Indigenous Paddy Varieties under SRI and Conventional Practices: A Performance Study

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Assessing and documenting the experiences of various organizations and farmers with regard to on-site yield performance of IPVs under SRI, this study, commissioned by NCS, identifies specific areas for future action in research and policy on the subject.

This study was commissioned by National Consortium of SRI (NCS) to assess and document the experiences of various organizations and farmers with regard to the onsite yield performance of Indigenous Paddy Varieties (IPVs) under SRI. IPVs or folk rice are cultivars that are native to areas with a long traditional history of farming. The results of the study will help identify, test and improve the potential of IPVs under SRI so as to bring them into common use and to promote their in situ conservation.

An objective of the study was to develop a database of IPVs that show promising performance in production under SRI and conventional systems. Another was to develop appropriate methods, tools of data compilation and analysis of an in situ assessment of the comparative yield performance of indigenous varieties. Compiling farmers' perspectives on the subject, the study was conducted across different regions and ecosystems with 24 organizations in six states using IPVs. These organizations were selected in consultation with NCS and other field practitioners.

MANAGEMENT SYSTEMS—PADDY

In this study, four different management systems were found, namely—SRI, Single Plant Transplant (SPT), traditional systems of transplant and direct seeded. Table 1 cites the salient features of these management systems.

Methodology

The methodology adopted was to identify at least 10 indigenous varieties per location visited that were performing well, in terms of yield (4 t/ha and above) as per the organization's experiences over the years. Indigenous varieties are defined as paddy cultivars that:

a. Are on the verge of extinction.

b. Are grown over small areas by limited cultivators.

c. Have special features and grain characters.

d. Have a long traditional farming history in the area.

A detailed format was prepared, to record the basic characteristics of IPVs, and the growth and observations data; besides this, a supplementary format was developed for documenting management practices, to record details of the nursery, the main field and costing.

The following tools were used for data collection and compilation. In most cases, the yield and other information about IPVs under SRI was collected from different organizations through the supervized crop-cutting method (primarily by harvesting the crop over a 25 sq m area and taking the weight of the grain after threshing and sun drying for two to three days) for the *kharif* 2012 crop. In places (usually in the non–SRI areas) where such precise information had not been recorded by the organization, yield and other data was collected based on the farmers' estimates and observations.

FINDINGS

Locations

The survey was carried out in 24 organizations across six states, namely, Chhattisgarh, Maharashtra, Meghalaya, Odisha, Tamil Nadu and West Bengal. Approximately, 200 IPVs were identified during the study. The IPVs show amazing diversity, ranging from the submerged deep water saline tolerant varieties to ones growing in dry up-lands and in altitudes

Table 1: Salient Features of Management Systems

SRI	SPT	Conventional Transplant	Direct Seeded (Broadcast)—Biasi
Seed treatment, 2–3 kg seed/acre; nursery at the corner of field-0.1 decimal, drainage	Seed treatment, 1-3 kg/acre	Nursery preparation, 25–30 kg seed/acre, 10 decimals	Land is ploughed twice
Transplanting at 7–14 days, 2-leaf stage	Transplanting at 6–15 days	25–30 days transplantation, seedling removed by pulling; multiple (2–10) seedlings per hill, spacing 4 inches	Seeds are broadcast 40–60 kg/acre
Seedlings taken out with mud ball.	Seedlings taken out with mud ball.	Main field preparation	Land is ploughed again after 30–50 days
One seedling per hill	One seedling per hill	Manual weeding at 50–60 days	Thinning and distribution done
Line sowing and spacing of 6 (plant-plant)–10 inches (row-row)	Line sowing and spacing of 10 inches		One hand weeding
Multiple weeding 10–15 days, 20–30 days, 30–45 days, using mechanical weeders	One hand weeding		

up to 1,700 m. The locations were spread across diverse eco-systems and agro-climatic zones, including the deltaic and coastal regions of the Sundarbans (West Bengal), Ganjam (Odisha) and Tamil Nadu, the plain regions in Bilaspur district (Chhattisgarh), Baramba-Cuttack district (Odisha), the plateaus in the Eastern Ghats (Koraput and Rayagada in Odisha, Bastar and Sarguja in Chhattisgarh, Gadchiroli in Maharashtra) and the mountains in the Garo Hills (Meghalaya).

Communities

The study revealed that 65 per cent of the IPVs are being cultivated by indigenous communities, residing in marginal lands across varied agro-climatic regions. This is the best example of in situ conservation as it is the indigenous communities who have, in many instances, been slow to shift to modern varieties and continued cultivating the local varieties thus conserving and developing these unique cultivars. However, in many cases, the varieties are under critical risk of extinction because they are being cultivated by a lone farmer. Besides these, six organizations are into in situ conservation of a number of varieties.

Management

Of the IPVs, 47 percent (97) were cultivated under SRI farming, whereas the remaining were cultivated under Conventional Transplant (CT), Broadcast (BD) or SPT techniques.

The 16 organizations using SRI adopted the SRI steps in different degrees, listed in Table 2.

Irrigation

Ninety-one per cent of the varieties was cultivated under rain-fed conditions although in some cases where irrigation possibilities exist, protective irrigation was provided on need basis. The study looked at 98 per cent of the varieties that were cultivated in the *kharif* season. Kalinga, Barijata (Sarguja, Chhattisgarh), Thoymalle and Vaikuntha (Tamil Nadu) were the varieties cultivated under irrigated conditions in the summer and *rabi* seasons. Pandidavar (Kanker, Chhattisgarh) is also a variety suitable for the summer season.

Habitat

About 59 varieties (29 per cent) are cultivated in lowlands and 40 per cent in rain-fed medium lands (RML) each whereas 19 varieties (9 per cent) can be grown both in lowlands and RML; 33 varieties (16 per cent) are dry up-land cultivars and six can be grown both in medium and up-lands; Five varieties are adapted to submerged habitats as shown in Fig.1.

Table 2: Adoption of SRI Steps

SRI Steps	Remarks
Reduction in seed rate	Adoption: High. Seed rate reduced by two-thirds in most cases.
Seed selection and treatment	Adoption: Medium. Seed treated with cow urine or concoctions.
Early transplantation	Adoption: Medium. Seedlings transplanted within two weeks.
Line transplantation	Adoption: High.
One seedling per hill	Single seedling adoption: Low; 2-5 seedlings per hill generally.
Weeding	Adoption: Medium. Some locations had only manual weeding.

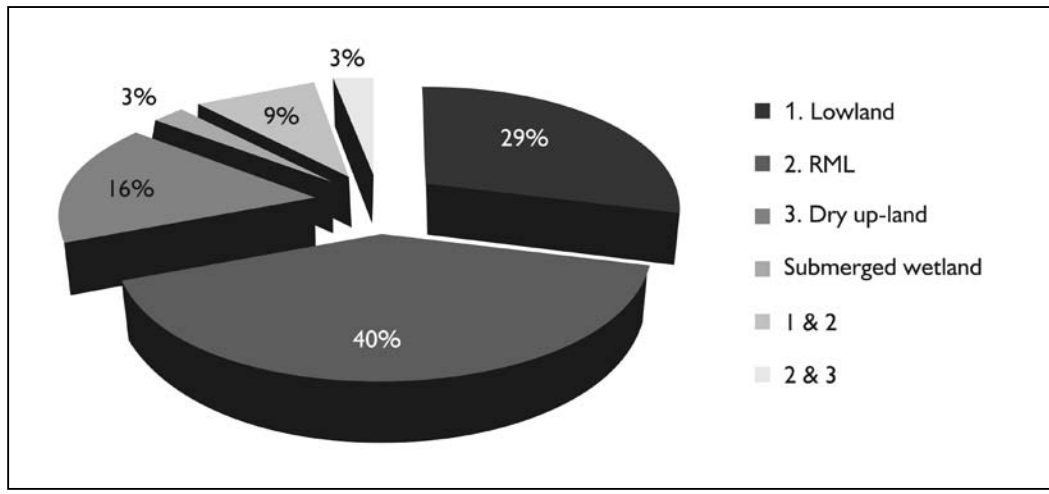

Fig. 1: IPVs Cultivated in Different Land Types

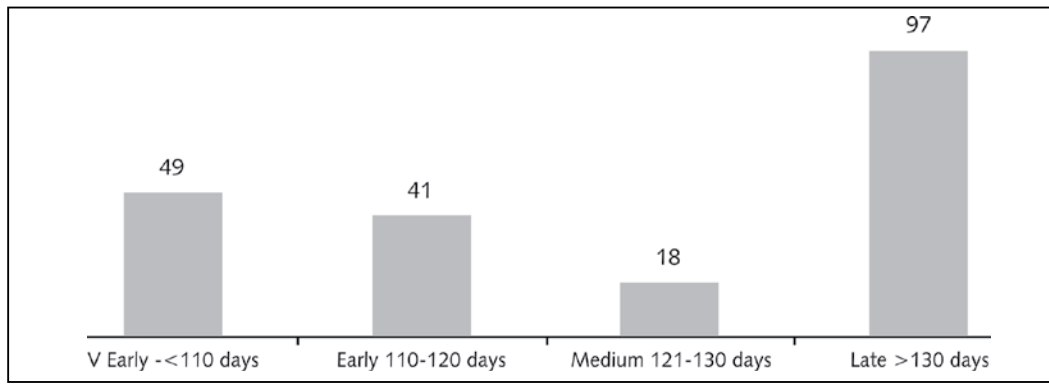

Fig. 2: Maturity Period of Different IPVs

Crop duration

The majority (47 per cent) of the cultivars are late varieties, with maturation times of more than 130 days whereas 24 per cent mature very early in 60 to 110 days (Fig 2).

Table 3 shows the habitats and management practices adapted by various varieties. The very early cultivars are usually cultivated in the dry up-lands under BD; the early varieties and medium duration varieties are cultivated in the RMLs primarily under SRI whereas the late varieties are cultivated in the lowlands under SRI or SPT.

Table 3: Habitats and Management Practices of Cultivars

Cultivars	Habitat	Management
Very early	55% in up-lands, 35% in RML	43% BD and 37% SRI
Early	56% in RML & 27% in lowlands	54% SRI, 27% CT
Medium	72% in RML, 28% in lowlands	78% SRI, 17% BD
Late	50% in lowlands, 44% in RML	44% SRI, 42% SPT

GROWTH & OBSERVATIONS

Sowing and transplant

Most of the varieties are sown at the time of commencement of the monsoon. Thus, with the arrival of a late monsoon, 61 per cent of the varieties are sown in July (Fig 3.); in terms of transplant, 77 per cent are carried out in July stretching to August (Fig 4.). IPVs, being photo-period sensitive, have the remarkable ability to adapt to late agricultural activities and are still able to maintain productivity, as compared to photo-period insensitive modern varieties. This greatly affects yields.

Days to flowering

Flowering days (Fig. 5) vary from 35–125 days, depending on crop maturity, with a mean of 90 days; 50 per cent of the cultivars flower within 90 days.

Table 4 shows the tillers, panicle percentage, panicle length, grains per panicle and range in different management practices.

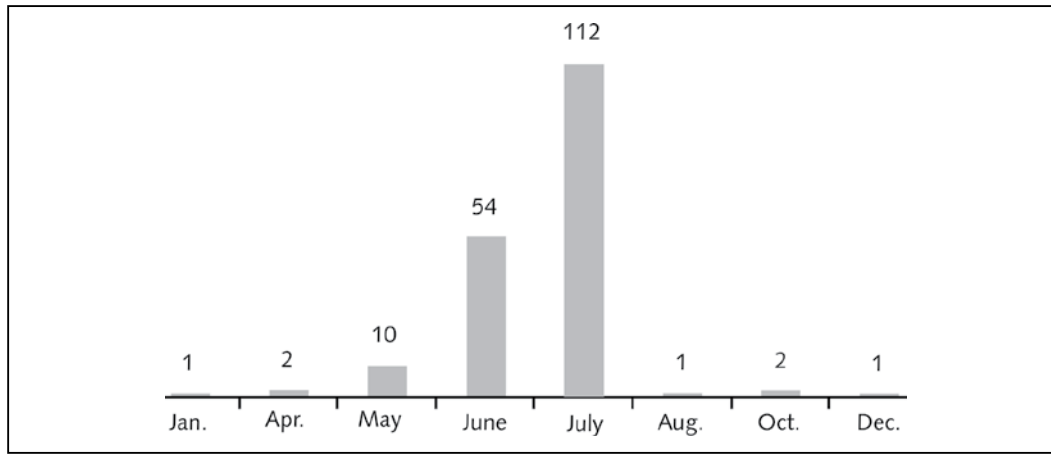

Fig. 3: Sowing Time of Different IPVs

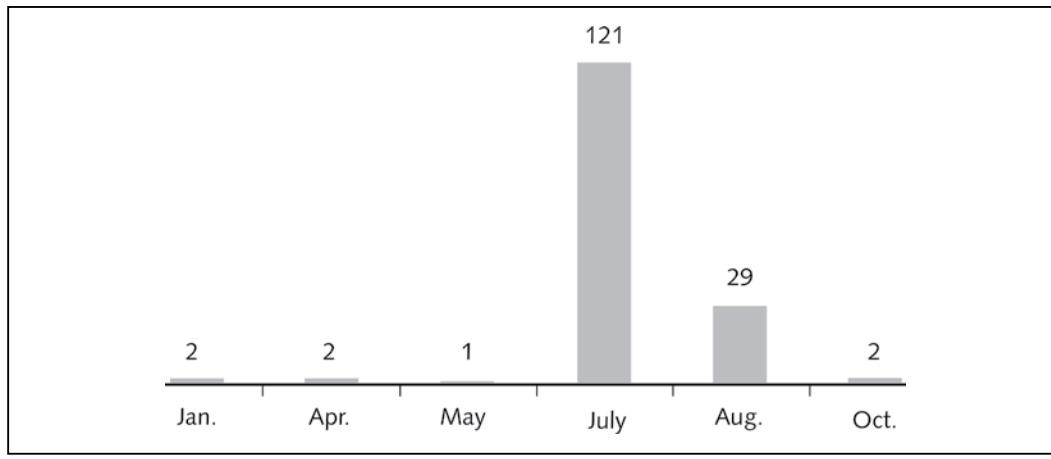

Fig. 4: Transplanting Time of Different IPVs

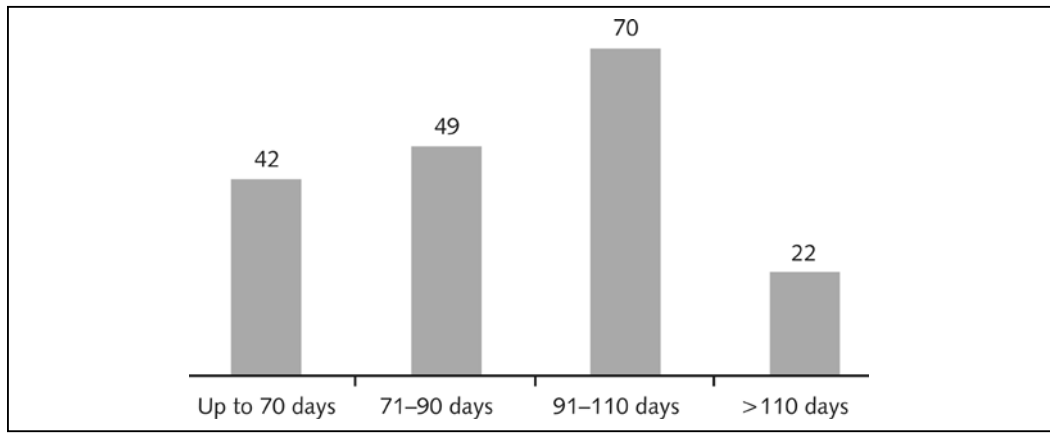

Fig. 5: Flowering Days of Different IPVs

Table 4: Comparison of Yield in Various Management Practices

Practice	Mean Tillers	Range	Mean Panicle %	Range	Mean Panicle Length in Cm	Range in Cm	Mean Grains/ Panicle	Range
SRI	28	8–80	93	58–100	26	15–35	263	105–450
CT	13	2–45	95	84–100	20	15–29	187	125–300
BD	7	2–14	94	80–100	17	13–28	125	50–275
SPT	15	8–25	95	79–100	25	15–38	231	90–600

As observed, the tillers, panicle length and grains per panicle are higher in SRI and SPT.

Table 5 shows cultivars that have the highest number of tillers, panicle length and grains per panicle.

Plant Height

The mean height of the paddy plants is 1.3 m, with a range of 0.6 to 5.7 m. Fig. 6 shows the range of heights and the number of cultivars.

About 90 per cent of IPVs are non-dwarf varieties, primarily in the dry up-lands or RMLs whereas the very tall varieties found in flood-

Table 5: Tillers, Panicle Length and Grains Per Panicle of Different Cultivars

Parameter	Cultivars	Location
Tillers	Rudra–125	Sarguja, Chhattisgarh
	Kanchan Safri–80	Kanker, Chhattisgarh
Panicle length in centimetres	Sundarbans, West Bengal	Sundarbans, West Bengal
Grains per panicle	Bahurupi–600 Bahurani–600	Rayagada, Odisha

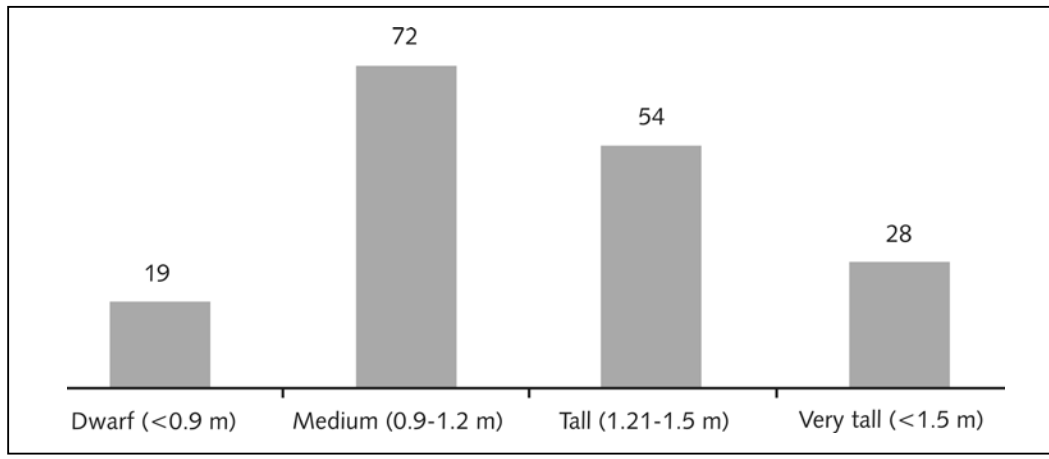

Fig 6: Height Ranges of Different IPVs

prone or coastal areas are able to tolerate flood, submergence and salinity. Due to higher plant heights, as compared to modern varieties, there is a tendency to lodge, ranging from leaning, moderate lodging to prostrate, during the final stages of grain ripening or in stormy or windy situations. However, under SRI, traditionally lodging IPVs showed an erect stand.

Stand

Many IPVs, being tall cultivars, show lodging, primarily at the final stages of maturity or under stormy and windy weather conditions. About 83 per cent of IPVs recorded did not show lodging, except at the final stages of grain ripening (on account of the weight of the grains). Lodging, though considered a negative quality, is accepted as an appropriate adaptation by many farmers and field practitioners and is not reported to reduce yields (in the Katarangi of Sundarbans, lodging results in higher productivity). Under SRI, many of the lodging IPVs did not show any lodging due to the higher culm/plant strength and spacing. Almost 87 per cent of the IPVs cultivated under SRI and 92 per cent of the IPVs under the SPT showed no lodging, except in the final stages or in abnormal weather conditions of storm and wind. The application of chemical fertilizers in IPVs results in lodging.

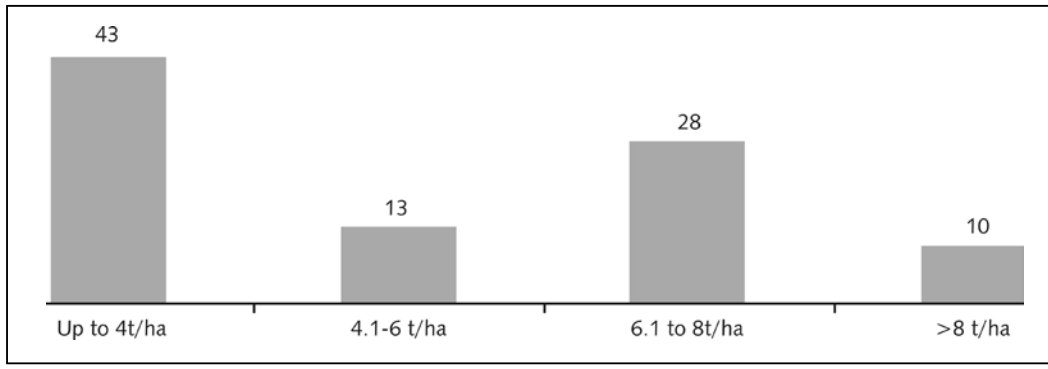

Fig. 7: Yield Range of IPVs under SRI

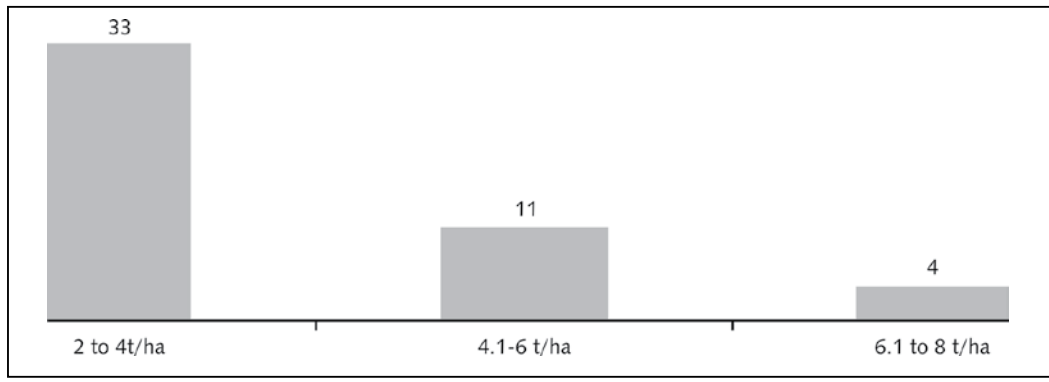

Fig. 8: Yield Range of IPVs under SPT

Grain Yield

The mean yield of 94 IPVs under SRI management across different locations for the year 2011–12 is 5.08 t/ha; 54 IPVs reported yields above 4 t/ha. Fig. 7 shows the number of varieties in different range of yields.

In terms of yield of IPVs in different states, Odisha reported the highest mean yield of 6.1 t/ha, followed by Chhattisgarh of 4.9 t/ha and Maharashtra at 4.5 t/ha; the remaining states of Meghalaya and Tamil Nadu reported yields below 4 t/ha whereas no variety was cultivated under SRI in West Bengal. Forty-eight varieties were cultivated under SPT (primarily in West Bengal), with a mean yield of 4 t/ha. Of these, 15 cultivars showed yields above 4 t/ha. Fig. 8 shows yield ranges.

Thirty-one IPVs recorded were cultivated under the CT system, with a mean yield of 3.1 t/ha. Of these, 20 IPVs showed yields above 2 t/ha and 29 IPVs recorded were cultivated under the BD system, with a mean yield of 2.4 t/ha. Fig. 9 and 10 show yield ranges and the number of varieties.

Table 6 shows the comparative yield of popular modern varieties in the respective regions.

As can be observed, the mean yields are similar to those of modern varieties, and even in the

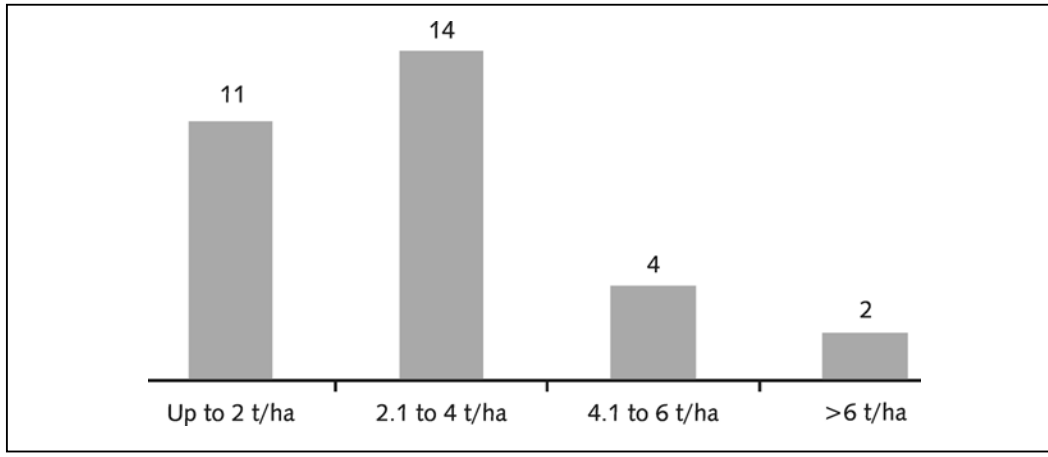

Fig. 9: Yield Range of IPVs in CT System

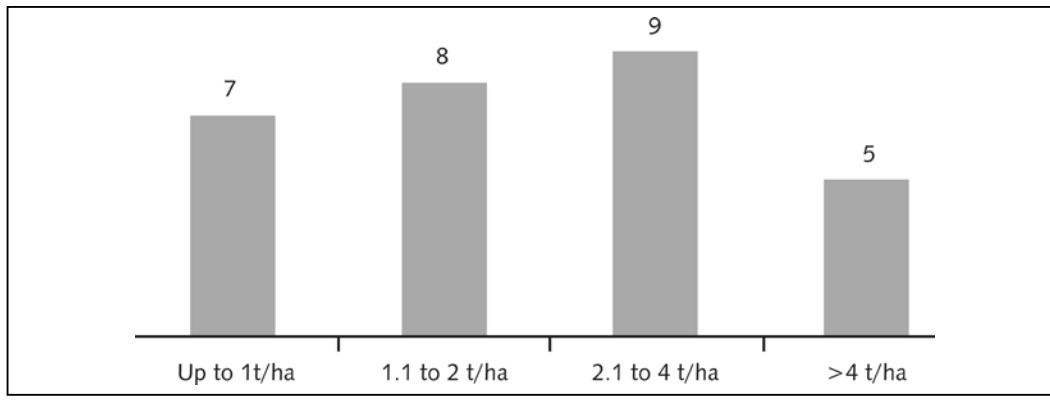

Fig. 10: Yield Range of IPVs in BD System

Table 6: Comparative Yield of IPVs and Popular Modern Varieties

State	IPVs	Modern Varieties
Chhattisgarh	6.1	6.1
Maharashtra	4.5	4.6
Meghalaya	3.7*	5.3
Odisha	6.1	5
West Bengal	4**	4.1

***under CT, **under SPT**

areas where SRI has not been attempted with the IPVs, the potential for having higher yields exists. Most IPVs are being cultivated under organic farming systems as against high input chemical farming in modern varieties.

Straw Yield

The data on straw yield was collected for 123 IPVs, with a mean production of 5.7 t/ha. Being taller varieties, the grain-to-straw ratio is 1:1. Unlike in modern varieties, the straw of IPVs has a number of traditional uses, in terms of

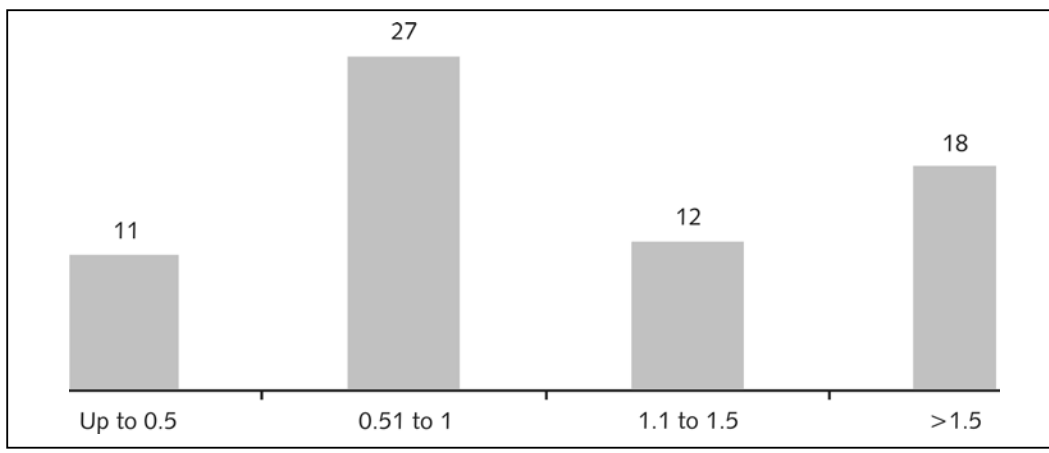

Fig. 11: Straw Yield Ranges of Indigenous Varieties

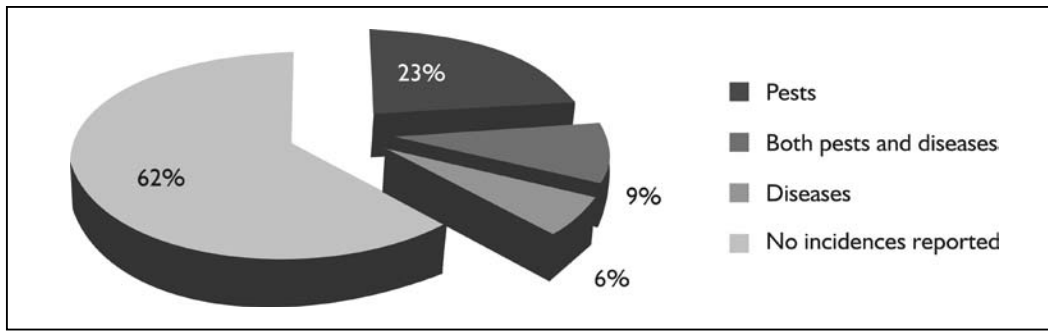

Fig. 12: Pests and Diseases Reported from IPVs

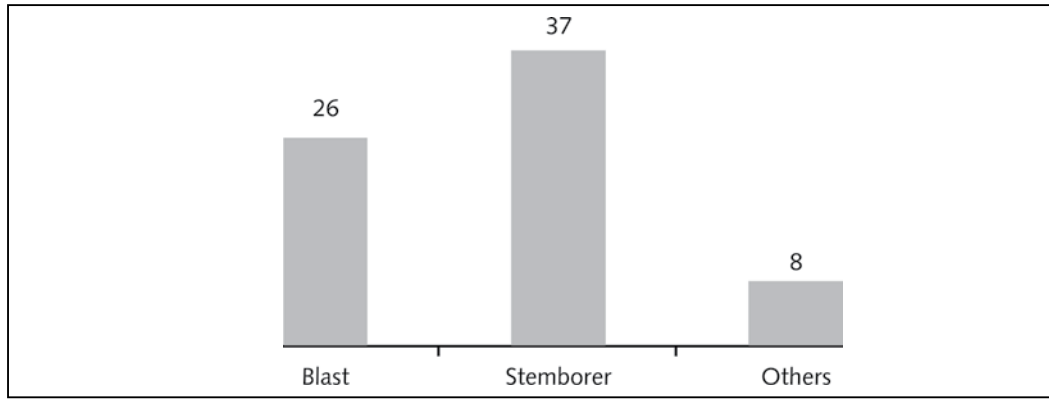

Fig. 13: Most Prevalent Diseases and Pests

fodder, thatching, grain storage structures and other household uses. The cattle also finds the straw more palatable and preferable compared to that of modern varieties. Fig. 11 shows the number of IPVs with different grain-to-straw ratios; 40 per cent IPVs have a ratio between 0.5: 1 and 1:1.

Pests and Diseases

Usually, under favourable weather conditions, there are few pest or disease incidences in IPVs; of the 205 IPVs recorded, cases of pest and diseases were seen only in 71 varieties (35 per cent). Fig. 12 shows the incidences of percentage of varieties.

Fig. 13 shows that 37 per cent of the cases had stemborers, 26 per cent had blast and the rest had other pests such as gall midge and gundhi bug.

Tolerance

The tolerance to drought, flood, pests, diseases and other special features such as salinity were recorded for 78 per cent of IPVs. Table 7 shows IPVs under different stress resistances.

Table 7: IPVs under Different Stress Resistances

Drought	Flood	Pests & Diseases	Salinity
114	30	113	11
56%	15%	55%	5%

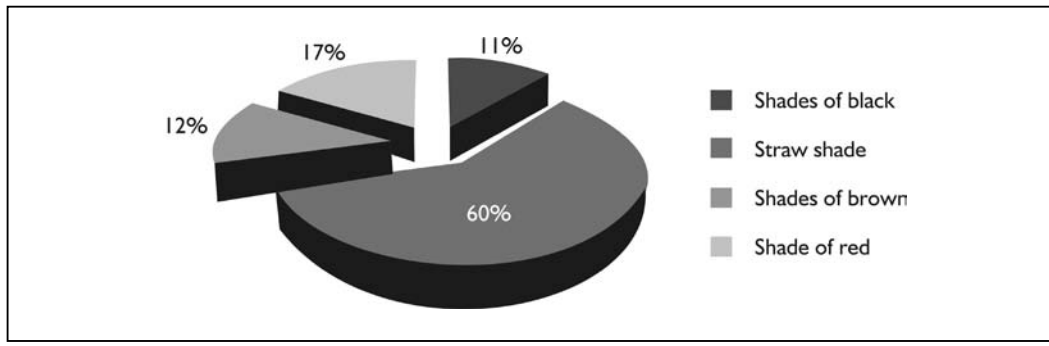

Fig. 14: Hull Colour of IPVs

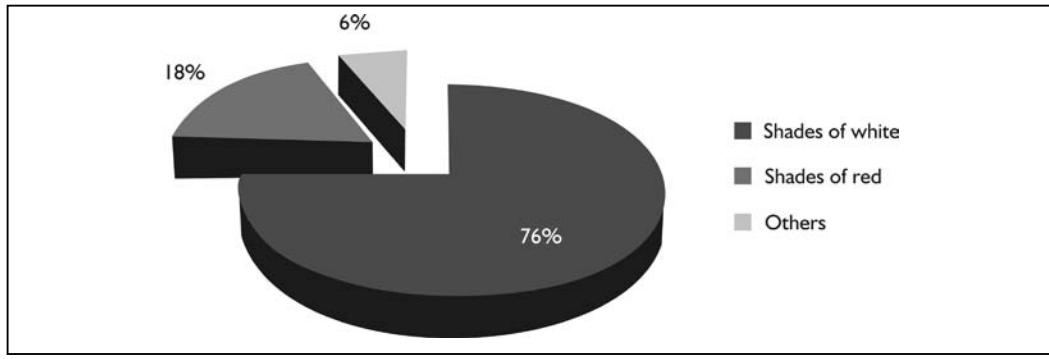

Fig. 15: Kernel Colour of IPVs

IPVs being cultivated in the Central Plateau and the highlands showed increased tolerance to drought. The Sundarbans and Mahanadi basin IPVs show flood tolerance up to 30 days of submergence. Salinity tolerance was reported in 10 IPVs in the Sundarbans delta region. IPVs showed a remarkable ability to adapt to changing environs. Many IPVs not known for flood or salinity tolerance usually showed good yields in saline soils and also tolerated submergence; this was clearly observed in the Sundarbans delta, where after the Aila cyclone, the paddy lands had become saline. Initially, experts were wary about whether paddy would ever grow in these regions because modern varieties had failed to grow on such soil. However, a number of IPVs (Bahurupi, Kerelasundari), not known traditionally for saline tolerance, showed good productivity of 5.6 t/ha in 6 mS/cm salinity. IPVs such as Chamormoni (Sundarbans, West Bengal) can tolerate salinity as well as tolerate 1.5 to 1.8 m of standing water for a month. Their height increases with the rising water. Similar traits are also seen in the Champaisiari (Mahanadi basin, Odisha) and Jalkamini (24 Parganas, West Bengal), which grow to 5 m, remain completely submerged and float. The Katarangi (Sundarbans, West Bengal) continues to thrive despite complete submergence for a week. Many IPVs show resistance to prevalent diseases such as blast or other pests; farmers reported higher incidences of pests and diseases in modern varieties. Some varieties also show tolerance to strong winds.

GRAIN PROPERTIES

Hull and Kernel Colour

Sixty per cent of the IPVs had hulls with shades of straw colour whereas 76 per cent of the kernels were shades of white. Apart

from this, black, red and brown hulls with red, brown, black and amber kernels were recorded. In a number of instances, non-white rice was considered rich in minerals and possessed medicinal properties. However, modern milling and polishing make all rice look white.

Most farmers reported that IPVs are usually nutritional and flavourful (sweeter and tastier), have a good appearance, texture, cooking (grain elongation) and keeping quality, as compared to modern varieties and this is one of the primary reasons for cultivating IPVs

Grade

Grade was measured in three types: round, bold and slender, based on the rice kernel length-to-breadth ratio (l/b ratio) as shown in Table 8.

Table 8: Grading of Rice Kernels

Round (l/b < 2)	Bold (l/b- 2- <3)	Slender (l/b >=3)
20	149	31

Almost 75 per cent of IPVs have a bold grain with an l/b ratio of between 2 and 3.

Qualitative Features

Some qualitative features such as fragrance, end uses (apart from daily cooking) or any other special features (Table 9) were recorded.

Most farmers reported that IPVs are usually nutritional and flavourful (sweeter and tastier), have a good appearance, texture, cooking (grain elongation) and keeping quality, as compared to modern varieties and this is one of the primary reasons for cultivating IPVs. A number of varieties also have high satiety and thus preferred by economically weaker sections. Some IPVs are used for a number of rituals, making of traditional sweets *(kheer, pitha, alsa, moa, liya, roti,* etc.), local culinary delights *(phenbhat, pokhalbhath, amat, pech, biryani, idli),* and rice beer *(landah, pochai, dikha).* A number of varieties also do not need to be parboiled and can be eaten raw, directly after harvest. IPVs also show less breakage in milling and have less percentage of chaffy grains as compared to modern varieties. Jugal and Ramlaxman are double-seeded varieties whereas Sateen and Ramlaxmansita are triple-seeded varieties.

REASONS FOR PREFERRING IPVs

Farmers across different states and regions cited various reasons for continuing with IPVs in spite of the Green Revolution and the overwhelming promotion of the modern varieties, namely:

- Low cost of cultivation due to low external inputs (in terms of seeds, fertilizers, pesticides, irrigation and labour).
- Tolerance to weather vagaries of drought, flood, submergence, salinity, wind, etc.
- Flexibility to varied timings, practices and adaptability to a changing environment.
- Resistance or low incidences of pests and diseases.
- Possibility of re-using the seeds over long periods.
- Minimal chaffy grains and loss in milling.
- Availability of quality straw for fodder, thatching and other uses.

Table 9: Qualitative Feature of IPV

FRAGRANCE		END USES			
Light Aroma	Strong Aroma	Puffed Rice	Rice Flakes	Popped Rice	Medicinal
14	42	24	9	10	4

- Ecologically and environmentally safer.
- Rejuvenation of soil and water.
- Healthy, nutritious, flavourful and keeping quality for home
- Consumption.
- Traditional food, sweets, recipes, drinks and rituals.
- Medicinal and nutritional properties.
- Higher price (in scented/fine rice IPVs).
- Possibilities of innovations and development of new cultivars through selection.

Advantages of SRI with IPVs

- Higher productivity
- Less or no lodging
- Less time and labour requirement in agricultural operations
- Reduced seed rates

Record Production of Indigenous Varieties under SRI

Sahabhagi Samaj Sevi Sangsthan (Charama, Kanker District, Chhattisgarh) has been promoting SRI among farmers of Kanker and Kondagoan since 2008–09. At Lihagaon village in Rajpur block of Kondagoan district, Chhattisgarh, under the able guidance of Jeevan Baghel, Punaram Netam cultivated kanchan safri (a 110-day, slender-grain IPV) in three acres of land under SRI and got a yield of 9.2 t/ha. The crop had 70–90 tillers/plant with 90 per cent panicles, with a length of 28 cm and 275 grains. This variety was brought by Jeevan Baghel's father about 40 years ago from the neighbouring district of Nabarangpur in Odisha, where it was predominantly grown.

Gangaram Markam and Bajrang Markam of the same village cultivated a scented IPV-*basabhog* (120-day, small-bold IPV) under SRI, to get an yield of 10.4 t/ha. The plants had 40–45 tillers with 90 per cent effective panicles, a length of 32 cm and 350 grains. The *kumlichudi,* a reddish-yellow rice variety also gave a yield of 9.2 t/ha under SRI (40–50 tillers/plant, 90 per cent panicles, with a length of 28 cm and 275 grains). *Adanbargi,* a 95-day, red-rice IPV gave an yield of 8.8 t/ha under SRI in the same village (35 tillers/plant, 90 per cent panicles, with a length of 27 cm and 225 grains). Inspired by the results of SRI, the community has taken up SRI in Finger Millet, with encouraging results of 6t/ha.

Chaupal (Ambikapur, Sarguja District, Chhattisgarh) is actively promoting SRI among tribal farmers of Udaipur Block. Agar Sai, an SRI farmer in village Tunga, cultivated mansuri (a 120-day, bold-grained IPV), in 40 decimals of land, to get a yield of 8.4 t/ha. The IPV showed 50–60 tillers/plant and 90 per cent effective panicles, with a length of 25 cm and 285 grains. Agar Sai also cultivated a 135-day, black IPV—kajri—and had a yield of 8 t/ha under SRI. The variety had 45 tillers/plant, 90 per cent panicles, with a length of 25 cm and 290 grains.

The Gramin Yuva Pragatik Mandal, GYPM, (Bhandara, Maharashtra) has been promoting SRI for the last five years in Bhandara and Gondia districts of Maharashtra. Vashist Devaji Gadwe and Damo Gopichand Pandre, of Sarpewada village in Bhandara district of Maharashtra cultivated lochai (120-day, bold IPVs) under SRI in 30 decimals of land each, to get an yield of 7.4 t/ha (40–45 tillers/plant, 95 per cent panicles, with a length of 24 cm and 275 grains). These IPVs had been growing in these areas earlier but had gone extinct with the advent of HYVs and hybrids. GYPM re-introduced these varieties by getting seeds from Gondia district.

THE SEED KEEPERS

The study revealed a number of organizations and individuals, who have gone against all odds to conserve, document and promote IPVs among farmers. Working under severe constraints with limited financial, infrastructural and human resources, these organizations have demonstrated the enormous potential of indigenous varieties.

The Dharohar Samity, Kondagaon, Chhattisgarh, inspired by the rural communes, has been into the conservation of IPVs since 1995. Initiated with 135 varieties from Bastar region, it has 255 cultivars at present. About 60 IPVs are being cultivated under SRI here in 1 sq m plots, for distribution among farmers. In 2012, about 100 farmers received seeds from the Samity. The seeds are given free to the farmers, with an understanding that they will return the amount of seed taken after the harvest. The organization is composed of grass-roots workers and local farmers, and is managed by Sri Shivnath Yadav, who is also the Secretary. Apart from conserving and distributing seeds, the Dharohar Samity has also been making farmers aware about SRI with organic inputs and on various indigenous varieties. The Samity has 15 dry up-land varieties, 26 RML and remaining lowland cultivars. There are 20 scented varieties as well as one double- and triple-seeded variety of *Ramlaxman* and *Ramlaxmansita.*

Dr. Debal Deb of VIRHI, Kerandiguda-Bissamcuttuck, Odisha, has been conserving 820 IPVs for the last 17 years. Dr. Deb, an ardent ecologist from the University of California at Berkeley and Indian Institute of Science, Bangalore, gave up his well-paid job at the WWF in 1996, to set up VIRHI—the first non-governmental seed bank in West Bengal, with 200 IPVs. In 2002, he set up a small farm of 0.7 ha in Bankura district, West Bengal, to grow and multiply IPVs. Dr Deb shifted to Odisha two years ago and has been conserving and distributing IPVs among farmers, facilitated by Living Farms, a non-profit organization working to promote sustainable farming in Odisha. The seeds are maintained in a number of earthen pots, labelled and coded with the names of different IPVs in a two-room hut. Kerandiguda Village, surrounded by the Niyamgiri range. Each of the pots stacked one above the other has a bunch of panicles of different varieties. The unique collection has 100 scented varieties, 130 dry up-land IPVs, 6 salinity tolerant and 12 submergence tolerant IPVs, apart from a number of rare IPVs including the two-grained jugal and the three-grained sateen. About 0.5 ha of land has been leased from local farmers for cultivating IPVs. Each variety is cultivated on an area of 4 sq m, with 64 plants under SPT. To prevent cross pollination, Dr Deb plants different IPVs with different flowering dates. Under the able guidance of Dr Debal, Debdulal Bhattacharyya meticulously does all the farm operations, recording data and collecting the panicles to be stored for seed as well as developing new cultivars through selection.

The seeds are maintained in a number of earthen pots labelled and coded with the names of different IPVs in a two-room hut

Natobor Sarangi (Rajendra Deshi Arthaniti Adhyan Kendra), an octogenarian retired school teacher and a resident of Norisho village near Niali, Cuttack (Odisha), has been conserving and cultivating 365 IPVs since 1999. Sarangi used to grow HYVs, used chemical fertilizers and pesticides in his farms and he had been chosen to promote modern varieties in and around his village by companies and government officials. He switched to organic agriculture when a labourer spraying carbofuran on the farm collapsed and had to be rushed to hospital. Though the labourer survived, Sarangi was convinced of the

serious consequences and hazards of chemical farming. Initially, he used organic inputs with HYVs; his son Rajendra (who was involved in a number of environmental movements), however, advised Sarangi to use IPVs. Most of the cultivars had disappeared from the area by then. In 1999, Rajendra and his friend Jubraj travelled across Odisha and brought dozens of varieties from indigenous farmers. All these varieties were tried and more IPVs were collected. They cultivate 365 varieties now.

Sudhir Patnaik from *Samadrusti,* an Oriya journal, has developed a two-volume album of IPVs, in which each page has small packets of IPVs with their characteristics. Sarangi grows three crops on his land—paddy, followed by green gram and finally gourd in summer. This way, he gets fodder as well as mulching material. The overall productivity of his farm is high.

The Paschim Sridhar Kati Jonokalyan Shongo (PSKJS), in Hingalgunj Block of North 24 Parganas, West Bengal, established in 1988, has been conserving and distributing 300 IPVs among farmers since 2009. It has one main seed bank at Jogeshgunj and 10 associated seed banks in 18 villages across five *panchayats.* Currently, 800 farmers are members of the seed bank. The programme was initiated after the AILA cyclone when modern varieties failed due to high soil salinity. The organization, under the leadership of Bishnupado Mridha, collected IPVs from the Sundarbans and other parts of West Bengal, to initiate the seed bank at Jogeshgunj. It also has a small farm where IPVs are cultivated every year for conservation, multiplication, distribution and research. The organization boasts of a unique collection of 8 salinity tolerant IPVs, 5 deep submergence tolerant IPVs, 17 scented and 10 fine rice IPVs. The PSKJS has been involved in farmers' awareness activities on organic farming with IPVs in the area.

Dr. Anupam Pal, Deputy Director at the Agricultural Training Centre (ATC), Phulia, Nadia district, West Bengal, has been conserving 248 IPVs for the last 11 years. The centre distributed 78 IPVs among farmers in 2012. The varieties are cultivated in the farm of the ATC under SPT. Dr. Anupam has been closely associated with Dr. Debal and both have been instrumental in motivating PSKJS in the Sundarbans area and Richaria Conservation Centre at Abhirampur, Burdwan district, West Bengal, about IPV conservation and distribution. Dr. Anupam has been involved in a number of training programmes, to promote organic practices and indigenous varieties at different levels.

Sambhav is an organization set up in 1988 by a group of like-minded persons deeply concerned about acute problems of conserving our common habitat. It has established a facility in Rohibank, Nayagarh district, Odisha, across 40 ha of wasteland. The name 'Sambhav', meaning possible, was inspired while selecting the highly degraded land where there were only nine trees, gullies, hard rocky soil and heavy grazing. All the local people had remarked that it was 'impossible' to reclaim this land but today the area is a thriving forest with deer and other wild animals and more than 1,200 plant species. The vision of Sambhav's founder, Prof Radhamohan and the untiring efforts of Sabarmatee, Namita and the Sambhav team have not only created a seeming impossibility but have also been conserving 435 IPVs through SRI in its two acres of farm. Apart from IPVs, Sambhav also conserves a number of indigenous vegetables, millet, pigeon pea, fruit trees, etc. Sambhav is a resource centre for organic farming, where a number of residential training programmes are held every year for farmers, creating awareness about sustainable agriculture. Sambhav has been instrumental in motivating and

providing indigenous seeds for SRI to a number of organizations and interested farmers and individuals in Odisha. Sambhav believes that SRI with IPVs is critical to increasing outreach among farmers.

In the Rampur Block of Nayagarh district, Odisha, Nilomani has helped conserve 70 IPVs across three to four *panchayats,* involving about 200 farmers. Nilomoni says the absence of irrigation facilities, fewer pests and diseases, and the lower cost of cultivation have prompted farmers to continue with IPVs, in spite of the promotion of modern varieties in the area. In spite of having no financial support or encouragement from his organization, Nilomoni facilitates and motivates farmers to go for IPVs under organic farming.

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CONCLUSION

The study of IPVs under SRI clearly indicates that mean productivities are at par with those of modern varieties and these are much better adapted and suited to the unique local conditions and thus able to tolerate climate change and adapt to changing environs. IPVs are also embedded in the cultural and traditional milieu of the indigenous communities, in terms of their presence in rituals, food, drink, medicinal uses and household items. IPVs are primarily grown under organic conditions, have a low cost of cultivation, maintain and rejuvenate the soil and are environmentally safe as well as nutritious and healthy to eat. A number of IPVs are scented fine rice, thus offering enormous possibilities of higher end marketing and generating additional income for the farmers.

In view of the above points, the promotion of IPVs under SRI management will not only bring in food and nutrition security but also reduce the cost of cultivation, excessive dependency on markets for inputs, as well as make farming sustainable and less hazardous. The efforts in marketing of scented and fine rice will also lead to increased farm income.

Though this was an exploratory study on the potential of IPVs under SRI management; subsequent studies need to be more comprehensive involving locations in other states as well as more robust in terms of sampling especially in relation to the yield variables. Crop measurements and observations need to be carried out in situ in the respective farmer's field over 2–3 years in different stages of the standing crop to validate the results.

Some of the interventions that could be taken up are:

- Increasing Organic SRI outreach with IPVs: Efforts have to be made to increase SRI management across different regions (modifications need to be made for submerged wetlands and dry up-lands) with IPVs, rather than rejecting them for low productivity and introducing hybrids and HYVs. The adoption of practices, especially the one seedling per hill and weeding with organic inputs, need to be emphasized.
- Generating awareness of and action towards adopting SRI with IPVs: There is urgent need to campaign for promoting SRI with IPVs, as opposed to hybrids, in an effort to clear the myths of low productivity, lodging and other negative traits cited against IPVs. Organizations and institutions already involved in

the promotion of IPVs need to spread and share the potential of IPVs among farmers and regions that have lost most traditional seeds through IEC, as well as demonstrations, exposure and seed fests. Policy advocacy and sharing of farmers' experiences and issues with government departments and institutions are critical in bringing back IPVs.

- Supporting existing seed banks and organizations/individuals: The study documented eight indigenous seed keepers and banks. However, in most cases, the organizations are working under enormous constraints. Efforts need to be made to support these endeavours by empowering farmers. Documenting experiences and characteristics of cultivars in the seed bank is greatly needed.
- Farmers' field trials and setting up of decentralized community seed banks and farms: All-round efforts have to be made to collect IPVs across various regions and set-up community seed banks, not only for conservation but to multiply, distribute and release among farmers, thus re-establishing the lost or endangered varieties. Selection, trials, research and documentation of IPVs will help in characterizing and maintaining the breed purity of IPVs as well as bring back the innovative spirit among farmers.
- Protecting IPVs as a community resource as against individual patents: Currently, there are no provisions for protecting IPVs from the onslaught of bio-piracy and patents; a number of processes for individual patents are in place but there are no provisions for protecting IPVs as a critical community resource. There is a strong need for a united approach to effective policy formulation, aimed at protecting IPVs as a community resource.
- Marketing of scented fine rice: There are more than 100 scented and fine IPVs still being cultivated. Sixteen scented IPVs also have more than 4 t/ha under SRI. There is, however, very little awareness, demand or markets for these. Most people understand long-grained basmati as the only scented variety. Barring some popular scented IPVs, in most cases there are no price incentives to cultivate these IPVs as opposed to the bold varieties because there are only two categories in government paddy procurement programme—Bold and Medium. The scented IPVs, thus, end up being sold at the price of medium grade at the most. The traders' report of erratic supply of scented-fine IPVs thus reduced the demand and led to unfair prices. The present laws also forbid the export of non-basmati rice and thus scented-fine rice has no high-end markets as opposed to basmati. The stabilization of production would need to be followed up by effective marketing of scented varieties at high-end markets and exclusive stores. Apart from scented IPVs, there are enormous possibilities of promoting nutritional and medicinal properties of many IPVs.
- Documentation of IPVs: Studies to document IPVs in different states, characterizing and recording of farmers' experiences are important to promote IPVs and bring them under SRI. Analytical studies on nutritional and medicinal qualities of IPVs will help characterize and market the same.