Study of Performance of Indigenous Paddy Varieties under SRI and Conventional Practices






NATIONAL CONSORTIUM of SRI

New Delhi

The study was commissioned by

National Consortium of SRI-NCS, New Delhi

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Cover photo- Top left: Assorted varieties of indigenous paddy
Top right: Patnai paddy variety at maturity, Kerandiguda, Rayagada-Odisha
Centre left: Summer paddy transplantation at Salhe village, Gadchiroli-Maharashtra
Centre right: Jateya paddy variety, Ambikapur-Chhattisgarh
Bottom left- Jaha paddy variety, Garo Hills-Meghalaya
Bottom right- Lalmokro paddy variety, Bastar-Chhattisgarh

ACRONYMS

BD: Broadcast

CG: Chhattisgarh

CT: Conventional transplanting

IPVs: Indigenous paddy varieties

RML: Rainfed medium land

SPT: Single plant transplanting

SRI: System of Rice Intensification

WB: West Bengal

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1- Introduction

1.1- Background

Rice is the seed of the monocot plant *Oryza sativa* (Asian Rice) family *Gramineae*. As a cereal grain it is the most important staple food for a large proportion of world's population, especially in Asia. It is the grain with the second highest world-wide production after maize in 2010. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one-fifth of the calories consumed worldwide by the human species. About 185-200 million tons of rice is eaten every year, and it forms the staple food of about half of the human race.

In 2009-10, the estimated area under paddy cultivation in India was 41.92 million ha, and production was 89.9 million MT, giving an average productivity of 2.12 MT/ha. The top 5 main growing states are: West Bengal, Uttar Pradesh Odisha, Chhattisgarh, and Andhra Pradesh, covering 53 % area and producing 60% of national paddy crop. Among the top producers, Punjab has the highest productivity of 4.01 MT/ha, while Chhattisgarh has the lowest at 1.1 MT/ha.

Fig 1.1- Parts of Rice Plant

Out of the 27 species of the genus *Oryza*, 25 are wild and only 2 are cu (mainly in Africa); The earliest remains of rice in the Indian subcontinent have been found in the Indo-Gangetic Plain and date from 7000–6000 BC, although the earliest widely-accepted date for cultivated rice is placed at around 3000–2500 BC based on findings in regions belonging to the Indus Valley Civilization. Perennial wild rice still grows in Assam and Nepal.

Rice seems to have appeared around 1400 BC in southern India after its domestication in the northern plains. It then spread to all the fertile alluvial plains watered by rivers. From a wild aquatic grass, Indian farmers over the centuries selected and cultivated thousands of varieties of rice; no other cultivated crop has been developed to such an extent to fit thousands of ecological niches all over the country. Local indigenous rice varieties have adjusted over long periods to the ecosystems of their regions including environmental and climatic variations, thus ensuring at least minimum levels of output even in bad years.

India's varietal diversity can be considered the richest in the world with a total number of cultivars estimated to be around 200,000. Indian rices possess a wide range of morphological and physiological characteristics ranging from 60 to over 200 days to attain maturity; growing in varied elevations from sea level to an altitude of above 2000 m; adapted to different seasons in both dry uplands and submerged wetlands; on one extreme are varieties growing in 6-15 m of water and at the other end are varieties that survive in rainfall of 650 mm. Rice grains show enormous diversity with colors ranging from complete purple, red to white, grain lengths of 3.5-14 mm, breadth from 1.9 – 3 mm, short, long, glutinous, scented and non-scented varieties. Further there are variations in respect to resistance to diseases and pests (like blast, stem borer, gall midge, gundhi bug, etc.) as well as tolerance to different environment stresses like drought, flood, salinity, and low temperature.

Out of the 3 sub species of *Oryza Sativa* - *Indica, Japonica* and *Javanica* -- all Indigenous Paddy Varieties (IPVs) belong to the *Indica* group with broad and light green leaves, flat grains, majority without awns or short-awned grains, and tall stature. Rice is generally self-pollinating; however about 4% of the cultivars show aptitutde for cross-pollination in different regions.

The traditional varieties have been generally considered to have low productivity compared to the 'improved' and hybrid varieties; thus they are usually neglected and even avoided in mainstream seed programs. On the other hand, alarmed by the fast disappearance of these indigenous varieties, a number of organizations and practitioners have been making a case for these varieties to be conserved, improved and promoted to conserve biodiversity.

Several instances of the indigenous varieties are reported to perform at par with or better than the modern varieties if they are given adequate management and care. In particular, there are indications that many indigenous varieties respond well to the management methods of the System of Rice Intensification (SRI). Some of the IPVs in Chhattisgarh

and Odisha are reported to give better yields than the modern varieties cultivated locally if given SRI or other management. However, these observations and experiences are mostly not documented in a systematic manner. Favorable responses of IPVs to SRI management provide a unique win-win situation as this performance may not only bring back the disappearing rice diversity but also increase household food security at more affordable cost as SRI methods can lower purchase requirements compared to recommended 'modern' practices. This would also develop sustainable and healthy farming environment, empowering farmers by reducing their dependence on purchased inputs, and making the promotion of high-input hybrids and modern varieties unnecessary.

With the above backdrop, the present study titled ***"Study of performance of Indigenous varieties of rice under conventional and SRI practices"*** was commissioned by National Consortium of SRI (NCS) to assess and document the experiences of various organizations and farmers in regard to the on-site yield performances of IPVs under the SRI. The results of the study will help to identify specific areas for future action in research and policy on the subject.

1.2 Objectives of the study

The broad objectives of the study are-

- Developing a database of Indigenous varieties that show promising performance in production under SRI and conventional systems.
- Develop appropriate methods and tools of data compilation and analysis for *in situ* assessment of comparative yield performance of indigenous varieties.
- Comparative study of indigenous varieties with respect to production performance in SRI and other conventional systems
- Compile farmers' perspectives on the subject.

1.3 About the organizations

National Consortium of SRI (NCS) is a resource pool of policy makers, practitioners, support organizations, and scientists working towards promoting scientific understanding of SRI, promotion of its practice and evolving appropriate policies for enabling the spread of SRI across the country. PRADAN-New Delhi is the present secretariat.

NCS Vision statement

To enable India to provide global leadership to agro-ecological innovations that reduces agrarian distress:

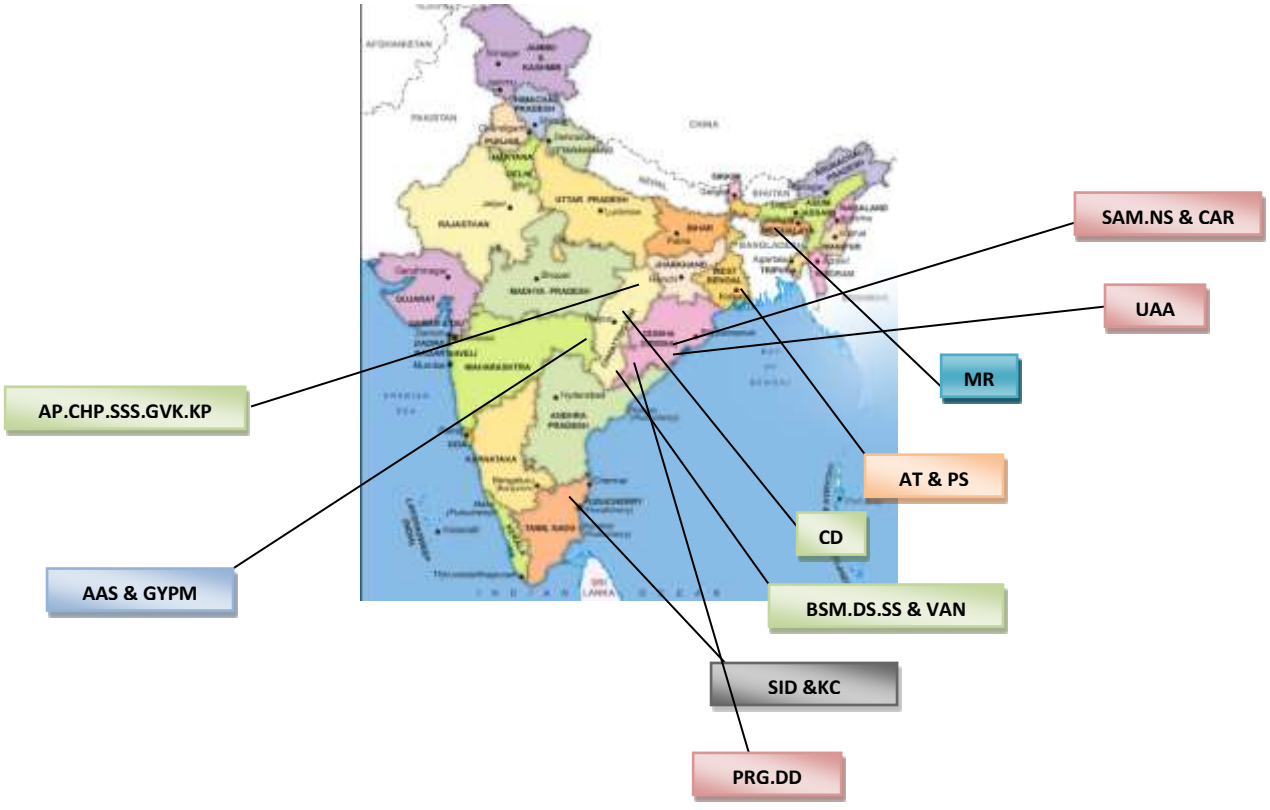
- By demonstrating enhanced farm incomes
- Sustainable eco-friendly and resource-conserving and enhancing systems of crop intensification
- Through novel institutional mechanisms that build on farmer's knowledge and that enhance local capacities with active participation of civil society, researchers and government agencies.

For conducting the study across different regions and ecosystems, 22 organizations in 6 states working with IPVs were selected with consultation of NCS and other field practitioners. All the organizations were requested for supporting the study.

Table 1.1 gives the list of organizations visited; Fig 1.2 gives their various locations around the country:

SN	Organizations	Code	State
1	Sambhav	SAM	Nayagarh, Odisha
2	Centre for Agriculture and Rural Reconstruction-CARR	CAR	Cuttack, Odisha
3	United Artisans Association-UAA	UAA	Ganjam, Odisha
4	Rajendra Deshi Arthaniti Adhyan Kendra	NS	Cuttack, Odisha
5	Pragati	PRG	Koraput, Odisha

6	Virihi	DD	Rayagada, Odisha
7	Agricultural Training Institute-ATI	AT	Phulia, W Bengal
8	Paschim Sridhar Kanti Jonokalyan Songho	PS	Jojeshgunj, W Bengal
9	Adarsh Prahari Samaj Sevi Sanstha	AP	Ambikapur, Chhattisgarh
10	Sangata Sahabhagi Gramin Vikas Sansthan	SSS	Ambikapur, Chhattisgarh
11	Chaupal Gramin Vikas Prashikshan Evam Sodh Sansthan	CHP	Ambikapur, Chhattisgarh
12	Karma Prashikshan Evam Vikash Sansthan	KP	Ambikapur, Chhattisgarh
13	Gramin Vikash Kendra	GVK	Jashpur, Chhattisgarh
14	CARMDAKSH	CD	Bilaspur, Chhattisgarh
15	Sahabhagi Samaj Sevi Sansthan,	SS	Kanker, Chhattisgarh
16	Bastar Sewak Mandal	BSM	Bastar, Chhattisgarh
17	Dharohar Samiti	DS	Kondagaon, Chhattisgarh
18	Vanya	VAN	Dantewada, Chhattisgarh
19	Gramin Yuma Pragatik Mandal	GYPM	Bhandara, Maharashtra
20	Amhi Amchya Arogyasathi	AAS	Gadchiroli, Maharashtra
21	Meghalaya Rural Development Society	MR	Shillong, Meghalaya
22	Point Return	SID	Maduranthakam, Tamil Nadu
23	K C Jaishankar	KC	Salem, Tamil Nadu



1.4- Management Systems-Paddy

In this study, 4 different management systems were found namely- SRI, Single Plant Transplant (SPT), traditional systems of transplant, and direct-seeded crop establishment. Table 1.2 cites the salient features-

SRI	Single Plant Transplanting	Conventional Transplanting	Direct-Seeded (broadcast)-*Biasi*
Seed treatment, 2-3 kg seed/ac, nursery at a corner of field-0.1 decimal, drainage	Seed treatment, 1-3 kg/ac	Nursery preparation, 25-30 kg seed/ac, 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/ac
Seedling taken out with mud ball.	Seedling taken out with mud ball.	Main field preparation	@ 30-50 days the land is ploughed again
1 seedling per hill	1 seedling per hill	Manual weeding at 50-60 days	Thinning and distribution done
Line sowing and spacing of 6 (plant-plant) and10 inches (row-row)	Line sowing and spacing of 10 inches		1 hand weeding
Multiple weedings @ 10-15 days, 20-30 days, and 30-45 days using mechanical weeder	1 hand weeding		

2- METHODOLOGY

The methodology being adopted for identifying at least 10 indigenous varieties per location visited that were performing well in terms of yield as per the organization's experiences over the years.

Indigenous varieties are defined as paddy cultivars:

1. On the verge of extinction,
2. Grown over small areas by limited number of cultivators,
3. Having special features and grain characters, and
4. Having long traditional farming history in the area.

A detailed format was prepared to record basic characteristics of the IPV, growth and observation data; apart from this, for documenting the management practices, a supplementary format was developed to record details of nursery and main field management and costing of operations. The formats were developed through consultation with Dr Mahendra Kumar (Senior Scientist, Department of Agronomy-Directorate of Rice Research-Hyderabad). Photographs of all available varieties are also being taken.

The following tools were used for data collection and compilation-

- Discussions with the organization's key persons,
- Observations and study of seed albums, samples, documents, etc. in office,
- Field visit and observations of crop,
- Focus Group Discussions (FGDs) or individual interviews with farmers cultivating IPVs, and
- Secondary information where available.

In most cases, the yield and other information of IPVs under SRI was collected from the different organizations through supervised crop-cutting methods (primarily by harvesting the crop over a 25 sq.m. area and taking the weight of grains after individual threshing and sun drying for 2-3 days) for the kharif 2012 crop.

In places where such precise information had not been recorded by the organization (usually in non-SRI areas), yield and other data were collected based on farmers' estimates and observations.

Table 2.1 shows the details on how yield data weres collected from different regions-

Organization	Code	State	Yield estimation method
Sambhav	SAM	Odisha	Crop cutting
Centre for Agriculture and Rural Reconstruction -CARR	CAR	Odisha	Crop cutting
United Artisans Association-UAA	UAA	Odisha	Crop cutting
Pragati	PRG	Odisha	Crop cutting
Virhi	DD	Odisha	Crop cutting
Dharohar Samity	DS	Chhattisgarh	Crop cutting
Sahabhagi Samaj Sevi Sansthan,	SS	Chhattisgarh	Crop cutting
Bastar Sevak Mandal-BSM	BSM	Chhattisgarh	Farmer's estimates
Vanya	VAN	Chhattisgarh	Farmer's estimates
Carmdaksh	CD	Chhattisgarh	Crop cutting
Adarsh Prahari Samaj Sevi Sanstha	AP	Chhattisgarh	Crop cutting
Sangata Sahabhagi Gramin Vikas Sansthan	SSS	Chhattisgarh	Crop cutting
Chaupal Gramin Vikas Prashikshan Evam Sodh Sansthan	CHP	Chhattisgarh	Crop cutting
Karma Prashikshan Evam Vikash Sansthan	KP	Chhattisgarh	Crop cutting
Gramin Vikash Kendra	GVK	Chhattisgarh	Crop cutting
Ami Amcha Arogya Sathi	AAS	Maharashtra	Farmer's estimates
Gramin Yuva Pragatik Mandal	GYPM	Maharashtra	Crop cutting
Agriculture Training Centre-ATC	AT	West Bengal	Crop cutting
Paschim Sridhar Kanti Jonokalyan Songho	PS	West Bengal	Farmer's estimates
Meghalaya Rural Development Society	MR	Meghalaya	Farmer's estimates
Point Return	SID	Tamil Nadu	Farmer's estimates
K C Jaishankar	KC	Tamil Nadu	Farmer's estimates






Plate 2.1- Crop Cutting at Baramba, Cuttuck-Odisha, 2.2- IPVs in display at Pragati office, Koraput-Odisha, 2.3- Display book of IPVs at Sambhav, Nayagarh-Odisha, 2.4- FGD with farmers at Birgahni village, Bilaspur-Chhattisgarh, 2.5- FGD at Erand, Ambikapur, Chhattisgarh, 2.6- SGE at Napak Songma, East Garo Hills, Meghalaya

3-FINDINGS

3.1- Locations

The survey was carried out in 24 organizations across 6 states, namely Chhattisgarh, Maharashtra, Meghalaya, Odisha, Tamil Nadu and West Bengal. 200 Indigenous Paddy Varieties (IPV) were identified during the study. Fig 3.1 shows the number of varieties studied in different states, while Fig 3.2 shows the number of organizations covered in the 6 states.

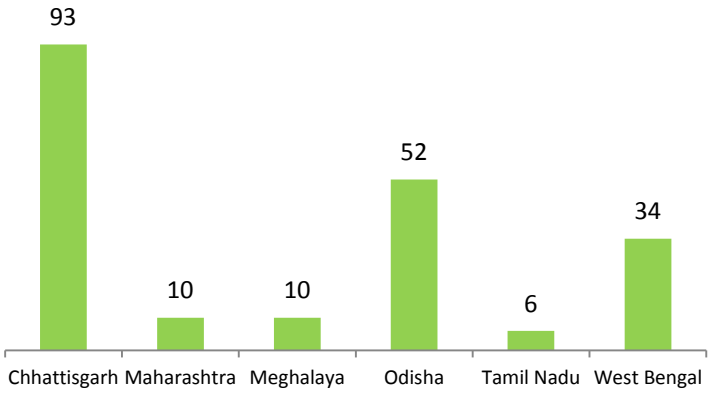


Fig 3.1- IPVs recorded in different states

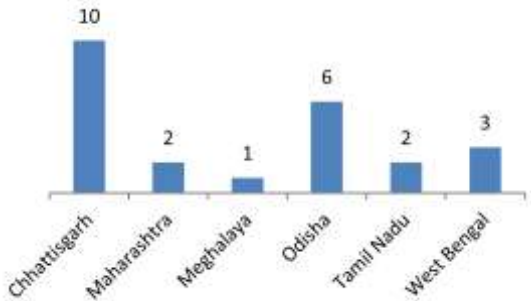


Fig 3.2- Organizations covered in different states

IPVs show amazing diversity, ranging from submerged deep-water, saline-tolerant varieties to ones growing in dry uplands and at altitudes up to 1700 m. The locations were spread across diverse ecosystems and agro-climatic zones, including the deltaic and coastal regions of Sundarbans (West Bengal), Ganjam (Odisha) and Tamil Nadu; plains regions in Bilaspur district (Chhattisgarh) and Baramba-Cuttuck district (Odisha); plateaus in the Eastern Ghats (Koraput & Rayagada in Odisha, Bastar and Sarguja - Chhattisgarh, Gadchiroli-Maharashtra); and mountains in the Garo Hills (Meghalaya).

3.2- Communities

65% of the IPVs identified in this study are being cultivated by indigenous communities (Fig 3.3 and Table 3.1) 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 resisted adoption of modern varieties and continued to have faith in their local varieties and who continue to cultivate them, thus conserving and developing these unique cultivars. However, in many cases the varieties are under critical risk of extinction as they are being cultivated by a single lone farmer. Apart from this, 6 organizations (as listed in Table 3.2) are into *in situ* conservation of a number of varieties.

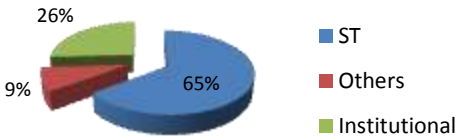


Fig 3.3- IPVs grown by communities, institutions

States	Communities
Chhattisgarh	Gond, Kawar, Nagwansi, Oraon, Bhatra, Majhi
Maharashtra	Gond
Meghalaya	Garo, Rabha
Odisha	Kondho, Poroja

Table 3.2- Organizations involved in IPV conservation

Organizations	Location	No. of cultivars conserved
Agricultural Training Centre-ATC	Phulia, Nadia, West Bengal	248
Dharohar Samity	Golavand, Kondagaon, Chhattisgarh	225
Rajendra Deshi Arthaniti Adhyan Kendra	Norisho, Cuttuck, Odisha	365
Paschim Sridhar Kati Jonokalyan Sangho	Jojeshgunj, North 24 Parganas, West Bengal	300
Richaria Conservation Centre	Abhirampur, Burdwan, West Bengal	150
Sambhav	Rohibank, Nayagarh, Odisha	435
Virhi	Kerandiguda, Bissamcuttuck, Rayagada Odisha	820

3.3- Management

47% (97) of IPVs were cultivated under SRI farming, while the remaining varieties were grown under Conventional Transplanting (CT), Broadcasting (BD), or Single Plant Transplant (SPT) techniques as shown in Fig 3.4

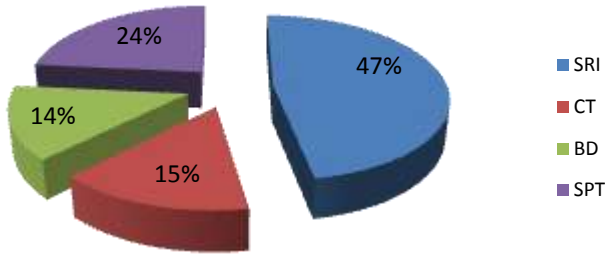


Fig 3.4- IPVs cultivated under different techniques

Out of the 16 organizations adopting SRI, there were different degrees of adoption of all the SRI steps as listed in Table 3.3

SRI Steps	Remarks
Reduction in seed rate	Adoption - High, seed rate reduced by 2/3 in most cases
Seed Selection & Treatment	Adoption - Medium, seed treated with cow urine or concoctions
Early transplantation	Adoption - Medium, seedlings transplanted within 2 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

3.4- Irrigation

91% of the varieties were cultivated under rainfed conditions although in some cases where irrigation possibilities exist, protective irrigation was provided on as-needed basis. 98% of the varieties were cultivated in Kharif season; Kalinga, Barijata (Sarguja, Chhattisgarh), Thoymalle and Vaikuntha (Tamil Nadu) were the varieties cultivated under irrigated conditions in summer and Rabi seasons. Pandidavar (Kanker, Chhattisgarh) is also a variety suitable for summer season.

3.5- Habitat

About 59 varieties (29%) are cultivated in lowland, and 40% in rainfed medium lands (RML) each, while 19 (9%) can be grown both in lowland and rainfed medium lands (RML); 33 (16%) varieties are dry upland cultivars, and 6 can be grown both in medium and uplands; 5 varieties are adopted to submerged habitats as shown in Fig 3.5

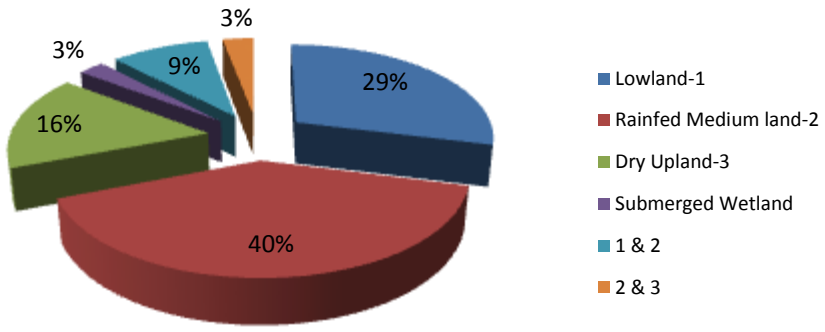


Fig 3.5-% of IPVs cultivated in different land types

3.6- Crop Duration

A plurality (47%) of the cultivars are late (long-duration) varieties having maturation times of more than 130 days, while 24% are very early maturing in 60 to 110 days (Fig 3.6).

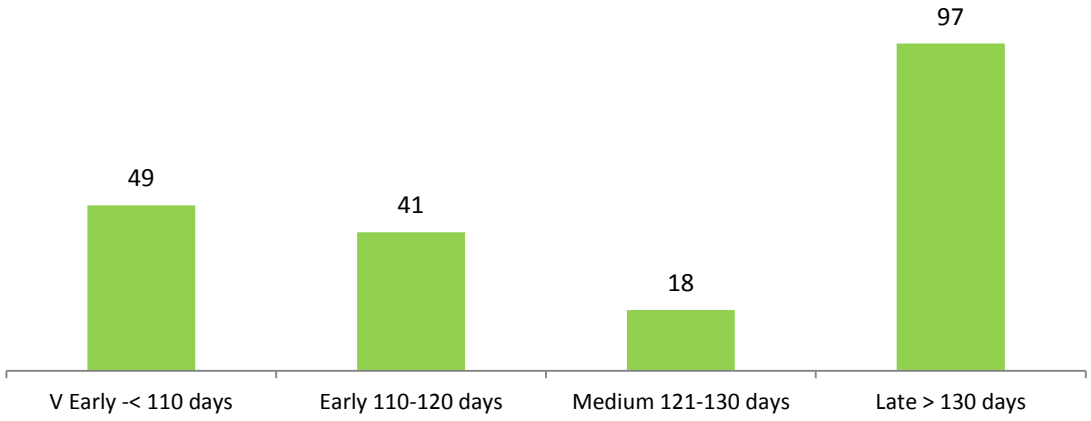


Fig 3.6- Maturity periods of different IPVs

Table 3.4 shows the habitats and management practices adapted by various varieties; Very Early cultivars are usually cultivated in dry uplands under broadcasting; Early varieties and Medium-duration varieties are cultivated in rainfed medium lands, primarily under SRI while the late varieties are cultivated in lowlands under SRI or SPT.

Cultivars	Habitat	Management
V Early	55% in uplands, 35% in RML	43% Broadcast and 37% SRI
Early	56% in RML & 27% in lowland	54% SRI, 27% CT
Medium	72% In RML, 28% in lowland	78% SRI, 17% BD
Late	50% in lowland, 44% in RML	44% SRI, 42% SPT

3.7- Growth & Observations

Sowing & Transplanting

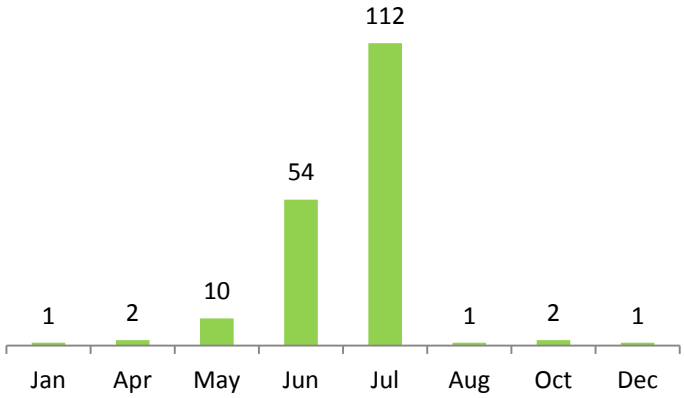


Fig 3.7 A- Sowing time of different IPVs

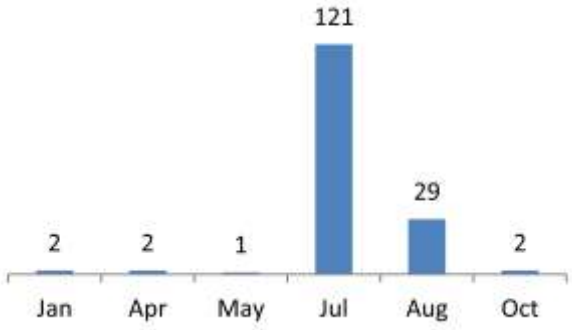


Fig 3.7 B- Transplanting time of different IPVs

Most of the varieties are sown with the commencement of the monsoon, thus with the arrival of late monsoons, 61% of the varieties are sown in July (Fig 3.7A); in terms of transplanting, 77% are carried out in July stretching into August (Fig 3.7B). IPVs being photoperiod-sensitive have the remarkable ability to adapt to late agricultural activities and still be able to maintain productivity as compared to photoperiod-insensitive modern varieties, thus greatly affecting yields.

Days to flowering

The number of days to flowering (Fig 3.8) varies from 35 – 125 days, depending on the time to crop maturity, with a mean of 90 days; 50% of the cultivars were flowering within 90 days.

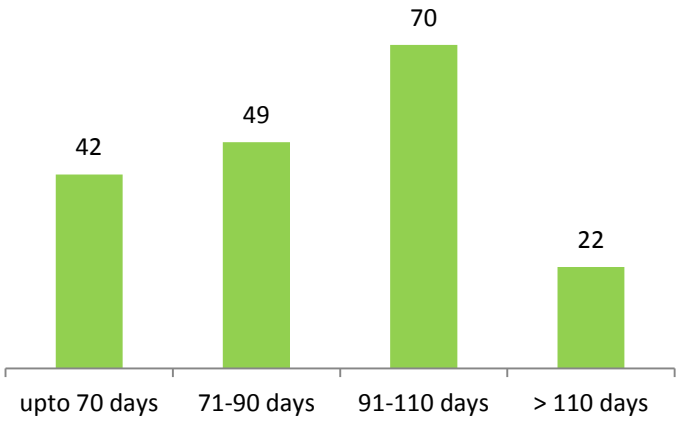


Fig 3.8-Flowering days of different IPVs

Tillers, Panicle %, Panicle Length & Number of Grains

Table 3.5 shows the tillers, panicle %, panicle length, grains per panicle, and range with different management practices.

Practice	Mean Tillers	Range	Mean Panicle %	Range	Mean Panicle Length (cm)	Range (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 can be observed that tillers, panicle length, and grains per panicle are higher in SRI and SPT practices. Table 3.6 shows the cultivars having highest number of tillers, panicle length and grains per panicle.

Parameter	Cultivars	Location
Tillers	Rudra -125 Kanchan Safri-80	Sarguja-Chhattisgarh Kanker-Chhattisgarh
Panicle Length (cm)	Gheus-40 Gotraphor-38	Sundarban-West Bengal
Grains per panicle	Bahurupi-600 Bahurani-600	Rayagada-Odisha

Plant Height

The mean height of the paddy plants is 1.3 m with a range of 0.6 to 5.7 m; Fig 3.9 gives range of heights and the number of cultivars

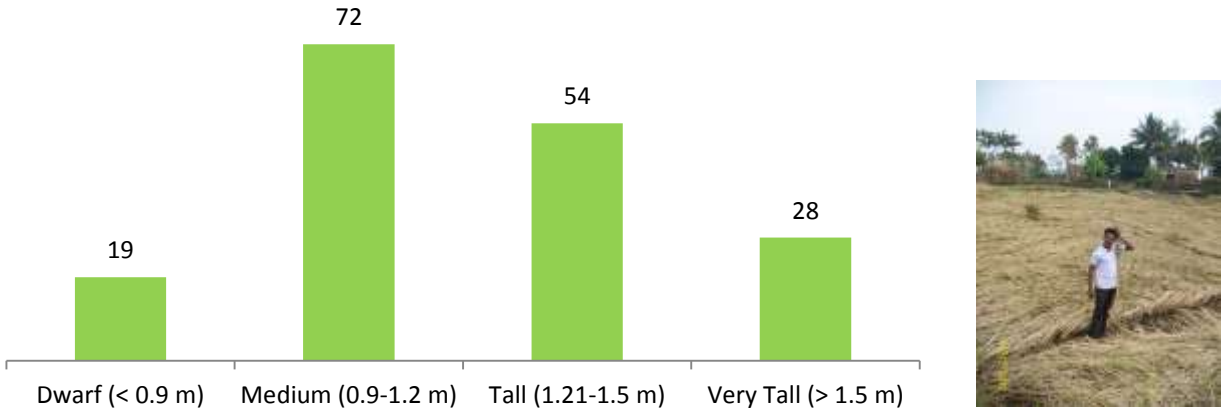


Fig 3.9- Height ranges of different IPVs

About 90% of the IPVs are non-dwarf varieties, primarily in dry uplands or rainfed medium lands, while the very tall varieties are found in flood-prone or coastal areas, able to tolerate flooding, 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 complete, prostrate collapse during the final stages of grain ripening or in stormy/windy situations. However, under SRI traditionally-lodging IPVs showed an erect stand.

Stand

Many of the IPVs being tall cultivars show lodging, but primarily at their final stages of maturity or under stormy and windy weather conditions. 83% of the IPVs assessed were reported not to show lodging except at their final stages of grain ripening (on account of the weight of the grains). Lodging although considered a negative quality is generally considered to be an appropriate adaptation by many farmers and field practitioners and is not reported to reduce yields (with Katarangi of the Sundarbans, lodging is reported to result in higher productivity). Under SRI, many of the lodging IPVs did not show any lodging due to higher culm strength and spacing. 87% of the IPVs cultivated under SRI, and 92% IPVs under SPT showed no lodging except in the final stages or in abnormal weather conditions of storm and wind. Application of chemical fertilizers in IPVs generally results in lodging.

Grain Yield

The mean yield for 94 IPVs under SRI management across different locations for the year 2011-12 was **5.08 t/ha;** 54 of the IPVs (57%) reported yields above 4 t/ha. Fig 3.10 shows the number of varieties in different range of yields

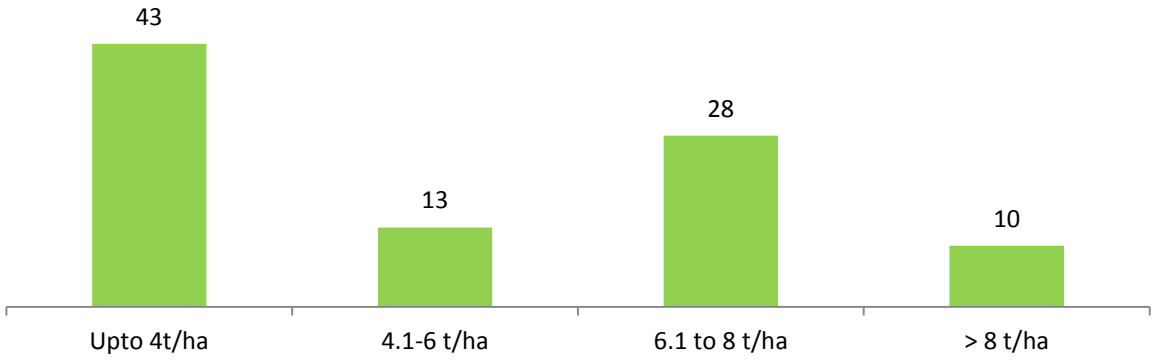


Fig 3.10- Yield range of IPVs under SRI

Table 3.7 shows yields of IPVs in different states, Odisha reported the highest mean yield of 6.1 t/ha, followed by Chhattisgarh with 4.9 t/ha and Maharashtra with 4.5 t/ha; the remaining states of Meghalaya and Tamil Nadu reported yields below 4 t/ha, while no variety was cultivated under SRI in West Bengal.

State	No of IPVs under SRI					
	Total	Up to 4 t/ha	4.1-6 t/ha	6.1 to 8 t/ha	> 8 t/ha	MEAN
Chhattisgarh	49	25	5	14	5	4.9
Maharashtra	5	3	0	2	0	4.5
Meghalaya	2	2	0	0	0	1.1
Odisha	33	8	8	12	5	6.1
Tamil Nadu	5	5	0	0	0	3.6
Total	**94**	**43**	**13**	**28**	**10**	**5.08**

Table 3.8 gives details of the IPVs under SRI showing more than 6 t/ha productivity-

Code	Variety name	Habitat	Duration (days)	Tillers /plant	Panicle Length (cm)	% Panicles	Grains /panicle	Grain Yield (t/ha)	Stress Tolerance	Grain Grade	Special features
AP-2	LOHONDI	Lowland	150	17	25	90	200	6	1	2	1, F2, no need to parboil
PRG7	RONGOCHURI	Lowland	120	40	18	38	120	6.2	1,3,4	2	1, F1, Biryani making, grain elongation on cooking
CHP-1	KALINGA	Med Upland	90	25	20	90	200	6.2	1	2	1, Summer paddy, Rs 10/kg
CR-2	JHUMPURI	Lowland	160	32	30	93	290	6.2	1	2	1, Straw is strong, this is alternated with Champaisiari for avoiding weeds
DS-1	ASAMCHUDI	Lowland	135	25	27	100	385	6.2	1, 3,4	2	1, High satiety, rice porridge (Pejh,Amat), rice beer (Landah)
DS-12	RAMIPAREVA	Med Upland	130	15	25	100	346	6.2	3,4	2	1, 2, 3
GYPM-1	PUIRI LOCHAI	Med Upland	125	43	24	100	275	6.2	1,3,4	2	1, Rs 12.5/kg
AP-1	JEERAPHUL	Lowland	150	50	25	90	200	6.4	1	2	1, F2, no need to parboil
SAM8	TULSIBAS	Med Upland	135	21	29	13	355	6.5		2	F2, rice tate-50/kg, ratooning
DS-11	BANDILUCHAI	Lowland	135	23	NA	100	390	6.7	1, 3,4	2	1, 3, 4, rice porridge (Pejh, Amat), grain elongation on cooking
PRG8	SOPORI	Lowland	150	45	25	40	140	6.9	3,4	3	F1, Pitha making, tastes sweet
CR-1	CHAMPAISIARI	Lowland	160	35	32	95	320	7	2 (30 d)	2	1, tasty, preferred by poor
GVK-1	JAUPHUL	Med Upland	145	70	19	100	280	7	1,3,4	2	1, F2, Rice-50/kg
SAM10	SAROGOTORA	Med Upland	135	26	29	23	350	7		3	1, fine non-scented rice, short-length straw suitable as fodder
SAM7	MOURIKHAS	Lowland	140	22	30	18	345	7		2	F2, rice rate-Rs 50-55/kg
SAM9	KHAJURCHERI	Med Upland	128	25	25	NA	245	7		3	1, fine non-scented rice, good as raw & parboiled, cross-pollinating cluster variety
CHP-3	DHANIAPHUL	Lowland	140	45	25	90	330	7.2		1	1
KP-1	BHATAPHUL	Med Upland	95	25	28	100	300	7.2	1,3,4	1	1, F2
KP-2	BIRHOLI	Med Upland	95	25	28	100	300	7.2	1,3,4	1	1, F2
CHP-6	KUMDHEN	Lowland	110	25	25	100	250	7.4	1	2	1, F1
GYPM-2	LAL LOCHAI	Med Upland	125	33	23	100	250	7.4	1,3,4	2	1, Rs 12.5/kg
SSS-4	KALAJEERA	Lowland	145	20	25	100	NA	7.4		1	1, F2
DS-13	LALMOKRO	Lowland	135	15	27	100	271	7.5	1, 3,4	2	1, 2, 3
CR-6	LATAMOHU	Lowland	160	43	30	97	250	7.6	1, 3,4	2	1, F1, tasty
CR-8	KALACHAMPA	Med Upland	150	37	34	85	327	7.6	1	2	1
CHP-2	KAJRI	Lowland	135	45	25	90	285	8		2	1
DS-2	KURLUBUTI	Lowland	135	19	26	100	271	8	1, 3,4	2	1, rice porridge (Pejh, Amat), less breaking while milling
SAM6	RADHATILAK	Med Upland	135	21	29	17	345	8		2	1, F2, rice rate- Rs

											50/kg
CHP-4	MAHSURI	Lowland	125	55	25	90	285	8.4		2	1, tasty, Rs 10/kg
SS-7	ADANBARGI	Lowland	100	35	28	90	225	8.8	1,3,4	2	1
SAM3	AGNILAL	Med Upland	130	16	26	11	220	9	4 (Blast)	2	1,7 - good for pregnant women
SAM4	RED 1009	Med Upland	135	27	25	22	232	9		2	1, 2, 3, strong straw used for growing mushrooms and thatching
SAM5	LALUCHURA	Med Upland	130	25	29	18	245	9		2	1, 2,4, bold variety preferred by economically-weaker sections, straw good for thatching
SS-5	KANCHAN SAFRI	Med Upland	110	80	28	90	275	9.2	1,3,4	3	1
SS-6	KUMLICHUDI	Lowland	120	45	28	90	275	9.2	1,3,4	2	1
SAM2	SUNGIBARAM	Lowland	130	21	29	18	285	10	4 (Blast)	2	1
SS-4	BASHABHOG	Med Upland	120	43	32	90	350	10.4	1	2	1, F2
SAM1	TALOMULI	Med Upland	130	31	30	18	280	11	1, 3	2	1, 4

Stress tolerance- 1-Drought, 2-Flood, 3-Pests, 4-Diseases; Grain grade- 1-Round, 2-Bold, and 3-Slender; Special features- 1-Daily cooking, 2-Puffed rice, 3-Rice flakes, 4-Popped rice, 7-Medicinal, F1- Light-scented, F2-Strong-scented

48 varieties were cultivated under SPT (primarily in West Bengal) with a mean yield of 4 t/ha; 15 cultivars showed yields above 4 t/ha, fig 3.11 shows yield ranges and number of varieties

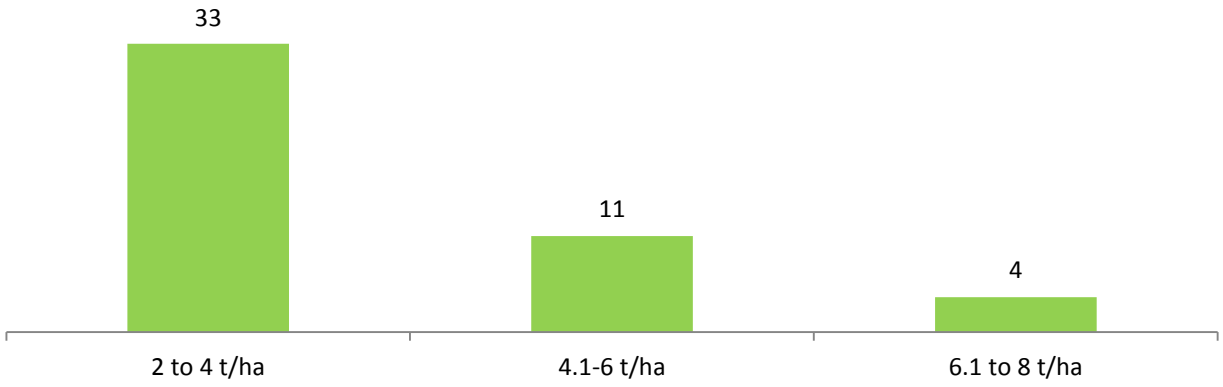


Fig 3.11- Yield range of IPVs under SP

31 IPVs recorded were cultivated under conventional transplanting system with a mean yield of 3.1 t/ha; 20 IPVs showed yields above 2 t/ha. 29 IPVs recorded were cultivated under broadcasting system with a mean yield of 2.4 t/ha, fig 3.12A and B shows yield ranges and number of varieties

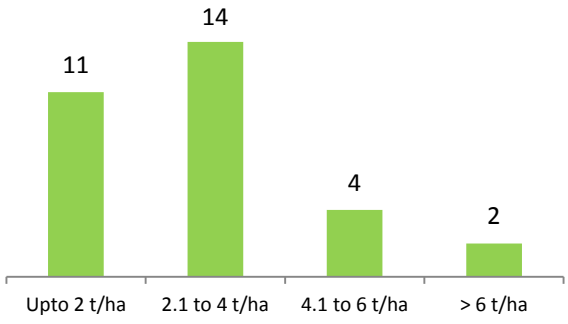


Fig 3.12A- Yield range of IPVs in conventional system

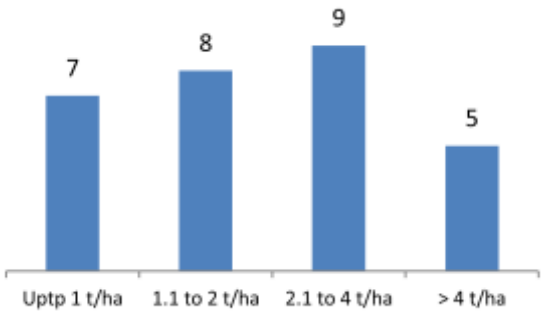


Fig 3.12B- Yield range of IPVs in Broadcast system

Table 3.9 shows comparative yields of popular modern varieties in the respective regions

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 conventional transplant ** under SPT*

As can be observed, the mean yields of IPVs under SRI or SPT management are close to those of modern varieties with more costly inputs; even in areas where SRI has not been attempted with IPVs, the potential for having higher yields exists. Most of the IPVs are being cultivated under organic farming systems as compared to high-input chemical farming as introduced for modern varieties.

Straw Yield

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 modern varieties, the straw of IPVs has a number of traditional uses in terms of fodder, thatching, grain storage structures, and other household items etc. Cattle also find the straw more palatable and prefer it as compared to modern varieties. Fig 3.13 shows the number of IPVs having different grain-to-straw ratios, 40% of IPVs have a ratio between 0.5 and 1.

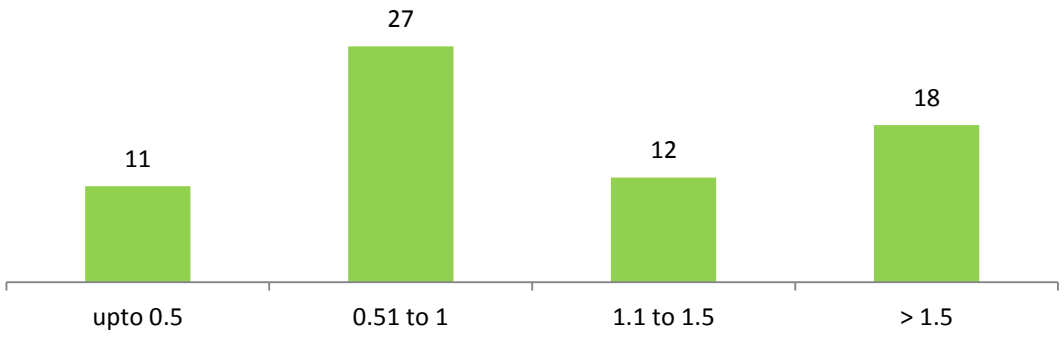


Fig 3.13-Straw yield ranges of indigenous varieties

Plate 3.2: Paddy Straw (L-R) A) heaped up at Sundarbans, West Bengal; B) Paddy seed granary and C) stool made of straw at Sarguja, Chhattisgarh

Pests & Diseases

Generally under favorable weather conditions, there are hardly any pest or disease incidences in IPVs; out of 205 IPVs, recorded cases of pest and diseases were recorded only with 71 varieties (35%). Fig 3.14 shows the incidences of percentage of varieties.

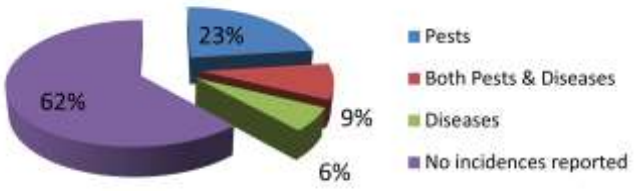
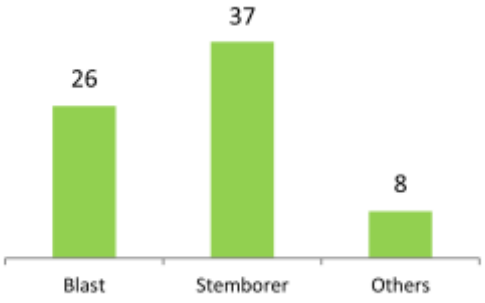


Fig 3.14- Pests and diseases reported from IPVs



3.15- Most prelavent disease and pest

Fig 3.15 shows that 52% of the cases were stem borer, 37% were blast, and the rest were other cases like gall midge, gundhi bug, etc.

Tolerance

Tolerance to drought, flooding, pests, diseases and other special stresses like salinity, etc. were recorded for 78% of the IPVs. Table 3.10 shows the IPVs in terms of different stress-resistances.

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

IPVs being cultivated in the central plateau and highlands showed increased tolerance to drought; Sundarban and Mahanadi basin IPVs show flood tolerance up to 30 days of submergence. Salinity tolerance was reported in 10 IPVs in the Sundarban delta region. IPVs showed a remarkable ability to adapt to changing environs; many of the IPVs not known for flood or salinity tolerance generally showed good yields in saline soils and also tolerated submergence. This was observed in Sundarban delta where after Cyclone Ayla much of the paddy lands had become saline. Experts were wary whether paddy would ever grow in these regions again as the modern varieties 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 like Chamormoni (Sundarbans, West Bengal) can tolerate salinity as well as tolerate 1.5 to 1.8 m of standing water for a month; there height increases with rising water. Similar traits are also seen in Champaisiari (Mahanadi basin, Odisha), and Jalkamini (24 Parganas, West Bengal) grows up to 5 m while remaining completely submerged and floating; Katarangi (Sundarbans, West Bengal) continues to thrive in spite of complete submergence for a week. Many of the IPVs show resistance to prevalent diseases like blast or other pests, whereas farmers reported higher incidences of pests and diseases in modern varieties. Some varieties also show tolerance to strong winds.

Plate 3.3- Drought-tolerant- Sat Ka Dhan, Bastar & Dantewada-Chhattisgarh
Plate 3.4- Flood-tolerant-Chamormoni, Sundarbans-West Bengal

Plate 3.5- Salinity-tolerant IPVs- (L – R) Dudeswar & Bahurupi, Sundarbans-West Bengal

3.8- Grain properties

Hull & Kernel Color

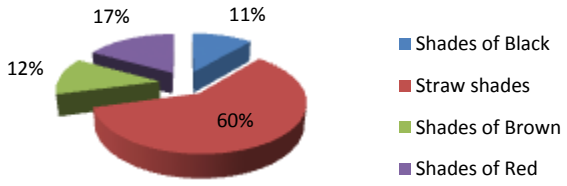


Fig 3.16- Hull colors of IPVs

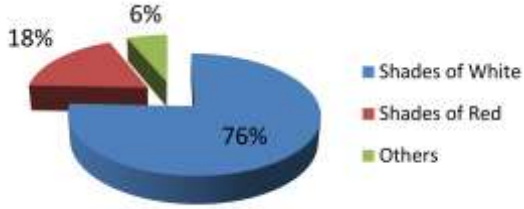


Fig 3.17- Kernel colors of IPVs

60% of the IPVs had hulls with shades of straw color, while 76% of the kernels were shades of white. Apart from this, black, red and brown hulls were also recorded, while red, brown, black and amber kernels were recorded. In a number of instances, non-white rice was considered rich in minerals and possessing medicinal properties. However, modern milling and polishing make all rice look white.

Plate 3.6- L-R Different colors of IPVs- A) Kalajeera, B) Gangabaru, C) Sadamota, D) Laldhan

Grades

Grade was measured in terms of 3 types -- round, bold and slender -- based on the rice kernel length to breadth ratio (l/b ratio) as shown in Table 3.11

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

75% of the IPVs have bold grains having a l/b ratio between 2 & 3.

Plate 3.7 (L-R): Grades of grain -- Round- Malheria, Bold-Sikhar, and Slender-Basmati

Qualitative Features

Some qualitative features were recorded like fragrance, end uses (apart from daily cooking), or any other special features as listed in Table 3.12

FRAGRANCE		END USES			
Light aroma	Strong aroma	Puffed rice	Rice flakes	Popped rice	Medicinal uses
14	42	24	9	10	4

Most farmers reported that IPVs are generally nutritional and flavorful (sweeter and tastier), have good appearance and texture, and better cooking (grain elongation) and keeping qualities as compared to modern varieties, and this is one of the primary reasons given for cultivating the same. A number of varieties also have high satiety and thus are preferred by economically-weaker sections. Further, some of the 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 taken raw directly after harvest; IPVs also commonly show less breakage in milling and have less percentage of chaffy grains as compared to modern varieties. Jugal and Ramlaxman are double-seeded varieties, while Sateen and Ramlaxmansita are triple-seeded varieties.

Plate 3.8 (L-R):
A) Aromatic-Jeeraphul, B) Light scented-Bishnubhog, C) Good for puffed rice and rice flakes- Ramipareva D) Medicinal - Karheni

3.9 Reasons of farmers preferring IPVs

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

- Lower cost of cultivation due to less reliance on external inputs (in terms of seeds, fertilizers, pesticides, irrigation and labor).
- More tolerance to weather vagaries of drought, flood, submergence, salinity, wind, etc.
- Flexibility to varied timings, practices, and adaptability to changing environment
- Resistance to or low incidences of pests and diseases
- Possibility of re-using the seeds over long periods.
- Minimal chaffy grains and less loss in milling
- Availability of quality straw for fodder, thatching, and other uses.
- Ecologically and environmentally safer
- Rejuvenation of soil and water quality
- Healthy, nutritious, flavorful, and good keeping quality for home consumption
- Use for traditional foods, sweets, recipes, drinks, and rituals
- Medicinal and nutritional properties
- Higher price received in market (for scented/fine rice IPVs)
- Possibilities of innovations and development of new cultivars through selection.

3.10 Advantages of SRI with IPVs

- Higher productivity
- Less or no lodging
- Less time and labor requird in agricultural operations
- Reduced seed rates

3.11- Record Production of Indigenous Varieties under SRI

Sahabhagi Samaj Sevi Sangsthan (Charama, Kanker District, Chattisgarh) has been promoting SRI among famers of Kanker and Kondagoan for the last 4 years. At Lihagaon village in Rajpur block of Kondagoan district, Chattisgarh, under the able guidance of Jeevan Baghel (photo-second from right), farmer Punaram Netam (photo-extreme left) had cultivated KANCHAN SAFRI (a 110-day slender grain IPV) in 3 acres of land under SRI management and got an yield of 9.2 t/ha. The crop had 70-90 tillers/plant with 90% panicle formation, panicles having average length of 28 cm and 275 grains. This variety was brought by his 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 and got a yield of 10.4 t/ha. Their plants had 40-45 tillers with 90% effective panicles, having average length of 32 cm and 350 grains.

Plate-3.9 (TL-BR): SRI Farmers at Lihagaon, Chhattisgarh; clockwise: Kanchan Safri, Kumlichudi and Adanbargi

KUMLICHUDI, a reddish-yellow rice variety, also gave an yield of 9.2 t/ha under SRI (40-50 tillers/plant, 90% panicle formation, with panicle 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% panicles, with length of 27 cm and 225 grains). Inspired by the results in SRI, the community has taken up SRI methods with finger millet with encouraging results of 6 t/ha.

Chaupal (Ambikapur, Sarguja District, Chhattisgarh) is actively promoting SRI among tribal farmers of Udaipur block in Sarguja district of Chhattisgarh. Agar Sai, an SRI farmer in village Tunga, had cultivated MANSURI (a 120-day bold-grained IPV) in 40 decimals of land and got a yield of 8.4 t/ha. This IPV showed 50-60 tillers/plant with 90% effective panicles having a length of 25 cm and 285 grains. Agar Sai also cultivated a 135-day black IPV, KAJRI, which had a yield of 8 t/ha under SRI. The variety had 45 tillers/plant with 90% panicles having length of 25 cm and 290 grains.

Plate 3.10- SRI Farmer Agar Sai with his daughter, Tunga, Sarguja, CG IPVs- Mansuri and Kajri

Gramin Yuva Pragatik Mandal (GYPM, Bhandara, Maharashtra) has been promoting SRI for the last 5 years in Bhandara and Gondia districts of Maharashtra. **Vashist Devaji** Gadwe and **Damo Goipichand Pandre** of Sarpewada village in Bhandara district of Maharashtra cultivated LOCHAI (120-day bold IPV) under SRI in 30 decimals of land, and each got a yield of 7.4 t/ha (40-45 tillers/plant with 95% panicles having length of 24 cm and 275 grains). These IPVs had been growing in these areas earlier but had practically gone extinct with the advent of HYVs and hybrids. GYPM re-introduced these varieties by getting seeds from Gondia district.

Plate 3.11- SRI Farmers Vashist Gadwe and Damo Pandre, Sarpewada, Bhandara, MS; IPVs- Piuri and Lal Lochai

3.12- The Seed Keepers

During the course of the study, we came across a number of organizations and individuals who have gone against the odds towards conserving, documenting and promoting 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 short descriptions below give the details-

Dharohar Samity (DS), Kondagaon-Chhattisgarh: Inspired by rura communities DS has been into conservation of IPVs since 1995. Starting with 135 varieties from Bastar region, DS has 255 IPV cultivars presently About 60 IPVs are being cultivated under SRI here in 1 sq.m. plots for distribution among famers. In 2012, about 100 farmers received seeds from the Samity. The seeds are given to the farmers free but there is an understanding that after harvest, the farmer will deposit the same amount of seed he had taken with the Samity. The organization is composed of grassroot workers and local farmers being managed by Sr Shivnath Yadav, who is also the secretary.

Apart from conserving and distributing seeds Dharohar Samity has also been making farmers aware on SRI with organic inputs and on various indigenous varieties. The Samity has 15 dry upland varieties, 26 RML varieties, and the remaining are lowland cultivars. There are 20 scented varieties as well as a double- and a triple-seeded variety, Ramlaxman and Ramlaxmansita, respectively.

Plate- 3.12- IPVs kept at Dharohar Samity, 3-grained Ramlaxmansita, Members of Dharohar Samity and Demonstration Farm at Golavand, Kondagaon, CG

Dr **Debal Deb** of **VIRHI**, Kerandiguda-Bissamcuttuck, Odisha, has been conserving 820 IPVs since the last 17 years. Dr Deb, an ardent ecologist with previous postdocs at the University of California at Berkeley and the Indian Institute of Science, Bangalore, left his well-paid job with WWF in 1996 to set up VIRHI, the first non-governmental seed bank in West Bengal havingh 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 2 years back and has since 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 labeled and coded with the names of the different IPVs in a 2-room hut in Kerandiguda village surrounded by the Niyamgiri range. Each of the pots stacked over each other has a bunch of panicles of different varieties. The unique collection has 100 scented varieties, 130 dry upland IPVs, 6 salinity-tolerant

and 12 submergence-tolerant IPVs, apart from a number of rare IPVs including the 2-grained Jugal and 3-grained Sateen. About 0.5 ha of land has been leased from local farmers for cultivating the 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 adjacent to one another. Under the able guidance of Dr Debal, Debdulal Bhattacharyya meticulously works in the farm doing all the farm operations, recording data, and collecting the panicles to be stored for seed as well as developing new cultivars through selection.

Plate 3.13- IPVs stored in pots (top row); Dr Deb in paddy field; Debdulal Bhattacharya with IPVs; Patnai paddy variety grown under SPT; and 2-grained Jugal at VIRHI-Kerandiguda, Rayagada-Odisha

Natabor Sarangi (Rajendra Deshi Arthaniti Adhyan Kendra), an octogenarian retired school teacher, resident in Norisho village near Niali, Cuttuck (Odisha), has been conserving and cultivating 365 IPVs since 1999. Sarangi used to grow HYVs and used chemical fertilizers and pesticides in his farms. He even had been one of the persons chosen to promote modern varieties in and around his village by companies and government officials. He switched to organic agriculture when a laborer spraying carbofuran collapsed and had to be rushed to the hospital. Although the laborer survived, Sarangi became convinced of the serious consequences and hazards of chemical farming. Initially he had used organic inputs with HYVs; however, his son Rajendra (who had been involved in a number of environmental movements) advised Sarangi to go for IPVs. Most of local paddy cultivars had disappeared from the area, so 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 to reach 365 now.

Sudhir Patnaik from Samadrusti an Odia journal has developed a 2-volume album of the IPVs with each page having small packets of the IPVs with their characteristics. Sarangi takes 3 crops in his land: paddy, followed by green gram, and finally gourds in the summer. This way he gets fodder as well as mulching material, thus overall productivity is high.

Plate 3.14- Seed album, Natabor Sarangi & Jubraj, Paddy harvesting and Farm at Norisho, Cuttuck-Odisha

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 a main Seed Bank at Jogeshgunj and 10 associated seed banks in 18 villages across 5 panchayats. Presently, 800 farmers are members of the seed bank. The program was initiated after the Ayla cyclone when modern varieties failed due to high soil salinity. The organisation under the leadership of Bishnupado Mridha collected IPVs from different parts of the Sundarbans as well as from other parts of West Bengal to initiate the main seed bank at Jogeshgunj. They also have a small farm where the IPVs are cultivated every year for conservation, multiplication, distribution, and research. The organisation boasts of an unique collection of 8 salinity-tolerant IPVs, 5 deep-submergence-tolerance IPVs, 17 scented, and 10 fine rice IPVs. PSKJS has been involved in farmers' awareness activities on organic farming with IPVs in the area.

Plate 3.15-Prakash Mondol with IPVs in pots at PSKJS Seed Bank-Jojeshgunj, Sundarbans,WB

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

Plate 3.16- Dr Anupam Pal et al at ATC Demonstration Farm, Phulia, Nadia WB, IPVs stored in pots, IPV-Khara and Komol

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 9 trees, many gullies, mosly hard rocky soil with 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 been conserving 435 IPVs through SRI in its 2 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, annually holding a number of residential training programs for farmers on sustainable agriculture. Sambhav has been instrumental in motivating and providing indigenous seeds for SRI to a number of organizations and interested farmers/individuals in Odisha. Sambhav believes that SRI with IPVs is critical to increasing outreach among farmers.

Plate 3.17- IPVs in display, Sabarmatee and Namita examining IPVs, Paddy harvesting in progress-Sambhav, Nayagarh, Odisha

In Rampur block of Nayagarh district, Odisha **Nilomani** has helped conserve 70 IPVs across 3-4 panchayats involving about 200 farmers; Nilomoni says the absence of irrigation facilities, less pests and diseases, and reduced costs of cultivation have prompted farmers to continue with their 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.

Plate 3.18-Nilomoni with IPVs

4- CONCLUSIONS & RECOMMENDATIONS

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

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

Some of the interventions that could be taken up-

- **Increasing organic SRI outreach with IPVs**- Efforts have to be made to increase SRI management across different regions (modifications would have to be made for submerged wetlands and dry uplands) with IPVs rather than rejecting them for low productivity and introducing hybrids and HYVs. Adoption of practices, especially 1 seedling per hill and weeding with organic inputs, would need to be stressed.
- **Generating awareness and action towards SRI with IPVs**- There is an urgent need to campaign for promoting SRI with IPVs as opposed to the 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 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 farmer's experiences and issues with Govt. departments and institutions would be critical in bringing back IPVs. These efforts need to be buttressed by extensive and systematic data so that farmers and others can have confidence in IPV alternatives.
- **Supporting existing seed banks and organizations/individuals**- The study documented 8 indigenous seed keepers/banks; however in most cases these organizations are working under enormous constraints. Efforts need to be made to support these endeavors in their true spirit of empowering farmers. Documenting their experiences and characteristics of the cultivars in seed bank is greatly needed.
- **Farmer's 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 to set-up Community Seed Banks not only for conservation but for multiplying seeds to be distributed and released among famers, thus reestablishing lost or endangered varieties. Selection, trials, research and documentation of the IPVs would help in characterizing them and maintaining breed purity of the various IPVs as well as bringing back the innovative spirit among the farmers.
- **Protecting IPVs as community resource against individual patenting-** Presently there are no provisions of protecting IPVs from anonslaught of biopiracy and patents. A number of processes for individual patents are in place, but there are no provisions of protecting IPVs as a critical community resource. There is a strong need towards a united approach for effective policy formulation aimed at protecting the IPVs as a community resource.
- **Marketing of scented fine rice-** There are 100+ scented and fine IPVs still being cultivated; 16 scented IPVs which were identified in this stud have more than 4 t/ha under SRI. However, there is very little awareness, demand or markets for the same. Most people understand long-grained Basmati as the only scented rice, labeled as Basmati Barring some popular scented IPVs, in most cases there are no price incentives to cultivate

these IPVs rather than bolder varieties as there are only 2 categories in Govt. Paddy procurement program - Bold and Medium. Thus scented IPVs at most end up being sold at the price of medium grade. Traders' reports of erratic supply of scented-fine IPVs have reduced demand and given rise to unfair prices. Present laws also forbid export of non-basmati rice, and thus scented-fine rice has no high-end markets as compared to Basmati. Stabilization of production would need to be followed by effective marketing of the scented varieties at high-end markets and in exclusive stores. Apart from scented IPVs, there are enormous possibilities for promoting nutritional and medicinal properties of many of the IPVs.

- **Documentation of IPVs**- Studies to document IPVs in different states, characterizing and recording of farmers' experience would be important to promote IPVs and bring them under SRI cultivation. Analytical studies on nutritional and medicinal qualities of IPVs would also be helpful in characterizing and marketing of the same.