INTEGRATED CROP MANAGEMENT (ICM)

Implementing ICM Technology in Timor-Leste

August 2008

INTEGRATED CROP MANAGEMENT (ICM)

Implementing ICM Technology in Timor-Leste

Richard Ogoshi
Department of Tropical Plant and Soil Sciences, University of Hawaii, USA

Vethaiya Balasubramanian
International Agricultural Consultant, Coimbatore, India

Michael Jones
formerly of the Department of Tropical Plant and Soil Sciences, University of Hawaii, USA
and the German Technical Cooperation (GTZ), Baucau, Timor-Leste

August 2008

This brochure was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the Soil Management CRSP (Grant No. LAG-G-00-97-00002-00) of the University of Hawaii and do not necessarily reflect the views of the USAID or the United States Government.

OVERVIEW

A large rice yield gap exists among developing countries (Table 1). Indonesia, for example, has an average yield of 4.50 tons/ha while Cambodia has only 2.15 tons/ha. Access to physical resources and environmental factors in these two countries may help explain the yield differences. Knowledge and management practices, however, may also play an equally crucial role.

In many cases, farmers in developing countries can increase rice yield and gross margins and reduce labor with the physical resources currently available to them. Yields of 5 to 6 tons/ha are possible in countries that currently average 2 to 4 tons/ha (Table 1). A few simple tools and different methodologies and a willingness to try new management practices can dramatically increase rice yields and improve farmers' livelihoods.

In this bulletin, a set of best management practices for rice production, collectively known as Integrated Crop Management (ICM), will be presented. ICM has been shown to improve yield and reduce inputs and labor in a number of countries in Asia and Southeast Asia, including East Timor, India, Vietnam, Indonesia and the Philippines.

INTEGRATED CROP MANAGEMENT PRACTICES

ICM is composed of six practices that increase yield and reduce inputs and five practices that improve grain quality.

ICM Practices that Increase Yield

1. ***Plant high yielding variety adapted to region.***
   Adapted varieties are essential for resistance to pests/diseases that are present locally. High yielding varieties have high tillering capacity that provide the advantage of low seed requirement and reduced labor to transplant. Local varieties can be planted as long as they have high tillering capacity.

2. ***Use high quality seed.***
   High quality seeds help reduce the disease pressure in the nursery. Quality seeds can be obtained from seed distributors or collected from a portion of the field that was pest/disease-free, with large panicles and fully filled grains, in the previous season. Discolored seed (an indicator of disease) should be removed manually.

3. ***Transplant strong, whole seedlings produced in a modified mat nursery.***
   A modified mat nursery is made by delineating one meter square sections of a paddy with banana sheaths, bamboo or a soil bund. Banana leaves or a thick layer of rice hulls are placed at the bottom of the section. A mixture of 8 buckets of soil, 2 buckets of compost or decomposed chicken manure and 1 bucket of rice hulls is place over the leaves or rice hulls (Figure 1A). One hundred grams of pre-germinated rice seed (soaked in water for 1 day and placed in damp cloth for 1 day) is spread over the soil and lightly covered to 1 cm depth. Banana or palm leaves are spread over the nursery to prevent rapid

Table 1. Rough rice yield from Asian and Southeast Asian countries from 1998 to 2007. USDA (2008).

	Country				
Year	Cambodia	India	Philippines	Vietnam	Indonesia
1998	1.78	2.90	2.83	4.02	4.25
1999	1.95	2.98	2.99	4.14	4.40
2000	2.12	2.87	3.11	4.14	4.44
2001	2.07	3.14	3.19	4.27	4.41
2002	1.91	2.67	3.17	4.37	4.50
2003	2.10	3.13	3.46	4.48	4.56
2004	1.99	2.95	3.54	4.62	4.64
2005	2.48	3.17	3.63	4.72	4.59
2006	2.49	3.18	3.70	4.82	4.60
2007	2.56	3.26	3.84	4.86	4.63
Average	2.15	3.03	3.35	4.44	4.50

evaporation and protect the seed from birds. The soil mixture is kept moist with daily irrigations. At seven days after planting (DAP), a solution of 5 g urea in 1 liter of water is sprinkled to moisten the soil. The banana/palm leaves are removed when the seedlings begin to touch the bottom of the leaves. The seedlings are ready to transplant at 14 DAP (Figure 1B). To transplant, the seedlings can be lifted as a whole mat and carried to the paddy where the mat is easily separated into single, whole seedlings with intact roots (Figure 1C).

A

B

C

Figure 1 (A-C). The modified mat nursery is made from locally available materials. Banana stumps delineate the nursery and leaves line the bottom. A mixture of soil, manure, and rice husks is poured into the nursery bed (A). The seedlings are ready to transplant 14 days later (B). The modified mat nursery produces healthy seedlings with an intact root system (C). (Photo C by Michael Jones.)

4. ***Transplant one seedling per hill at 20 cm distance from each other.***
   Single seedlings are transplanted per hill, which greatly reduces the seed required per hectare of paddy (Figure 2). One hundred grams of seed is planted in a square meter of nursery. A square meter of nursery is more than enough for 100 square meters of paddy. The seed requirement is 10 kg per ha of paddy. When the paddy has poor soil the narrow spacing (20 cm) is chosen to ensure canopy closure. In rich soil, the wider 25 cm spacing is selected.

5. ***Stir soil with hand-pushed mechanical weeder at 15 and 25 days after transplanting (DAT) and, if necessary, at 35 DAT.***
   Soil stirring produces two benefits, weed suppression and root growth stimulation. The canopy should close sometime after 25 DAT at which time weeding becomes unnecessary.

6. ***Apply fertilizer when needed.***
   Fertilizer recommendation can be based on soil testing or minus-plot method. The soil test kit and NuMaSS were found to be useful tools for soil analysis and fertilizer recommendations. All of the recommended phosphorus, 50 kg urea (nitrogen) and 1/2 of potassium recommendation are applied and incorporated just before transplanting. The remaining potassium is

Figure 2. Single seedlings are transplanted in rows 20 to 25 cm apart.

applied about 35 DAT. Leaf color is monitored with a leaf color chart weekly starting at 14 DAT (Figure 3). When leaf color reaches the threshold color, 50 kg urea/ha is broadcast immediately. Under-fertilizing reduces yield while over-fertilizing makes the rice plant susceptible to insect and disease.

Figure 3. A leaf color chart monitors the nitrogen status of the rice crop. When the leaf color lightens to a threshold color panel, nitrogen fertilizer is applied to the paddy. (Photo by Michael Jones.)

ICM Practices that Improve Grain Quality

1. ***Harvest when 95 percent of grain is yellow.***
   Because the stalk remains green when using ICM practices, the rice is harvested by monitoring grain color.

2. ***Thresh immediately after harvest.***
   In most countries, the rice is bundled and left in the field at harvest. Leaving the rice in the field may expose the grain to dew, which re-moistens the grain. Fissures are created and cause the grain to crack when milled.

3. ***Dry grain evenly.***
   Occasional mixing during sun-drying is necessary to ensure that grains dry evenly. Grain that is too moist will be macerated and grain that is too dry will crack during milling.

4. ***Mill grain at 14 percent moisture.***

5. ***Adjust mill roller spacing to specific variety grain size.***
   Improperly spaced rollers will either crack the grain or require multiple passes to dehusk the rice.

ICM IMPACTS IN TIMOR-LESTE

Farmers in Timor-Leste were invited to test ICM practices on their farm. They were given training to implement the ICM practices. Rice crops were grown in their paddies using their normal (farmer) practices and ICM in the 2007 season. The training sessions were implemented by the Ministry of Agriculture and Fisheries and local German Technical Cooperation (GTZ) staff, advised by Soil Management Collaborative Research Support Program (SM CRSP) scientists and private consultant Dr. Vethaiya Balasubramanian. Input costs, labor and yield were recorded. ICM practices increased yields and gross margins and reduced labor and costs (Table 2). The increased yield was not as high as expected due to an in-season drought and severe locust infestation. On-farm tests conducted by the SM CRSP in 2005 produced yields as high as 5 tons/ha.

Risk-averse farmers focused on input minimization were more receptive to certain ICM practices than others. They liked producing seedlings with the modified mat nursery because the seed requirement of 10 kg/ha was 25 to 30 kg/ha lower than normally used, and much less labor was needed to prepare the nursery and seedlings for transplanting (Figures 4 A-C). Farmers also liked planting in rows. The labor required was reduced since the normal random planting typically resulted in 35 to 40 hills/m^2, while planting in rows required only 16 to 25 hills/m^2. Farmers were less enthusiastic about thorough land preparation and soil stirring with the mechanical weeder. In some regions, farmers unaccustomed to using chemical fertilizer were hesitant to use it. The combination of high upfront costs and, in their minds, uncertainty of its efficacy made these farmers reluctant users.

Table 2. Yield, labor requirement, cost and gross margin between Farmer Practice (FP) and Integrated Crop Management (ICM) in Timor-Leste.

	FP	ICM
Yield (ton/ha)	2.5	3.5
Labor (person day/ha)	113	91
Cost ($/ha)	462	440
Gross margin ($/ha)	-$9.90	$103.70

A

B

C

Figure 4 (A-C). Farmers in Timor-Leste typically plant 500 square meters of nursery for each hectare of paddy, which takes about 10 days to pull up, wash and bundle the seedlings (A). The ICM practice of using a modified mat nursery requires only 100 square meters of nursery to plant a hectare of paddy and minimal labor to prepare the seedlings since they are simply lifted from the nursery (B), the excess soil shaken off and seedlings planted directly into the paddy (C). (Photos A and C by Michael Jones.)

ICM is not a prescription that must be followed completely. Some farmers may already be using one or more practices. Other farmers may find difficulty in applying a practice due to limited availability of resources. ICM practices should be applied where practicable. Employing any one practice will result in a modest yield increase. The most benefit results when all practices are used.

LESSONS LEARNED IN INTRODUCING ICM IN TIMOR-LESTE

The ICM practices alone are not sufficient to ensure an improved livelihood for farmers. Careful planning on how the practices are to be presented and how they fit within the circumstances of the family, land tenure, water resources, supplies, labor and the market are just as important. The objective is to have farmers adopt best management practices that meet their needs.

In Timor-Leste, extension agents were the primary contact for farmers. The initial meeting with farmers was immediately followed by a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis. Farmer problems were clarified and the opportunities to employ ICM identified. The role of the extension agent and farmer was clearly defined. The agents were to be technical advisors. Farmers obtained resources from local suppliers and performed day-to-day tasks. During the cropping season, the farmer and extension agent held field days at the farmer's paddy to introduce farmers from the surrounding area to ICM.

The ICM practices were tailored to the resources available in Timor-Leste. One key practice in ICM not mentioned so far is intermittent irrigation. This practice saves water and stimulates root growth. It is not being implemented in Timor-Leste because leveling the paddy was very difficult under the current circumstances. Instead, the paddy was kept flooded throughout the season. High yields were obtained despite the elimination of this practice. When leveling becomes practicable, intermittent irrigation will be promoted.

REFERENCES

USDA. 2008. PSD online.http://www.fas.usda.gov/psdonline/

Photos: Richard Ogoshi, except where noted.

For further information, please contact:

Dr. Richard Ogoshi
Department of Tropical Plant and Soil Sciences
University of Hawaii at Manoa
1955 East West Road, Ag Sci 206
Honolulu, HI 96822
T: +808-956-2716
E: ogoshi@hawaii.edu

Dr. Vethaiya Balasubramanian
International Agricultural Consultant: Crop & Resource Management; Training & Tech Delivery; Project Design/Management
42 (Old No. 174) Thadagam Road - Ramya Illam
Velandipalayam Post
Coimbatore - 641025, India
T: +91-422-240-0327
M: +91-94863-94901
E: vbalasubramanian@irrialumni.org