Good Practices: Agricultural Technology


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Title of Best Practice: Application of the “Three Reductions and Three Gains” Technique in increasing rice production and rice farmer’s income in Angiang Province

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Author: Ms. Nguyen Thi My Phung

Category of Practice: Participatory Applied Research and Field Farmer School (FFS)

Context and Genesis

Description of the Production or Service System

An Giang is the largest rice producing province of the Mekong Delta. The total cultivated area is 246,821 ha with rice area accounting for more than 82%. In recent years, with plant diversification, the systems of canals and closed dams were built so the farmers could grow 2-3 crops/year with an average yield of 6 tons/crop.

The IPM program (Integrated Pest Management) had been launched with the support of the FAO (Food Agriculture Organization) in An Giang in 1992. Farmers had an awareness of the importance of eco–systems therefore they have changed their pest management and insecticide application practices. In 1994 the FPR (Farmer Participatory Research) Program was developed in Angiang. Through the FPR program farmers discovered that spraying in the first 40 days after sowing was not necessary. Farmers were encouraged to see for themselves with a simple experiment: they sprayed only part of their crop and compared the yield of the sprayed with unsprayed portion. With the innovations above, the farmers’ income was still low because they did not followed extensive staff guidelines closely enough. They used unreasonably high levels of inputs; the application rates of seed rice (250 to 300 kg/ha), nitrogenous fertilizer (150-300 kg/ha) and pesticides exceeded recomendations.

Agricultural inputs shops are very common so farmers can easily purchase agricultural inputs even on credit. Farmers can sell products to buyers or private, governmental enterprises, and joint-stock companies.

Social, Economic and Institutional Context

An Giang is located west of the Mekong Delta between the Tien Giang and Hau Giang. The main ethnic groups found in the province are the Kinh, Khmer, Cham, and Hoa.

The region is located in a monsoon tropical climate where the annual average temperature varies between 26 and 28°C. The two distinct seasons are the dry season, from December to April, and
the rainy season, from May to November. Floods often occur from the middle of August to the middle of November.

An Giang is an agriculture-based province, where rice and fish are the key products. Industries consist of: processing of agro-forestry and fishery products; handicrafts industries; water supply; trading; services, and so on.

Organizations and Stakeholders
The pilot rice growing program was co-sponsored by International Rice Research Institute (IRRI) and the Ministry of Agriculture and Rural Development (MARD) Plant Protection Department, and was introduced by Agriculture and Rural Development Service of Angiang Province. The Plant Protection sub-Department (PPSD) has implemented the scheme.

The Practice

Description of the Innovations
Three Reductions program consists of:
- Reducing seed rates.
- Reducing nitrogenous fertilizer rates.
- Reducing insecticide use.

Three gains after the implementation
- Increasing crop yield.
- Increasing rice quality (safe quality).
- Increasing the production skills of farmers.

Main Activities

Experimental Aims
- To reduce seed rates.
- To reduce nitrogenous fertilizer rates.
- To reduce insecticide use.

Methods

1) Field selection
- Four good farmers that were enthusiastic for innovation were selected, with fields which had good drainage and convenient transport systems.
- Four experiments were carried out in Spring-Winter and Autumn-Summer rice crops. Every field was separated into two plots, one for Farmer (FP: Farmer plot) and one for 3R.
  * In the farmer plot, farmers cultivated with traditional methods.
  * In the 3R plot, farmers were shown how to plant rice seeding in straight lines with seed rate 120kg/ha and to use reasonable amounts of urea fertilizer based on leaf color chart (LCC).

2) Culture practices
There are the seven main steps in 3R rice culture as follows:
- It is very important to choose a suitable season to grow rice so that farmers can control some dangerous pests such as: thrips, whitefly, smite and yellow rice leaf. On the other hand, rice can develop well in the favorable weather with high yields.


**Rice seed preparation:** Choosing suitable rice seeds for every season with the following criteria:
- High purity, same size
- Lack of disease.
- Lack of weeds.
- Percentage of seed germination at least 90%.

- Treating seeds in 15% salt concentration (100 kg of rice seed soaked salt in 15% concentration) to remove unfulfilled seeds before incubation.
- Treating seeds chemically to remove dormancy and seed born disease.

**Land preparation/sanitation:** farmers should remove weeds and debris, plowing and drying the fields in Autumn-Summer season. These practices help rice grow well and prevent organic poisoning. Leveling the fields and making small canalets promote seed growth and facilitate herbicide application and drainage at 30 DAS. Manual collection of golden apple snails is necessary to lessen the damage in the next stage.

**Amounts of rice seed:**
- 100 – 120 kg / ha for broadcast direct seeded rice by hand.
- 70 – 100 kg / ha for direct seeded rice in straight lines by instrument.

**Weed control** helps prevent competition with weeds for sunlight, moisture and soil nutrients and promote rice growth in the first stage. The level fields facilitate the application of pre-emergence herbicide at 0-1 DAS. Note: if soil is dry at 5 – 7 day after sowing (DAS) the plot should be irrigated to increase the effectiveness of herbicide.

**Fertilizing:**

<table>
<thead>
<tr>
<th>Phase</th>
<th>DAS</th>
<th>Urea</th>
<th>DAP</th>
<th>KCL</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7 – 10</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>18 – 22</td>
<td>60</td>
<td>60</td>
<td>30</td>
<td>Adding fertilizer in low-growing places</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Following the Table 2.</td>
</tr>
<tr>
<td>4</td>
<td>60 – 70</td>
<td>20-30</td>
<td></td>
<td></td>
<td>Fertilizing when having symptoms on lack of nutrition.</td>
</tr>
</tbody>
</table>

* Leaf color chart should be used at the second and the third fertilizing phases.

Drainage at 25-30 DAS until the fields are dry is an important practice, aiming at:
- Limiting useless tillers.
- Well-aerated condition.
- Good root growth leading to better absorption of nutrients and stiffer rice stem to avoid lodging
- Removing organic poisons due to overloaded field.
Third fertilization: After draining the field completely at 25-30 DAS and the fields turn to yellow, irrigation and the third fertilization are started. The amount of fertilizer depends on the day the fields turning yellow (Table 2).

Table 2  The amount of fertilizer for the third fertilization

<table>
<thead>
<tr>
<th>Day of field turning to yellow (DAS)</th>
<th>Urea (kg/ha)</th>
<th>Kali (kg/ha)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>43</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>45</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>48</td>
<td>20</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Harvesting: draining the fields 7 days before harvesting, and harvesting when 80% of the paddies are mature. If harvesting later, rice can shatter.

Indicators:
- The amount of tillers in 10, 20, 30, 40, 50, 60, 70 DAS phases (tillers/m²).
- The amount of panicles at 80 DAS phases (panicles/m²).
- Density of insects and percentage of disease at 10, 20, 30, 40, 50, 60 DAS phases.
- Yield (tons/ha)

These indicators are collected at five fixed points (0.2 square meter/fixed point) per plot, every ten days for both 3R and FP.

Results
The result in Figure 1 shows that the amount of tillers at 10 DAS is 498 tillers/m² (3R) and 764 tillers/m² (FP). The tillers grow more and more and get the most tillers at 30 DAS, the tillers of FP are more than 3R (384 tillers). After that tillers decrease by 698 (3R) and 872 tillers/m² (FP) at 70 DAS. It show that the seed rates at 3R fewer than FP (90 kilos/ha) but the amount of panicles per square meter and rice yield are still higher than FP (Table 2 and Figure 3).

![Tillers/m²](image)

**Picture 1  Amount of tillers in FP (210 kg/ha) and 3R (120kg/ha)**
Besides, the quality of seed-rice is improved. All experiment plots used specific treated varieties. Meanwhile, trainers talked about seed heath.

\[ \text{Picture 2} \quad \text{Amount of seed-rice and urea fertilizer used in FP and 3R} \]

Reducing Urea Fertilizer

Depending on the result of Figure 2, the difference in nitrogenous fertilizer rates is 21.38 kg/ha/crop saving 64.14 kg urea/ha/year equivalent 139.4 kg urea/ha/year. So the farmers can save 767,000 d¥ng/ha/year. It is very significant given the unstable price of fertilizer. In addition, reducing nitrogenous fertilizer also decreases environmental pollution.

Reducing Pesticide Application

Although both FP and 3R plots have some main pests such as thrips, leaf folder, smite, and yellow leaf disease, the damage not considerable, farmers still sprayed pesticide many times. The pesticide application of FP is more than 3R 1.58 times (insecticide) and 0.73 times (fungicide) (Table 3) so production cost is also different. It was more important that farmers can find the use of high seed rates and fertilizer lead to high disease infestation.
Table 3  Amount of rice panicle and pesticide application in F and 3R plots

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Plot</th>
<th>3 R (120 kg/ha)</th>
<th>Farmer (210kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thrip/sprout</td>
<td>Leaf folder/m²</td>
<td>Yellow leaf disease</td>
</tr>
<tr>
<td>(10 DAS)</td>
<td>3.5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>(20 DAS)</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>(30 DAS)</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>(40 DAS)</td>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>(50 DAS)</td>
<td>2</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>(60 DAS)</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>(70 DAS)</td>
<td>8</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Panicles /m² (80 DAS)</td>
<td>659</td>
<td>712</td>
<td></td>
</tr>
<tr>
<td>Insecticide spray/season</td>
<td>0.82</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>Fungicide spray/season</td>
<td>2.3</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1.58</td>
<td>0.73</td>
<td></td>
</tr>
</tbody>
</table>

*Increasing yield, low cost, increasing incomes (one gain)*

*Increased yield:* The average amount of yield in 3R was 0.27 tons/ha higher than FP (Figure 3) due to:

- Reduced pest pressure.
- More reasonable amounts of fertilizer.
- Amount of filled grain per panicle in 3R is more than FP.

These results affirm that seed rates are reduced but the yield of 3R is still more than FP.

**Figure 3. Crop yield in 3R and FP**
Low cost: The average cost of production under 3R is less than FP by VND 188.6/kg due to the high cost of inputs of FP, particularly the excessive seed, fertilizer and pesticide application rates (Figure 4). This makes farmers feel safe when faced with unstable prices.

Increasing risk-averse incomes: Rice farmers participating in the pilot program can increase incomes to 963,000 VND/ha/crop. These incomes would increase by 211,860,000.000 VND if 3R program is implemented in 220,000 ha/crop (rice area of province per crop). Actually, this additional income is significant and can improve farm families and society.

Increasing Quality (the second gain)
Increasing quality means safer product given the production of rice with 3R reduced fertilizer rates and pesticide application, product would be safer.

Farmers’ Production Skills are Enhanced (the third gain)
Through the experiments, farmers believe in 3R program. The most success is farmers’ skills are enhanced, especially they can use LCC to fertilize and road-seedling drums.

Opportunities for Scaling Up to Province

Goals: scaling up 3R program to province to gain high quality rice with low cost.

Methods
There are eleven districts including 150 communes. There is a plant protection station in each district and a agricultural staff in each commune.

Based on successful results of the experiments, the Service of Agriculture and Rural Development of Angiang province manages PPSD and Extensive Center training Technical staff at Plant protection stations, showing demonstration fields, giving information and brochures of 3R as well as provincial government plans budget for launching the program at districts and communes with two training courses: FFS and Demonstration Field (DF).

- FFS: there are 20 - 30 farmers in a course who are eager to apply innovations.
- Establishing Demonstration Fields to help the transfer of 3R to farmers more quickly.

FFS and Demonstration Fields were conducted. Meanwhile, a 3R competition in the province was implemented to encourage farmers and others to take part in the program.

Results
Propaganda materials
There were in total 87,450 LCCs and 102,980 leaflets, 295 cassette tapes, and 348 small posters and 29 big posters released (Table 4). The purpose of these materials is to motivate farmers to adopt three Reductions and Gains.
Use of Line Seedling Drum

Line seedling drums help use less seed rice than manual seeding methods. The application of in-line seeders is encouraged because they bring out stronger rice plant, better photosynthesis, better pest prevention, less fertilizer, easier management and higher yield. It can be seen that use of lineseedling drums greatly contributes to the success of the 3Rs to produce high quality rice. The Agriculture and Rural development Service therefore launched the Project entitled “the Application of line seedling drums” which is implemented under two forms: Demonstration, field trips and workshops to encourage farmer’s use of line seedling drum.

- District Government advances VND 60 million to provide 150 line seedling drums to local agents (level 1) which sell them to farmers with deferred payment for three continuous crops.

- Saving of 1% and 2% of village Compliment Fund to praise local agents (level 1) if they have sold out 100% or more in-line seeders

Local agent (level 1): extensive station, plant protection station, pesticide shops, district Agriculture & Rural Development Unit open between 1 and 2 local agent (level 1)

Local agent 2: Co-operatives, farmer clubs, pesticide shops, good so-called farmers, village and ward People’s Committees open between 1 and 2 local agents (level 2) which receive in-line seeders from local agents (levels) and sell them to farmers.

Under the Project for four months (one crop season) the number of line seedling drums amounted to 770 pieces, a three fold increase over the period prior to the Project implementation. From 1997 to Winter Spring 04-05 there were only 5,391 pieces consumed across An Giang. So far, some 6,161 pieces are used by 193 seeding service groups Each group consists of 2-10 members managing 2-10 pieces. All the groups usually co-operate with cooperatives, farmers’ clubs and water supply teams. It takes one day for one piece to seed 2-3 ha and the associated unit operational cost is VND 50,000 per hectare.

Basing on the results of the first four farmer experiments in 2001, the An Giang Plant Protection Sub-Department has continued to organize scaling up to the whole province with two forms of training courses for farmers and demonstrations.

In Spring-Winter season 04-05 crop, we conducted the pilot program at one village with 500 hectare (total village area) and got rather good result. After that we continued to make scaling up to eleven districts. Number of local demonstrations scaling up depends on local condition.
During four years of the program (2001-2005), there were in total 432 FFS and 845 demonstrations (Table 5).

Table 5  Number of field farmer school (FFS) and demonstration

<table>
<thead>
<tr>
<th>Order</th>
<th>Content</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FFS</td>
<td>4</td>
<td>42</td>
<td>78</td>
<td>82</td>
<td>226</td>
<td>432</td>
</tr>
<tr>
<td>2</td>
<td>Demonstration</td>
<td>97</td>
<td>149</td>
<td>220</td>
<td>379</td>
<td></td>
<td>845</td>
</tr>
</tbody>
</table>

By the end of Summer-Autumn Crop 05, there are some of 147,971 farmer participants practicing 3R on some 220,653 hectare, representing 50.41% of rice-cultivated area per year (437,736 ha – 2 crops Spring-Winter 04 – 05 and Autumn-Summer 05) (Figure 5).

Figure 5  Amount of farmer participants and 3R applied area.

Resources Required
In addition to technical innovations, the Pilot Program has focused on promoting close links among farmers, processors, traders and bankers, all extension workers, provincial government and the central government officials. Through close co-ordination with bankers, processors and traders, farmers are free from worries about shortages of investment capital, product processing and marketing.

To implement the Program, there is totally VND 2,026,517,000 (USD 128,000) spent for four years. The fund for the program in 2005 was VND 1,109,022,000 (USD 74,000) comprising 18.86% from enterprises and 91.14% from government funds.

Main Stakeholders and Actors
Rice farmers, all extension workers, provincial government, Plant protection sub- department (PPSD) and the Plant protection station.
Main Target Groups
Rice farmers can apply technical innovations “three reductions” to produce high quality and low cost rice.

Assessment and Impact

Why was it Considered Successful?
A study shows that farmers can generally reduce seeding rates as well as cut down nitrogenous fertilizer and insecticide applications by 30 -50%, respectively. By adopting these practices, farmers will harvest three benefits that are income increase, pesticide-risks decrease and the environment improves by applying less polluted chemicals. The most successful program can be seen by the extensive application of the Program.

Evaluation of Benefits
Rice farmers gain most. In addition to reducing the production cost and increasing income, the Program helped decrease the farmers’ dependence on insecticides and their exposure to unnecessary health hazards. The next benefit group considered is extension workers, provincial government, Plant protection sub department, Plant protection station who make plan to protect crop yield and provide farmers with innovations easier. Pesticide selling shops lost because when adopting three reductions, rice farmers’ buying of pesticides and fertilizers was going down.

Most Significant Impacts
High quality and low cost rice, yield increase, in addition to the decrease of nitrogenous fertilizers and insecticides will contribute towards reducing pollution. Moreover, the most significant impacts were poverty alleviation, food security and the livelihoods of the poor.

Most Significant Outcomes
The provincial authorities have taken the leading role in scaling up to province in the next five years:
- Target 90% of cultivated area (468,000 ha/year) under the Program application
- Reach over 70% percent of area applied with high quality seed strains for export.
- Reduce seeding rates in straight lines by 80-100 kg/ha at 3R applied area and on average provincial seeding rates is 120 kg/ha.
- Reduce nitrogenous fertilizer rates by 20 kgN/ha/crop.
- Reduce insecticide sprays by 2 times /ha/crop.
- Reduce fungicide sprays by 1 times/ha/crop compared with the old method.
- Help 50% of farmers be aware of and control some main pests in rice paddies such as: Blast, sheath blight...
- Enable 30% of farmers to perfect their skills of rice production.

Factors Contributing to Successes and Failures:

Problems Encountered and Solutions Found in Implementing the Practice
Besides the support of provincial authorities, the mass media, good skilled farmers and good technicians and so on, there are some issues as follows:
- The irrigation system is not completed -- surrounding 20% still to be finished.
- The coordination between agencies is not synchronized because they don’t understand the targets of the program.
- Lack of technicians
- Language barrier between Vietnamese and ethnic languages.
- Lack of budget for demonstration

Main Reasons Contributing to Success
- The operations of the program are facilitated by the “High quality rice program” which is one of four main targets of the province.
- The interests of agriculture leaders, the aids of local authorities and union and the association with local agriculture expansion have created favorable conditions to deploy the program effectively.
- The information of the program rapidly spreads out thanks to the support of the mass media.
- The farmers are zealous and enthusiastic to register for the program.
- Zealous technicians are experienced in organizing and operating.
- The effectiveness of the cost sharing method 1:1 (province, district), 1:1:1 (province, district, enterprise)

Opportunities for Mainstreaming and Scaling-Up

In addition to the practices mentioned above, we conclude that it is necessary to consider some key solutions for scaling up:
- Setting up a co-operation or a village-scale demonstrations
- Scaling up to a 100 ha demonstration.
- Holding a competition to motivate stakeholders and farmers to participate
- Providing financial resources in the ratio 1:1:1 (Province: District: Enterprise)

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