SAVING RICE

Rice is at the heart of a fierce strategy debate as the country prepares to launch the second Green Revolution in the eastern states. Policymakers and scientists have drawn up ambitious plans to increase the productivity of this cereal which feeds two-thirds of Indians. Enormous funds are being poured into research aimed at improving seed varieties, with a heavy focus on developing hybrid rice. Is it the right option for millions of small rice farmers who are already battling high input costs and increasingly unpredictable weather? Or does part of the solution lie in efficient methods of cultivation that will cut down water use and improve yield?

Latha Jishnu analyses these varied strands as she visits research institutes and gets down into the paddy fields of Odisha and Andhra Pradesh to understand what might work. She discovers that traditional rice varieties are making a significant comeback in Odisha—as in Karnataka, where **Aparna Pallavi** finds some farmers have abandoned high-yielding varieties in favour of indigenous varieties and organic farming to meet the challenges of climate change. From West Bengal, **Sayantan Bera** reports that the largest rice producing state has a different set of problems to contend with if it has to reap the promise of the new Green Revolution.

SAYANTONI PALCHOUDHURI/ CSE

Something is stirring in paddy fields across India. New seeds, new crop management techniques and newly minted food security policies are about to hit the countryside. Not all of the changes that are being forged in Krishi Bhawan, headquarters of the Union agriculture ministry, in the top-flight research institutions across the country, and in the boardrooms of leading global and domestic seed companies are visible as yet. But these policies could transform the country's rice landscape, perhaps, in an unalterable manner.

Driving past lush green rice paddies in Odisha's Cuttack and Khordha districts, the picture seems timeless as ever. Farmers are surveying their ripening crop and counting panicles, the branching flower cluster that carries rice grains, to get an idea of the expected yield. It is a richly verdant tapestry that is on view for mile upon mile: the predominant expanse of high-yielding dwarf varieties broken here and there by fields of distinctively taller traditional rice plants. As one travels southwest to Koraput, the fields of traditional rice varieties appear to be more widespread. Here lines of colourfully clad women from tribal communities are working in the paddies, transplanting the same kind of rice they have been growing for centuries. This ageless picture of bucolic charm, so closely tied to the country's culture and history, is, however, deceptive.

There is a crisis in rice—both for the farmer, battling unprecedented changes in weather and escalating costs of cultivation, and the government, which needs to ramp up rice production by two million tonnes annually to ensure the nation's food security. There are other concerns as well. India is a highly water-stressed country. Since every kilogramme of rice requires 4,000-5,000 litres of water, making it an ecologically unsound crop, there is a question mark over the issue of increasing rice production. The biggest worry is stagnant yields. India has the largest area under rice in the world—about 44 million hectares (ha)—but its productivity is way behind a dozen other countries. High-yielding varieties cover slightly over 80 per cent of the rice acreage, but the yields of these varieties—the result of decades of research by the huge network of public-funded institutions—have touched a plateau. Farm experts say the primary reason is poor agronomic practices. In contrast, China, the biggest producer of rice in the world, churns out 193 million tonnes of paddy on just 29.2 million ha, notching up yields of 6.61 tonnes per ha compared with 3.37 by India.

There is a sharp dichotomy in the approach of the farmer and the policymaker on what can be done on this score. There lies a huge perception gap between the farmer's search for sustainable livelihood and ecologically sound practices in the face of climate uncertainties and dipping water table, and the government's focus on industry-promoted solutions for boosting rice yield.

Let's take a few examples. In Mandya district of Karnataka, paddy farmer Boregowda of Shivahalli village has switched to traditional rice varieties from the high-yielding Jaya and Tanu, which he was cultivating with chemical fertilisers and pesticides. Output had fallen from the initial 2.5-2.7 tonnes per acre (0.4 ha) to 1.8 tonnes, and given the cost of cultivation his farming was proving unremunerative. Besides, unpredictable weather was making his livelihood precarious. Boregowda started with his grandfather's favourites, Coimbatore Sanna and Doddibatha. The varieties, revered for their drought-tolerance and special taste, had disappeared after the Kannambadi dam brought irrigation to the area. He now harvests 2.7-3 tonnes per acre and gets a better price for his organically grown rice.

At the other end of the country, in Koraput, the M S Swaminathan Research Foundation has given the tribals an assured income through conservation and cultivation of the scented Kalajeera rice. Starting with just 5.6 ha in 2002, the prized rice is now grown over 48.8 ha, yielding 134 tonnes in 2008. The rice, says Susanta Sekhar Chaudhury, senior scientist at the foundation, is fetching cultivators a handsome premium. There are countless such stories where farmers are shrugging off modern farm practices to return to the healthier cultivation of the past (see 'Recovering a lost legacy' on p31).

But can traditional varieties alone meet the country's growing food needs? The Planning Commission estimates that India requires 122.1 million tonnes

of milled rice by 2020 to meet food security norms. At the existing 1.34 per cent rate of growth India can hope to produce no more than 106 million tonnes.

How is the country to bridge this deficit?

A major initiative to meet this challenge was kicked off in 2007 with the launch of the National Food Security Mission which has been mandated to bump up rice production by 10 million tonnes by 2011-12. The three-pronged mission—for rice, wheat and pulses—has been allocated generous funds of ₹4,882 crore with rice getting the lion's share of ₹1,963 crore. This year, Finance Minister Pranab Mukherjee announced another scheme, more ambitiously titled the Second Green Revolution for the eastern states, in his budget. With an outlay of ₹400 crore from the Rashtriya Krishi Vikas Yojna (RKVY) funds, the thrust is to step up rice yield, along with that of pulses and oilseeds, in the states of Bihar, Jharkhand, Chhattisgarh, Odisha, West Bengal and eastern Uttar Pradesh. This is good news for the rainfed region that has received little attention from policymakers in the last six decades. While agriculturists believe the region holds the greatest potential for meeting the country's galloping food requirements, there is a yet-to-be-settled debate on the path forward.

According to Union agriculture minister Sharad Pawar the best bet is the Chinese model. At the first conclave of agriculture ministers of the newly designated Green Revolution states in July, Pawar said there was much to learn from the Chinese model of agricultural growth, particularly in using hybrid paddy. To ensure that the correct strategies were followed, he announced the formation of a special task force on hybrid rice. One of the primary objectives of the task force would be to foster the production of hybrid rice seeds through public-private-partnerships (PPPs) and make these available at reasonable rates to farmers. The belief is that only hybrid rice can bridge the yield gap of one-two tonnes per ha. Ashish Bahuguna, additional secretary in the agriculture ministry who heads the task force—it is made up of half a dozen bureaucrats—confirms that the Green Revolution interventions would willy-nilly be focused on hybrid rice. In fact, to fast forward the process, India would import hybrid rice seeds from China, Indonesia and Vietnam. "There is no need to reinvent the wheel. Our institutions can continue with their adaptive research but we can test these varieties for the next kharif," Bahuguna says. This is a decision which could prove controversial.

Hybrid rice would will-nilly become the centrepiece of the new Green Revolution. To fast forward the process India would need to import hybrid rice seeds

Two decades of concentrated research on hybrids by premier research institutions in the country—the Directorate of Rice Research (DRR) in Hyderabad, the International Agriculture Research Institute (IARI) in Delhi and the Central Rice Research Institute (CRRI) in Cuttack—have not made much headway. Since the 1990s, the

APARNA PALLAVI / CSE

Rice index

All-India area, production and yield of rice

Year	Average area (million hectares)	Average production (million tonnes)	Compound growth rate of production (million tonnes)	Average yield (kg/hectare)	Compound growth rate yield (kg/hectare)
1950-1960	31.57	26.28	NA	829.9	NA
1960-1970	35.85	35.85	2.4	998.9	1.4
1970-1980	38.63	44.75	2.6	1,156.4	1.6
1980-1990	40.65	59.77	4.2	1,467.1	3.6
1990-2000	43.21	80.00	1.9	1,852.0	1.1
2000-2010	43.40	89.19	2.4*	2,052.8	2.1*

NA – Not available; *The compound growth rates are for 2000-08

Top rice producing states (2008-09)

State	Area (million hectares)	All India (percentage)	Production (million tonnes)	All India (percentage)	Yield (kg/hectare)
West Bengal	5.94	13.03	15.04	15.16	2,533
Andhra Pradesh	4.39	9.63	14.24	14.36	3,246
Uttar Pradesh	6.03	13.25	13.10	13.20	2,171
Odisha	4.45	9.78	6.81	6.87	1,529
Punjab	2.74	6.01	11.10	11.09	4,022
Assam	2.48	5.46	4.01	4.04	1,614

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation

Centre and states have released 43 hybrid rice varieties, of which 28 are developed by public labs. In addition, says Tapan Kumar Adhya, director of CRRI, 30-40 truthfully labelled hybrids developed by the private sector are being cultivated in the country. Yet, just about 3 per cent of the area under rice has gone over to hybrids (see 'Sterile growth—at home and abroad' on p33).

"We can't do without hybrids," insists B C Viraktamath, director of DRR. "Varieties may give us five tonnes per ha but that crucial extra tonne per ha can only come from hybrids." He, however, concedes that "increasing the yield should not be the only criterion" since it has "derailed the sustainability of rice production system". Therefore, "the Green Revolution in eastern India should be ushered in based on the principles of sustainability, soil health and environmental protection", Viraktamath says. He believes half the irrigated area under rice, that is 9-10 million ha, can be brought under hybrids if all goes well. DRR has just released its first hybrid variety in a marketing and licensing deal with four private companies.

It is perhaps on account of such poor acceptance that the National Food Security Mission (NFSM), too, is focusing much of its energy on popularising hybrid rice. It has set a target of bringing three million ha under hybrids by 2011 although mission officials have not found the response of farmers encouraging so far. Mukesh Khullar, joint secretary in the agriculture ministry, who heads NFSM says, "Farmers don't appear to see much benefit in using hybrids, and there are issues relating to quality and availability of the seed." The mission provides financial assistance for production of hybrid rice seed, ₹1,000 per 100 kg, because it concedes that "hybrid rice seed production is a very complex and risky task. The ultimate realisation per unit area in hybrid rice is very low". Along with funds for distributing mini kits of hybrid and high-yielding varieties, it also offers assistance for conducting demonstrations on farmers' field. Some of the eastern states have an issue with the priorities outlined by Pawar. A member of West Bengal Planning Commission, who did not wish to be named, says, "The large-scale transition to hybrid rice in India is not practical since the input costs are too

LATHA JISHNU / CSE

The custodian

A retired teacher grows 350 indigenous varieties on his farm

Natabar Sarangi looks at high-yielding varieties that hedge his farm with complete disdain. To him, the only rice that counts is an indigenous variety that boasts a history longer than his. Sarangi is 77.

This retired schoolmaster has but one passion in life—cultivation of traditional or indigenous varieties that have almost vanished from the public memory and to share them with other rice growers. Sarangi has an incredible 350 varieties growing on his two-hectare farm in Narisho, a hamlet in Khordha district of Odisha. In recent years, hundreds of farmers from across the state have made the pilgrimage to his nondescript hamlet, seeking the seeds of hope. Hope because the seeds that Sarangi nurtures require no costly inputs and give guaranteed yields. This year, a hundred farmers from Sambalpur took 10 quintals or 1,000 kg. Others came from Bargarh; a few bags have gone to the Niyamgiri Hills. Sarangi charges a nominal rate that barely covers his production cost. But more likely than not, he will give away the seeds for free if he is convinced that there is genuine passion for such rice. So when retired nuclear scientist P Parameswaran came from Kerala seeking 200 kg of flood-tolerant varieties, Sarangi gifted him the seeds.

Sarangi's aim in maintaining his farm, which he does with difficulty, due both to his age and means, is to demonstrate that rice grown in the old fashioned way can be paying and healthy for both farmers and consumers. Not a drop of chemical pesticide or a single gram of fertiliser pollutes his fields. He uses green manure, or *donicha*, made from plants that are grown along with the rice crop. He says it is the most economic source of nitrogen.

His rice varieties, all with lilting names like Kedara Gouri, Padma Kishori, Khas Kamini, Gobinda Bhog, Pimpudi Basa (so aromatic that red ants make a beeline for it), Kalajeera and Ratna Chudi have different uses and purposes that are closely linked to the local culture. And on the whole these are extremely sturdy varieties that can withstand floods and droughts. Kannia Patia, for instance, can take submergence of 22 days. "After the floods recede the plant will have 20-25 tillers (roots) and the farmer will harvest two tonnes of paddy for sure," says Sarangi. Sohra, Kalakiyari and Nadia Phulo are drought-resistant varieties of the kind that the Indian Council of Agricultural Research will find hard to match, he boasts.

But would other farmers settle for yields ranging from two to 4.5 tonnes per hectare? Clearly, many believe there are other advantages to be had.

high and it's not easy to convince farmers. Besides, hybrid rice requires better irrigation management which is not possible everywhere in West Bengal." In any case, even with the existing semi-dwarf high-yielding varieties, productivity of four-five tonnes per ha is achievable.

There are other gripes. K Samanta, additional director of research at Bidhan Chandra Krishi Viswavidyalaya, an agricultural university in Kalyani, West Bengal, points out that state agricultural scientists were not consulted during the formulation of the new Green Revolution plan. What has been overlooked in the formulation of the plan is that most farmers here are small and marginal landholders. They are efficient in crop management but are not suited to farm mechanisation, which is a significant component of the plan.

Overall, the obsession with promoting hybrid rice as a priority has not gone down well with the larger community of agriculture scientists. They point out that the new stress-tolerant varieties that have been introduced in several states have done much to revive the fortunes of rice cultivators—and add to the foodgrain kitty. One of the biggest breakthroughs has been the development of rice varieties that can take on prolonged submergence, drought and grow well in extreme salinity. Uma Shankar Singh, South Asia regional project coordinator of the International Rice Research Institute's STRASA (Stress Tolerant Rice for Africa and South Asia) project, points out that a significant strategy to enhance rice productivity in rainfed areas and mitigate the impact of climatic changes is to go for stress-tolerant rice varieties. A major success of the STRASA project in this line, partnered with the Central Rice Research Institute, is Swarna Sub1, which can rebound after over two weeks of submergence

Top rice producing countries (2008)

Japan does not grow hybrids, yet its productivity is higher than China's

Country	Production (million tonnes) of rough rice	Area (million hectares)	Productivity (tonnes/hectare)	Area under hybrids (million hectares)
China	193	29.2	6.61	19
India	**148.36**	**43.91**	**3.37**	**1.3**
Indonesia	57.83	11.85	4.88	0.13
Bangladesh	46.51	11.60	4.01	0.30
Vietnam	35.90	7.35	4.88	0.68
Thailand	29.30	10.68	2.75	nil
Myanmar	17.50	6.70	2.61	0.05
Philippines	16.81	4.40	3.82	0.20
Brazil	13	2.92	4.45	0.025
Japan	**11.02**	**1.63**	**6.78**	**Nil**

MURALIDHAR ADHIKARI

Women in Koraput harvest aromatic Lalat rice

Sterile growth—at home and abroad

For the new Green Revolution India is expected to queue up for China's hybrid seeds

China is the benchmark for rice productivity, and its success is supposed to have come from its early adoption of hybrid rice. But this is true only in parts.

Of the 29.2 million hectares (ha) that is under rice in China, 19 million ha are given over to hybrids. But as scientists at the Directorate of Rice Research (DRR) in Hyderabad point out, the high level of productivity (6.61 tonnes of paddy per ha compared with 3.37 for India) is partly due to the high productivity of its inbred varieties. There are several reasons for this. The soil is rich, the climate is conducive and over 90 per cent of the paddy fields are irrigated (56 per cent in India). Besides, China is known to favour high usage of fertiliser.

If one were to study the spread of hybrids elsewhere in the world, the report card is pretty dismal. All the other countries put together account for just three million ha of hybrid rice cultivation. Some, like Thailand and Japan, have clearly rejected the hybrid option. Japan has a higher productivity than China's and it does not grow hybrid rice (see tables). Similarly, in Egypt, the high yield of inbred varieties makes it impossible to develop hybrids with a 20-25 per cent advantage.

Because of the tardy pace of research and development in the Southeast Asian region, China is turning into a major trader of hybrid seeds, prime customers being Vietnam, Myanmar and Bangladesh. India is expected to become another shortly. The Chinese had a head start because research was initiated in the 1960s and the first hybrids were released in 1976. What helped, perhaps, was that all research was in the public sector. The situation is exactly the reverse in India: private companies outnumber the public research institutions. So partnerships are the order of the day with private companies being roped in for seed multiplication and marketing. And to ensure offtake, the Food Corporation of India is being asked to procure it.

Ashish Bahuguna, who heads the task force on hybrids, is the first to admit that there are huge problems with Indian hybrids: poor quality, high prices (hybrids add ₹1,600 to ₹2,000 per ha to the seed cost), limited shelf life, inadequate seed multiplication capacity, trade hostility and farmer resistance. Yet it has been given a pivotal role in rice renaissance in eastern India.

Slow road to hybrids

Private seed companies outnumber public research institutions in India

Country	Year research started	Government institutions	Private institutions	Status
Japan	**1983**	**2**	**1**	**Basic research under way. But cultivation unlikely because hybrids are not economically viable, so no demand**
Brazil	1984	1	1	On farm trials; prospects of limited commercialisation
Philippines	1980	3	6	8 hybrids released; major constraints high seed cost and low yields
Myanmar	1993	1	Nil	Limited cultivation with hybrids imported from China and India
Thailand	1993	1	Nil	Not much scope as Thailand is interested in growing quality rice for export
Vietnam	1985	4	2	2 indigenous hybrids released; importing seeds from China
Bangladesh	1993	1	4	2 indigenous hybrids released; 12 Chinese hybrids under cultivation
Indonesia	1986	2	4	35 hybrids released; no high-yielding hybrid identified so far
India	**1989**	**15**	**30**	**43 hybrids released so far. Poor acceptance because of limited yield gains**
China	1964	50	Nil	Facing major constraints of stagnant yields and poor quality grain; work under way on super hybrids

Source: Directorate of Rice Research

and is seen as a breakthrough for coastal areas. Similarly CSR36, a salt-tolerant variety developed by the Central Soil Salinity Research Institute in Karnal, Haryana, is performing exceptionally well. Stress-prone rice area in the country accounts for as much as 24 million ha, of the 44 million ha, posing a huge challenge for stabilising rice production.

All of this appears to have led to a quiet war in the research community over the right rice strategy for India. According to insiders, a group of scientists from the apex Indian Council for Agricultural Research (ICAR) has brought up this issue with Pawar and Krishi Bhawan officials, pointing out that tilt towards hybrids would only benefit the private seed companies. Hybrid seeds cannot be reused by farmers like other seeds and have to be procured each season from the developer. "Is it surprising therefore that private seed companies are not interested in inbred seed research but are focusing almost exclusively on hybrids?" asks a senior ICAR scientist who has worked on international programmes.

The new Green Revolution may well usher in a rice revolution in the east but before that it could lead to a bitter battle for India's rice market.

With inputs from Jyotika Sood

MORE WITH LESS

System of Rice Intensification is new mantra for reducing water usage and increasing productivity

Jai Sri is a common greeting in the Koraput countryside these days. A Paraja tribal woman working in her fields, a passing motorcyclist driving through the rutted lanes, a teacher heading for his school, they all greet each other and visitors with a Jai Sri. It has nothing to do with religious revivalism, but is the new buzzword sweeping the farmlands of Odisha—and large patches of India. SRI is the acronym for System of Rice Intensification, a new technique to grow rice more efficiently using much less water and seeds but yielding far greater quantities of rice.

It is a system that is being spread by a band of somewhat unlikely evangelists: academics, non-governmental organisations (NGOs), top-flight charitable trusts, crop research institutions, wildlife organisations, the World Bank and most surprisingly the Government of India.

Muralidhar Adhikari, who works with Koraput NGO Pragati, exemplifies the spirit of the SRI missionaries. He goes from farm to farm with a message that comes across as heretical to rice cultivators. Stop growing rice in standing water, use as little of the precious resource as possible, reduce seed consumption and throw out pesticides and chemical fertilisers. "Initially farmers are sceptical and it takes a lot of convincing to get them to try SRI," says Adhikari, district coordinator of Pragati which is channelling most of its energies into transforming rice cultivation in this backward tribal district of Odisha.

In SRI 8-14-day seedlings instead of the normal three-four-week-old seedlings are transplanted at wider spacing through a marker system for uniformity. Only one seedling is planted per hill. Water is used sparingly to keep the soil moist (alternate wetting and drying) but not continuously flooded. Weeding is carried out mechanically through a rotary weeder (small hand-driven machine), but instead of throwing out the weeds these are pushed into the soil for aeration and providing organic compost. Use of farmyard manure is encouraged because SRI cultivation responds better to organic fertiliser than chemical fertilisers. Seedlings are raised in unflooded nurseries, not planted densely and have to be well supplied with organic matter. There is an option of direct-seeding, but transplanting is common. Seedlings have to be transplanted quickly and carefully in a square pattern, usually of 25x25 cm, to give roots and leaves more space to grow.

It is these simple but time-consuming and intermittently labour-intensive practices that could prove the saviour of rice farmers, increasing yield between 30-80 per cent and cutting down water consumption by as much 40 per cent. Seed use, too, is drastically pared.

Ask Duddeda Sugunavva, a 38-year-old Dalit farmer from Katkur village in Warangal district of Andhra Pradesh. The delighted farmer, who works on two acres (0.8 ha) of leased land, says, "I was reluctant at first to try a method that was completely contrary to what I've been used to for decades." But grudgingly she tried out SRI on about one-tenth of an acre. But after harvesting six 70-kg bags rather than the usual four bags from that plot, she quickly extended the technique to the entire two acres, and has now been using only SRI practices for five seasons.

Her take-out is pretty stunning. Compared to the 35-40 bags of rice from one acre (2.8 tonnes/acre) that she would harvest earlier, Sugunavva now gets 55-60 bags (4.2 tonnes/acre). She has more reason to smile: costs have been slashed by ₹4,000 per acre. SRI in Andhra Pradesh is spearheaded by the World Wide Fund for Nature in collab-

Simple steps to SRI

Transplant 8-14-day seedlings, instead of the normal three-four-week-old seedlings, at wider spacing. Use marker system for uniformity. Plant only one seedling per hill. Use water sparingly to keep the soil moist, but do not flood the field continuously. Weed with a rotary weeder and push them into the soil for aeration and organic compost. Use organic fertiliser.

oration with the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)—an unusual partnership aimed at promoting more efficient use of water in agriculture.

The World Bank, too, is a champion of SRI. Working with Tamil Nadu to improve its irrigation service delivery, the Bank has helped to bring around 450,000 ha under the SRI system. Its logic: "any significant growth in agriculture depends on increasing the efficiency and productive use of water." It warns that by 2020, India's demand for water will outstrip all sources of supply.

Since India needs to increase rice production by 2.5 million tonnes a year, it cannot hope to do so by the conventional method of cultivation. That guzzles 4,000 to 5,000 litres of water per kg of rice. Nor can it expand its irrigated area to the required level because of constraints on land and water resources.

One reason Tamil Nadu is promoting SRI is because it is one of India's driest states, getting just 925 millimetres of rainfall a year. The per capita availability of water resources is 900 cubic metres a year compared with an average of 2,200 cubic metres for the country. And agriculture consumes 75 per cent of the state's water.

Perhaps as a result of Tamil Nadu's project, SRI has caught the imagination of the mandarins in Delhi, too, which has set aside ₹8 crore under the National Food Security Mission to propagate SRI in the selected districts where the programme runs. The mission has a target of covering five million ha by 2011-12 and is a key element in efforts to push up rice productivity.

LATHA JISHNU / CSE

Duddeda Sugunavva, a farmer in Warangal, has been practising SRI for five seasons. She now reaps almost double what she used to get earlier

NGOs are the foot soldiers of this innovative programme with nodal organisations stringing together district-wide networks to reach as many small and marginal farmers as possible. The NGO network from Pradhan in Bihar to CROPS in Jangoan, Andhra Pradesh, has been made possible thorough generous funding from private charities. The largest donor is the Sir Dorabji Tata Trust, which has selected SRI as one of two major initiatives under its natural resource management and rural livelihoods programme. Biswanath Sinha, senior programme officer with the Trust, says it started with an initial allocation of ₹11 crore in 2007-08 and has upped the figure to ₹24 crore for 2010-11.

Matching funds have come from the public sector. NABARD, for one, has taken up SRI in earnest and allocated ₹16 crore for the programme. It is also putting together data to prove SRI's efficacy. According to a survey compiled by its Raipur office, yield increases are as high as 50 per cent.

Scientists, however, are yet to be convinced.

U S Singh of the International Rice Research Institute's (IRRI's) STRASA programme in Delhi insists that there is no scientific data to corroborate the claims made by SRI proponents. IRRI incidentally promotes the direct-seeded technique of rice planting which also avoids the conventional puddling and submergence practices.

Shambu Prasad, associate professor at the Xavier Institute of Management, Bhubaneswar, who has put together a national alliance on SRI, believes that scientists tend to be dismissive of SRI because the technology has come from the farmers and not the formal research establishment. He admits that there are issues with SRI. One is labour costs. Although small farmers can come together to do the tansplanting and weeding at the critical times, costs can be a concern when farmers have to hire labour for these chores. One yardstick of the technique's success is that SRI is being adapted for a range of other crops from wheat to millets.

Modern agriculture, Prasad concedes, has been the most successful system of production in history. But it has also been the most stressful for natural resources—for soil, water and air. What is needed now is grassroots innovation that relieves these stresses. ■

PHOTOGRAPHS: MURALIDHAR ADHIKARI