRI method, single seedlings 10 days old were transplanted to each station. Due to heavy rain after transplanting, the plants were lodged at four locations (MA-Middle, S13-Head I, S13-Head II, and S14 Middle II). Re-transplanting was done at these locations using seedlings of wet seedbed. At one location (MA Middle), there was attack of blast disease also. Hence it is expected that the yield could have been higher.

Lessons and Conclusions

- FFS was found to be an excellent extension method to convince farmers of all levels (literate & illiterate).
- This programme should be conducted extensively thoughout SMIP area in all seasonal crops.
- Learning by doing/experimenting (action research) method of teaching was found to be superior in comparison to the traditional method (classroom teaching).
- As SRI method was found to be effective for boosting crop production (up to 200% increase), the following action research should be undertaken in the future.
    - ◊ Evaluation of the performance with SRI methods of different rice varieties
    - ◊ Responses of SRI plants to different doses of fertilisers and micro-nutrients
    - ◊ Impact of weedicide (more weedings are recommended for SRI, which needs more labour, which might be reduced by chemical use which, however, does nothing to aerate the soil which mechanic weeding accomplishes)
    - ◊ Transplanting of different ages of seedlings
    - ◊ Costs, returns, added cost, and value-added returns should also be included in the experiments and should be assessed.

POSTSCRIPT

Funding for continuation of FFS activities in the 2002-2003 Winter Season has been severely restricted, and currently there is no expectation of any funding at all for the 2003 spring and monsoon paddy seasons.

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