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Philippine Rice Research Institute (PhilRice)

Wet-Seeded Rice Production

Rice Technology Bulletin Series

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FOREWORD

The Direct-Seeded Irrigated Lowland Rice (DSILR) Program is one of the key programs at PhilRice that is catering to the increasing number of farmers who are shifting from transplanting to direct-seeding, especially during the dry season.

Through the DSILR program, PhilRice integrates the different researches addressing various problems on tillage, water, nutrient, and pest management, seedling establishment, and variety to develop socially acceptable and economically viable technologies.

Most of the outputs of the studies conducted under the DSILR program are integrated in this technology bulletin.

I would like also to acknowledge the experts of the Japan International Cooperation Agency (JICA) and their PhilRice counterparts for sharing the results of their research on direct-seeding, specifically on nutrient management.

We hope that this technology bulletin can help farmers who are direct-seeding to produce more rice. We also hope that the extension workers and farmer-leaders will be able to use this bulletin to promote direct-seeding in communities where it is appropriate.

LEOCADIO S. SEBASTIAN
Executive Director

Introduction

Direct-seeding is now becoming popular among rice farmers, especially during the dry season because it requires less labor and drudgery, makes planting faster and easier, advances harvesting by more than one week, uses less water, and allows dryland tillage.

Through direct-seeding, farmers can save at least P3,000 from the costs of labor and water for crop establishment such as nursery management, pulling, transporting, and transplanting of seedlings. In a hectare, only 1-2 persons are needed to direct-seed in half day.

A recent survey of PhilRice saw that more than 75% of farmers in major rice-producing provinces are adopting direct-seeding. Iloilo has the largest area devoted to direct-seeded rice followed by Occidental Mindoro and Negros Occidental.

Variety Selection

- Choose varieties that are:
  - adapted to local conditions;
  - high-yielding;
  - early or medium maturing;
  - resistant to major pests, diseases, and soil problems;
  - resistant to lodging;
  - of good eating quality;
  - of high seed quality (preferably certified seeds); and
  - of good crop stand when direct-seeded.

Land Preparation

- Spread the rice straw and other crop residues into the field and incorporate them during land preparation for these materials to be fully decomposed. However, it is recommended that organic materials be fully decomposed before they are incorporated into the field.

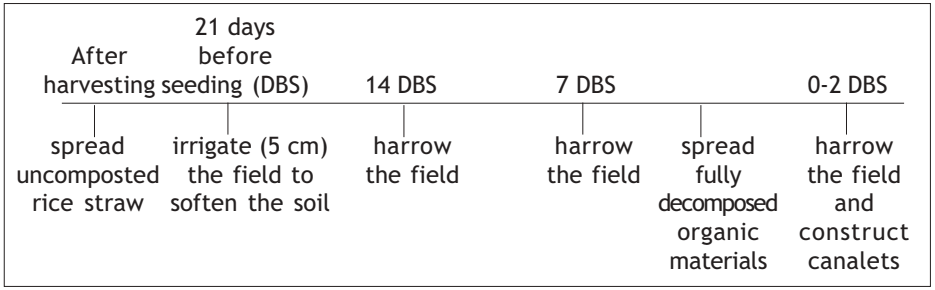


Fig. 1. Activities in preparing the field.

- Start preparing the field 3 weeks before seeding. Irrigate (5 cm water) the field to soften the soil.
- Plow the field to a depth of at least 10-15 cm to incorporate weeds and rice stubble and hasten decomposition.
- Harrow the field 7 days after the first plowing. Repeat it at 7 days before seeding.
- Apply fully decomposed or processed organic materials in the field before the last harrowing for these to be mixed thoroughly with the soil.

The field must be well-leveled to ensure stable seedling establishment.

- At 0-2 days before seeding, harrow and level the field thoroughly to ensure stable seedling establishment and good crop management. Construct canalets to serve as drainage ways of excess water and collecting spots for golden apple snail. They also serve as passage ways when planting the missing spots, applying fertilizers, spraying, weeding, roguing, and doing other farm operations.

NOTES

- During land preparation, avoid irrigating the field continuously to save water. Irrigate the field only during plowing and harrowing.
- It is important to level the field properly to attain uniform water depth in the field. This helps suppress growth of weeds, manage golden apple snails effectively, and maximize efficiency of fertilizer in the field.
- Use locally available organic fertilizers such as crop residues and animal manure. Rice straw from 5 tons of palay harvest can provide at least 25 kg nitrogen, 40 kg phosphorus, and 70 kg potassium. These materials must be well decomposed before seeding.

Crop Establishment

40-60 kg seeds is enough for 1 hectare

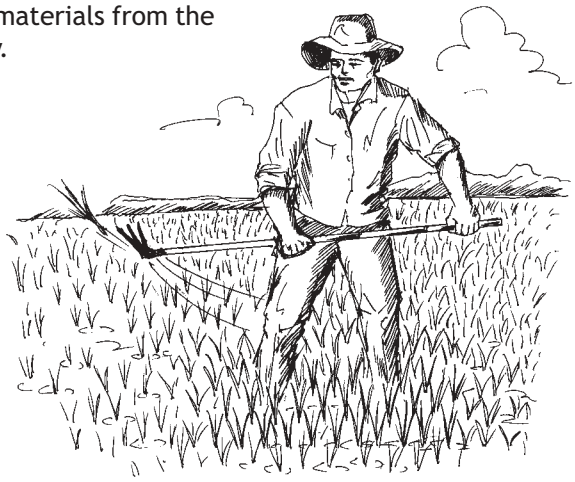
- In a community, synchronize seeding at the right time within one month to minimize occurrence of pests and prevent yield loss.
- A seeding rate of 40-60 kg seed per hectare is enough to avoid too close spacing that results in mutual shading, less tillers, and lanky plants that are susceptible to lodging.
- Soak seeds in water for 24 hours. For every 12 hours, change water and mix the seeds to attain even growth of roots.
- Incubate for 24-36 hours. Germinating seeds must have a uniform root length of 2-5 mm.
- During the wet season, sow the seeds 1-2 days after final leveling, depending on your soil type.
- During the dry season, sow the seeds just after final leveling.
- There are various machines that can be used for direct-seeding such as the PhilRice-JICA Handtractor-drawn and the PhilRice Manually-drawn Drum Seeders.
- Drain the field from 0 to 9 days after sowing to have good seedling emergence.

Row seeding with the use of the PhilRice and JICA-developed drumseeders is recommended to facilitate weeding, fertilizer and pesticide application, and other crop management activities.

- Ten days after sowing, start replanting vacant spots using *backhoe*. Get planting materials from the crowded hills within the paddy.

NOTES

- In Rizal, Nueva Ecija, farmers use a 4-toothed rake-type tool, which they call "backhoe" to replant missing hills and plant vacant spaces. This enables the replanted materials to tiller synchronously with the seeded plants.
- If seeds are over-incubated, uniformity of germination will be affected.



"backhoe"

Water Management

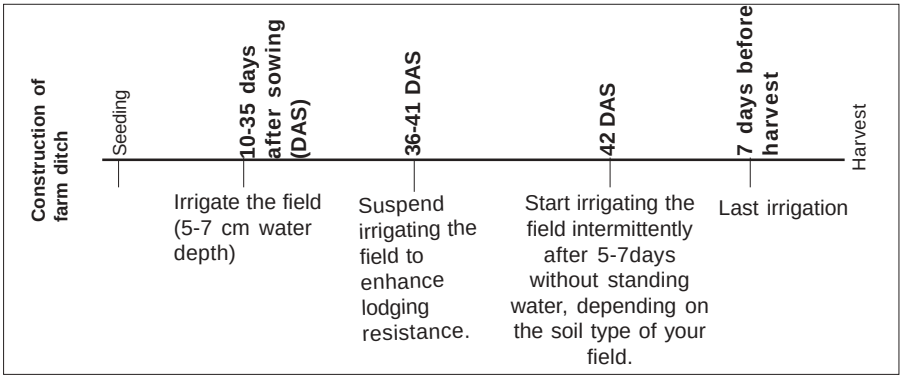


Fig. 2. Steps in using the intermittent irrigation for direct-seeded rice.

- Irrigate the field with about 5-7 cm water depth 10-35 DAS to facilitate fertilizer application and weed control.
- Suspend irrigating the field from 36 to 41 DAS to enhance lodging resistance and promote tillering.
- At 42 DAS, start irrigating the field intermittently until 7 days before harvest (DBH). The frequency may range from 5 to 7 days, depending on soil type and cropping season.

Nutrient Management

- For early- (EM) and medium- (MM) maturing varieties, the suggested amount and time of fertilizer application are shown in Tables 1 and 2, respectively. However, farmers must let their soil be analyzed to be able to know what soil nutrients are sufficient or limiting.

Table 1. Suggested amount of fertilizer and time of application for EM varieties.

10 DAS	30 DAS	45 DAS	60 DAS
Topdress 4 bags 14-14-14 and 1 bag 46-0-0 per hectare.	Topdress 1 bag 46-0-0 per hectare.	Topdress 1 bag 46-0-0 and 1 bag 0-0-60 per hectare.	Topdress 0.5-1 bag 46-0-0 or 1-2 bags 21-0-0 per hectare. However, this is OPTIONAL.

DAS - days after sowing

Table 2. Suggested amount of fertilizer and time of application for MM varieties.

10 DAS	35 DAS	50 DAS	65 DAS*
Topdress 4 bags 14-14-14 and 1 bag 46-0-0 per hectare.	Topdress 2 bags 46-0-0 per hectare.	Topdress 1 bag 46-0-0 and 1 bag 0-0-60 per hectare.	Topdress 0.5-1 bag 46-0-0 or 1-2 bags 21-0-0 per hectare.

Studies at PhilRice show that applying fertilizer at 60 DAS during dry season helps increase yield.

- To save on nitrogen (N) fertilizer and attain maximum yield, use the leaf color chart (LCC) to monitor the N fertilizer requirement of the plant. The LCC target for the corresponding number of days after sowing is shown in Table 3.

Table 3. LCC target to attain maximum yield.

No. of days after sowing	30-35	45-50	46-50	60-65	70	80 for MM varieties
LCC Target	**4.0-4.5**	**3.5-4.0**	**3.5-4.0**	**4.0**	**4.0-4.5**	**4.0-4.5**

- If LCC number of 5 leaves or more from the 10 plants are below the LCC target (refer to Table 3), apply 0.5-1.0 bag urea (46-0-0) per hectare or 1-2 bags ammonium sulfate (21-0-0) per hectare. Under PhilRice Maligaya condition, application of the recommended N fertilizer maintained the LCC target.

NOTES

- Weed before applying fertilizers.
- The field must be submerged in water before every application of fertilizer to minimize losses.
- If zinc deficiency symptoms appear, drain the field or broadcast 5-10 kg/ha of zinc sulfate with 2-3 cm water depth.
- Too much nitrogen fertilizer in the soil results in excessive vegetative growth, causing lodging of plants or increased incidence of diseases.
- Fertilizer application at start of flowering increases weight of grains. However, too much nitrogen at later stages of growth increases sterility of spikelets and induces production of late tillers.
- Observe the crop stand at flowering:
  - Uneven plant growth may mean that fertilizer application in the field was not uniform.
  - Too much fertilizer results in lodging.
  - Plants should have at least 3-4 leaves per tiller to support the root system and fill up spikelets with starch manufactured in the leaves.

Integrated Pest Management

IMPORTANT CONSIDERATIONS FOR IPM

- Adopt synchronous planting within a community. Synchronous planting stops food supply of pests and prevents continued multiplication of pests.
- Monitor the field regularly for pests, natural enemies, and other factors of pest build-up.
- Integrate all possible control strategies such as plant resistance and cultural, biological, and chemical practices to maintain pest population at economically damaging levels.
- Maximize the use of biological control agents such as parasitoids (*e.g.*, wasps), predators (*e.g.*, spider), and microbial agents (*e.g.*, *Metarhizium*) through proper cultural management and judicious use of pesticides.

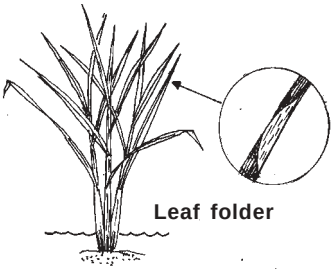
- Till the field after harvest to eliminate breeding places of insect pests and destroy disease inocula.

INSECTS

Plant within a month of the regular planting time to evade pest infestation. In a contiguous area, varieties of the same maturity must be planted at the same time. Plant also varieties that are resistant to the major pests in your area.

1. Defoliators

- Spraying during the first 40 DAS is unnecessary because rice plants can compensate for damage caused by defoliators.



Whorl maggot

- Drain and irrigate the field alternately because adults are attracted to fields with standing water.

Leaf folder

- Severe damage on the flag leaves from panicle initiation to grain filling stages is seldom observed. However, if it happens, apply the recommended amount of the commercially available insecticide.

Caseworm

- Drain the paddy for several days to kill the larvae.


Caseworm

2. Leafhopper and Planthopper

- If there is sufficient number of friendly organisms such as spiders, beetles, and mirids, spraying is not recommended.

Green leafhopper

Green leafhopper

- Spraying is not necessary if there is no source of tungro inoculum in the area or if you can use resistant varieties. In areas where tungro is endemic, spray appropriate insecticides as soon as GLH are observed.

Brown planthopper

- Flood and drain the field alternately to reduce planthopper population.
- Enhance the spread of biological control agents such as *Anagrus* by not spraying the field.

Brown planthopper

3. Stem borer

- Know the peak of stem borer population in your area as it helps you to time your seeding so that the crop will be harvested before the peak of stem borer population.
- Insecticide application is not needed during the vegetative stage because rice plants can compensate for stem borer damage by producing more tillers.
- For whiteheads, observe abundance of stem borer eggs from booting to flowering stages. If 1-2 egg masses are observed in every square meter in the field, insecticide application may be needed. Apply insecticide before the larvae enter the stem.

4. Rice bug

- Avoid planting earlier or later than most of the neighboring farmers.
- For rice black bugs, avoid planting alternate hosts such as gabi and corn. Use biological control agents such as the *Metarhizium* species of fungi.

DISEASES

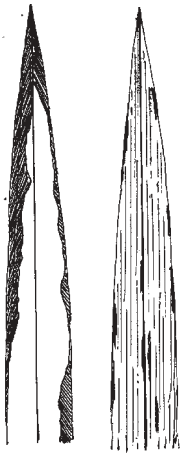
Plant resistant varieties and adopt synchronous planting. Destroy all infected rice stubble, ratoons, and weeds.

Bacterial blight (BLB)

- Plant resistant varieties and disease-free seeds to avoid this disease.
- Avoid excessive N fertilization.
- Practice field sanitation. After threshing, plow the field and allow it to dry.
- Avoid overflooding the field. Maintain a shallow irrigation water, about 2-3 cm.
- Avoid using chemicals. Bacteria easily develop resistance to antibiotics and bactericides.

Bacterial leaf streak (BLS)

- Plant resistant varieties and disease-free seeds.
- Apply moderate amount of N fertilizers.

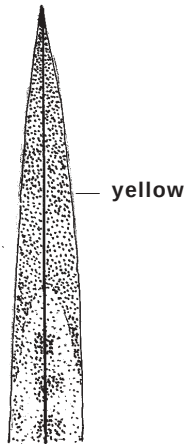


BLB BLS

Typical leaf lesions

Tungro

- Remove sources of virus diseases by eliminating infected rice plants and weeds.
- Prevent the disease during the early stages of plant growth. Infection at these stages cause the most damage.
- Split application of N fertilizer.
- Spraying is not necessary if there is no source of the inoculum in the area. Spray application based on tungro symptoms will be too late and unnecessary.



Leaf of a tungro-affected plant

Sheath Blight

- Plant moderately resistant varieties.
- Practice low density planting and field sanitation.
- Apply commercially available fungicide when infection is high during maximum tillering and booting stages.
- Apply a well balanced NPK fertilizer. Potassium application and row seeding can reduce the occurrence of the disease.

WEEDS

Prepare the land thoroughly. Apply pre-emergence herbicide at 1-3 days after sowing (DAS) or early post-emergence herbicide at 6-8 DAS. If needed, apply post-emergence herbicide at 15-30 DAS. Handweeding can also be done at 30 DAS in row-seeded rice.

The **Weed Control Action Indicator** (WCAI)* can also be used. This is a decision making tool for farmers to aid them in deciding if another herbicide application or handweeding is needed based on the relative weed cover (expressed as percentage weed cover [WC] and relative weed height [RWH]).

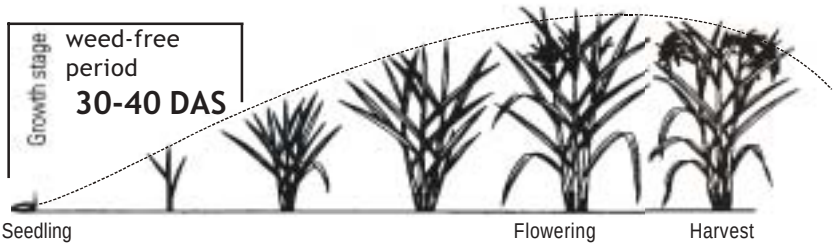
- Control action is needed at 15 DAS if RWH > 20% and WC > 50%
- Control action is needed at 30 DAS and 45 DAS if RWH > 30% and WC> 5% RWH and WC are determined using the following formula:

  RWC = Aggregate area covered by weeds (regardless of species and growth stages) as percent of the total sample area

**Paller and Marcelino 2001*

NOTES

- To minimize yield losses owing to weeds, the field must be weed-free during the first 30-40 days of the rice plants.
- Water management of about 5 cm depth at the early stage of rice is very effective to control weeds.



The ricefield should be weed-free in the first 30-40 days after sowing (DAS) because the highest competition for nutrients, sunlight, and water between the rice plant and weeds occur in this stage.

GOLDEN APPLE SNAIL

Handpick snails, repair dikes, and control water; put screen wires along water outlets; alternately drain and flood the field so snails will transfer to canalets where they can be picked easily; herd ducks in the field during fallow.

RATS

Management options

A. Using baits

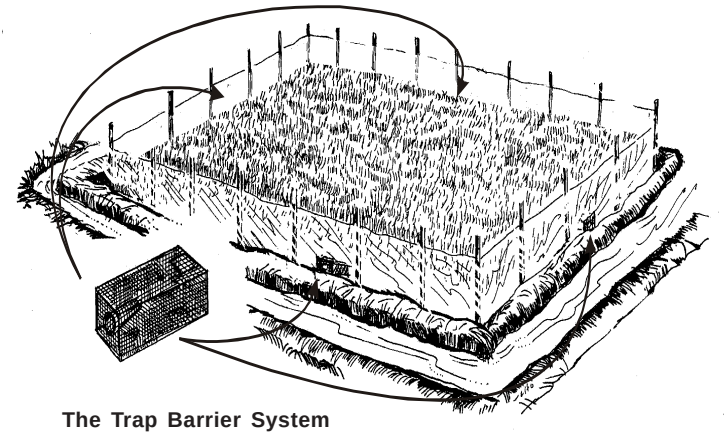
1. Pre-baiting. Distribute baits 2-4 days prior to massive acute baiting to familiarize the rats with the bait. This should be done before direct-seeding to target the rats that will try to eat the broadcasted seeds.
2. Apply acute rodenticide in areas where pre-baiting was successful to avoid the establishment of new rat population in the same area. This will increase the chances of killing rats by about 70%.
3. Two weeks after direct-seeding, install 5 initial baiting stations per hectare. Put chronic baits in the baiting stations at 6 tbsp/station to further reduce the remaining 30% population. Inspect all baiting stations everyday to replace consumed baits.
4. For every station visited by the rats, add 1-2 baiting stations 10 meters apart from the original baiting station.
5. Increase the amount of mixed baits to 8 tbsp/baiting station. Replace spoiled baits with new ones.
6. Before harvest time, collect all baiting stations. Clean, repair, and keep them for the next cropping period.

How to prepare the baits

- Use locally available materials, such as bamboo, oil cans, coconut husks, etc. as bait holders.
- Mix 1 kg of rodenticide with 19 kg of milled or broken rice.
- Deposit 100 mg of mixed bait per baiting station.
- Place baiting stations along rats' breeding places, such as irrigation dikes, and uncultivated areas.

B. Using the trap barrier system (TBS)

1. For every 10 hectares contiguous rice area, plant rice in a 20 x 20 meter area (dimension may be varied depending on the topography of the rat habitat) one month before normal planting time.
2. Use aromatic or good eating quality rice variety (e.g. MS 6, MS 8) as plant bait.
3. Fence the area with 24.5 inches tall plastic sheets (similar to the material which is used to cover notebooks and books).
4. Use bamboo stakes to erect the plastic materials. The stakes should be placed inside the plastic fence.
5. Install rat traps in four locations inside the fenced area.



The Trap Barrier System

NOTES

- The TBS requires only P2,700 (P1,900 for plastic, P600 for four rat traps, and P200 for labor) to control rats in a 10-hectare rice field.
- The trap is made of metal screen wire (rectangular in shape), having a cone-shaped inclined entrance tunnel narrowing to the end with bent metal wire. Rats are caught in the traps while trying to enter the trap barrier system.

C. Other forms of rat management

Physical control methods

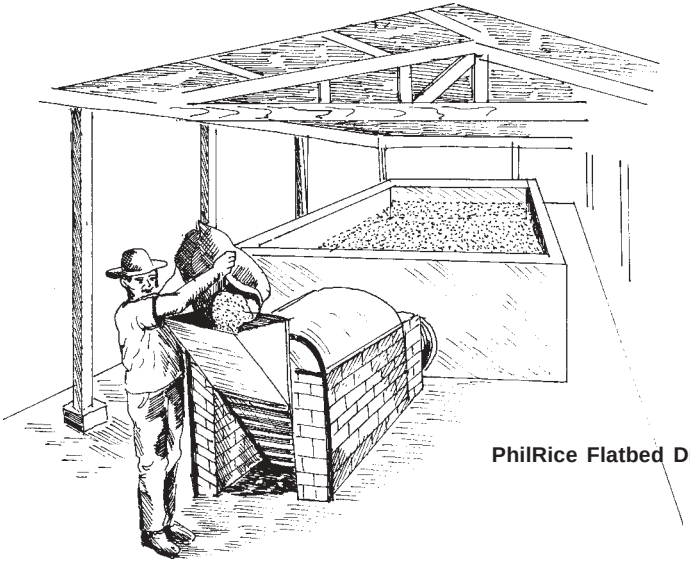
1. Digging of rat burrows and holes.
2. Blanketing method. A group of farmers surround the rats' hiding places, forcing them to come out and eventually clubbing them to death.
3. Use of flame thrower.

Cultural Control methods

1. Practice proper sanitation by removing all straw piles in the paddies after harvest.
2. Practice synchronous planting. Plant within a month of the regular planting time.
3. Minimize size of levees to 15 cm wide x 20 cm high (6 inches x 8 inches) to avoid rat burrows.

Harvest and Postharvest Operations

- Drain the field at 7 DBH. However, depending on soil type, gradually drain the field up to saturation point, preventing abrupt drying of the soil as this will affect grain quality.
- Harvest palay when 80-85% of the grains at the upper portion of the panicle are golden yellow or straw colored. Delayed harvesting can cause shattering of the grains.
- Thresh, clean, and dry grains immediately to 14% moisture content before storage. Field losses and grain quality problems are minimized if palay are threshed immediately.
- Spread the rice straw in the field after threshing for these to decompose before the next cropping.
- Plow the field to incorporate the crop residue and break the cycle of pests.
- Drain the field during fallow to improve the soil's physical and nutritional structure.



PhilRice Flatbed Dryer

NOTES

- Inefficient postproduction practices contribute 1-35% grain loss.
- Newly harvested palay has high moisture content (MC) of 20-26%, and must be dried immediately to 14% MC for good storage, better grain quality, and higher price.
- For sundrying, spread palay in concrete pavements at 2-4 cm thick, and mix every 30 minutes-1 hour for uniform drying and to prevent overheating. Use mechanical dryers such as the PhilRice Flatbed Dryer, if available.
- Milling losses arise from improper adjustment of machine, improper milling equipment, lack of trained operators or poor palay quality.
- Use clean sacks for storing the palay.

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PhilRice

The Philippine Rice Research Institute (PhilRice) is a government-owned and controlled corporation created through Executive Order 1061 approved on Nov. 5, 1985, which was amended by EO 60 dated Nov. 7, 1986 and EO 76 dated March 4, 2002 to help develop high-yielding technologies so that farmers can produce enough rice for all Filipinos. PhilRice accomplishes this mission through research, technology promotion, and policy advocacy, which are implemented through a network that includes 57 agencies and 95 seed centers strategically located nationwide.

Its interdisciplinary programs include the following: (1) direct-seeded and (2) transplanted irrigated lowland rice; (3) hybrid rice; (4) rice for adverse environments; (5) rice-based farming systems; (6) policy research and advocacy; and (7) technology promotion. With these programs, PhilRice aims to develop and promote technologies that are ecosystem-based, location- and problem-specific, and profitable to the Filipino farmers.

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