SRI - The Package of Practices

भात उत्पादन वाढीची 'श्री' पध्दत

Nature Protects if She is Protected

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महाराष्ट्र वन विभाग
Mangrove Cell

The Brochure

This brochure presents the package of practices for the System of Rice Intensification as followed in Sindhudurg and the results of the SRI pilot project supported under the GoI-UNDP-GEF Project titled: "Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in Sindhudurg Coast, Maharashtra State".

Acknowledgement

We express our sincere gratitude to Mayem Panlot Sangh for carrying out the demonstration of SRI in the three coastal talukas of Sindhudurg.

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Disclaimer

The results in this report have been compiled based on data collected and supplied by the field staff of the NGO involved who were not under scientific supervision so there may possibly be errors in the sampling and data collection. The statistical significance of the results has not been assessed with statistical methods. Many of the magnitudes in number of cases (N) and mean differences are such that significance (or not) is evident.

System of Rice Intensification

The Package of Practices

भात उत्पादन वाढीची 'श्री' पध्दत

Initiated under

GoI-UNDP-GEF Sindhudurg Project on
Mainstreaming Marine and Coastal Biodiversity Conservation into
Production Sectors in Sindhudurg Coast, Maharashtra

FOREWORD

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The initiative and results for applying System of Rice Intensification (SRI) principles and practices in the Sindhudurg coastal areas of Maharashtra state are welcome for several reasons. First, because they demonstrate that SRI's agro-ecological methods can be productive in yet another agro-ecosystem, quite different from most other areas of India where SRI has been introduced. Second, because they contribute to the conservation of natural ecosystems where nature's balances and resilience are under threat. And third, they contribute at the same time to improving the lives and livelihoods of the human population of this region, many of them in urgent need of greater security and well-being.

Dr. Subir Ghosh and his colleagues are to be greatly commended for their initiative and their systematic efforts to ensure both good understanding and then good application of the practices which constitute SRI and are laid out clearly in this brochure. I would add a note of caution, however, concerning how the concept of 'package of practices' is understood.

The brochure appropriately emphasizes from the outset that SRI is constructed from ideas, conveying new thinking and insights about how to enable rice plants to grow more robustly and productively. It is not an input-dependent technology, or rather, the inputs that make a difference are more mental than material. Those of us who have worked the longest with SRI think of this innovation as more like a menu than like a recipe. My hope is that readers will not understand 'package of practices' as meaning the latter. Do A, B, C and D according to instructions, and you will get X result. Rather, consider A, and B, and C, and D, understand what each can contribute to a healthy, productive rice plant, know the principles and usual practices, but be prepared to experiment, evaluate, adjust and even innovate. The plant has potentials that we do not yet fully know, as seen from these pictures from Indonesia and Liberia, with farmers showing pairs of rice plants that they have grown, of the same variety and from in the same soil. It is easy to see which are the SRI-grown plants.

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Readers of this manual should keep in mind that SRI should not be reduced to just a set of practices, to be followed mechanistically. SRI experience should be improving farmers' initiative and critical thinking, not just improving crop yields. The improvement of agriculture depends on farmers' advancement, not just adoption of given technologies. SRI represents paradigm shift for agriculture, seeking to bring out the full potential of each crop plant, by spacing, soil aeration, exposure to sunlight, etc., rather than 'massify' plants (a new word for which I apologize) and inanimate the soil. It should bring out the full potential of farmers too, and strengthen rather than attenuate the bonds between farmers and their vocation of agriculture. I do not expect that many Sindhudurg farmers will in their first year or two get the kind of plants that Ms. Miyatty Jannah and Mr. Edward Sohn are showing above. But they should know that this potential exists in their seeds and in themselves.

I hope that SRI will inculcate greater respect for plants and for the life in the soil as the soil's life is the foundation for its fertility, for its structure and functioning. Soil is much more than the mineral portion that we can easily see. In healthy soil, which is well-structured, porous, with low bulk density, the mineral portion constitutes only about half of the soil's volume. Roughly a quarter of its volume is ideally composed of water and another quarter is composed of air. Soil that is compacted, without microspaces and channels for water and air to flow and diffuse through it, is inhospitable for life, and this means that it is inhospitable for plants.

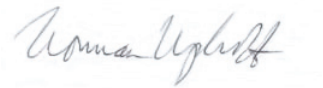
Organic matter, both living and dead, is a small portion of the soil's volume, about 5 percent, plus or minus several percent. But to use a figure of speech, it is 'the tail that wags the dog.' The structure and functioning of soil systems depends upon the activities and presence of soil organisms. The soil's ability to absorb and retain water depends largely upon the creatures, visible and mostly invisible, that live in it and upon the remains of myriad dead organisms, plants, animals and microbes.

SRI is thus a system of concurrent and integrative management of plants, soil, water and nutrients. Soil that is inert is literally dead and unproductive. Plants and soil organisms themselves live symbiotically, with plant root exudates supporting the life in the soil, and that life increasing plants' access to water and nutrients, protecting against pathogens, inducing systemic resistance to pests and disease. When agronomists say that soil organisms 'immobilize' nutrients, they might better way that they store up and bank nutrients where these can become subsequently available to plants, rather than be lost through volatilization, seepage or erosion.

This foreword calls attention to the life in the soil because agricultural production involves more than any given technology, depending upon the soil and its animate and inanimate portions, on the climate with its temperature and precipitation (or lack thereof), on the people involve, on implements, tools and machinery, on infrastructure, markets, prices, policies, institutions, etc.

SRI represents an intervention into this complex of interacting things, ideas and forces. SRI experience shows us that making some simple, but often counter-intuitive, changes in rice-growing practices -- some of them age-old -- can tap large, underutilized production potentials in the rice genome, of both traditional and modern varieties. Such changes have ramifications in many directions, interacting with people, implements, infrastructure, institutions, etc.

This is all the more reason that we not relegate SRI to the familiar status of a 'technology.' It has potential to make many changes in the quality and direction of rural life. Where and when this impetus will end we cannot say. It is up to farmers and those who work with them to make this potential as broadly and sustainably positive as possible. We in SRI-Rice look forward to learning from the on-going experimentation and experience with SRI, hoping it will bring greater prosperity and security to Sindhudurg communities and beyond.



By Norman Uphoff
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MESSAGE

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The economy of Sindhudurg is primarily agrarian, with approximately 87% of the population engaged in agriculture. In Sindhudurg, majority of the farmers have small and marginal landholdings; the average landholding of farmer is 1 ha of land that is lesser than the state average of 1.44 ha. Rice is the predominant food crop of people belonging to the coastal district of Sindhudurg in Maharashtra. Major crops are paddy, cashew, mango and coconut. These four crops together account for close to 95% of the gross cropped area in the district, with paddy being the largest (44.83% area) followed by cashew (27.31%) and mango (17.17%). The average gross cropped area under paddy in the district is 79,000 Ha. The total production being 245400 mt., the average productivity works out to be 3.17 mt. per ha.

It is heartening to know that the System of Rice Intensification technology (SRI), introduced in Sindhudurg by the UNDP-GEF Project in collaboration with the Government of Maharashtra in the year 2013 and the technology transfer pursued over a period of 4 years in Sindhudurg, has shown the possibility of (92.6%) increase in tillering, (30%) increase in grains per panicle, (23.54%) increase in grain yield and (17.3%) increase in straw yield over the results following traditional practice. The average productivity under SRI was observed to be 6.89 mt per ha: The average productivity of paddy in the district being 3.17 mt. per ha, there is a tremendous prospects of increasing paddy production in the district.

SRI technique is useful to farmers as they can get twice as much yield by using only 5 to 10 kg of seed per hectare instead of the 50 to 100 kg per hectare by using less irrigation. I am sure, the demonstration in farmers' fields carried out by the Project with the help of State Agriculture Department and NGOs will help in propagating the technology across Sindhudurg District, which is more productive, environmentally friendly and important from food security point of view of small and marginal farmers.

I have issued directives to the District Administration to incorporate SRI Technique in 'Chanda te Banda scheme' (Resource Based Planning and Implementation Scheme of Maharashtra Govt.) in Sindhudurg and Chandrapur districts for scaling up of this scheme. Sufficient funds have been allocated under Chanda te Banda scheme for SRI technique and mechanisation of agriculture to the tune of Rs 4 crore in financial year 2015-16 and Rs 5.10 crore for 2016-17 sanctioned for Sindhudurg district and Rs 5.50 crore & Rs 10 Crore respectively in Chandrapur District. Funds are also allocated for mechanisation in paddy cultivation. I have also instructed the District Administration and Agriculture Officer to concentrate on scaling up the SRI Technique.

Due to hard efforts of the Project and District Agriculture Department, we are getting best results in implementing SRI Technique. I am sure that in the coming years, propagation of this technology will be a success story for Maharashtra.

In days to come, I look forward to scaling up the activity throughout Maharashtra. The participation of the Agriculture Department in the scaling up programme will be vital in transfer of the technology across Maharashtra.

By Deepak Kesarkar
Minister of State for Home (Rural), Finance, Planning, Maharashtra State

PREFACE

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Agriculture is the mainstay of Maharashtra state's economy and the primary source of employment and income for most of the rural population. The agriculture of the coastal districts of Maharashtra is characterized by dependence on nature, low investment, low productivity, and mono-cropping, with paddy as the dominant crop. Inadequate irrigation facilities and dependence on the vagaries of the monsoon have made the agriculture sector very vulnerable, affecting the food security of the farming households, apart from affecting its overall contribution to state GDP.

The agriculture-based economy of Sindhudurg has been facing problems such as erratic rainfall, low level of irrigation, small and marginal landholding pattern, mono-cropping, sub-optimal level of technology adoption and low productivity resulting in food grain deficiency. The State Government has initiated several efforts to address these problems and stabilise agriculture by promoting improved methods of cultivation. Agriculture in the state needs to adopt drought-proofing strategies to minimise production risks. It is heartening to learn that demonstrations out in the district during last two years by Mayem Panlot Sangh under the GoI-UNDP-GEF Project, "Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in Sindhudurg Coast, Maharashtra", for popularising the System of Rice Intensification method of paddy cultivation among farmers of the district has yielded encouraging results. The demonstration farms in all the three coastal talukas, viz. Devgad, Malvan and Vengurla, have shown definite increase in paddy yield in comparison to the yield under traditional method of cultivation as well as the improved package of practices, viz. the *charsutri* system of cultivation. Results show higher grain yield (44-86%), higher straw yield (50-75%), with reduced irrigation (25-40%) and lower seed rate (10%) as compared to traditional cultivation method, thus reducing the cost of cultivation.

Having witnessed the results of the trials, the farmers in the district, particularly small and marginal landholders, have been motivated to adopt this method of paddy cultivation which would not only provide them with food security in getting higher paddy production from their land but also provide them adequate scope for growing more remunerative crops by making better use of water and land area. The most important development as a result of the demonstration of the programme is the decision taken by the District Collector of the district to scale up the System of Rice Intensification in the entire district, and a plan in this regard is under preparation by the District Agriculture Officer. I congratulate the District Administration for such a pro-active development measure.

As desired by the District administration, we have made an effort to bring out this bi-lingual handbook on the package of practice on System of Rice Intensification for ready reference of the farming community and agencies involved in promotion of the activity. I hope it meets the expectations of all stakeholders and, more particularly, that of the farming community of the district.

By N. Vasudevan
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CONTENTS

WHY SRI?

Rice production will need to increase substantially in the next few decades to meet the increasing demands of a growing population, as well as the existing global food and nutrition deficits. This increase is more challenging than before considering less per capita land availability, increasing water scarcity, increasing input costs, and increasing incidences of crop failure owing to climate-related changes.

India is the world's second largest rice producer, accounting for more than 20% of global production. Input-intensive agricultural practices have helped the country in achieving a quantum jump in food production in preceding decades. However, this production strategy has not benefited the millions of small and marginal farmers as desired. The strategy itself is no longer contributing as much as before to meeting national food security needs, as the rates of yield increase have slowed. There is still unacceptable food insecurity for millions of Indian households, and the cost to the country of maintaining huge subsidies for fertilizer, power and other inputs as well as price subsidies is a great fiscal burden for the nation. It is estimated that the reductions in water requirement with SRI use could reduce electrical power demand by about 3,151 kwh per hectare, which represents over Rs 12,600/- in subsidies. Finding local solutions to food production is essential to eliminating hunger and providing insurance against rising food prices.

Under these circumstances, the opportunities offered by the System of Rice Intensification (SRI) and its extensions to other crop production in many areas should be considered as effective tools for sustainable agricultural production. Besides, it may help in substantially reducing the need for embedded subsidies in every grain of rice or cereal that is produced by the farmers through reduced application of inorganic fertilisers (25%) and reduced water use for irrigation (up to 40%). With higher grain yield potentials (15% to 40% or more) and greater straw yield potentials (50% to 70% or more) over conventional methods, it could address the food security issue and fodder requirements very effectively.

Paddy cultivation in India being highly dependent on the monsoon is highly vulnerable to the vagaries of climate change, particularly the timely arrival of monsoon and adequate rainfall. SRI offers adaptation to climate change through its inherent drought-coping mechanism, attributed to low seed requirement (10% of traditional farming), permitting setting up of staggered nurseries at required intervals, matching the changing monsoon pattern. It also enjoys the potential to mitigate climate change through reduction in GHGs released into the atmosphere, owing to lower emission of methane (up to 60%) from paddy fields, attributed to alternate drying and wetting of paddy fields at different stages of the crop.

The System of Rice Intensification (SRI) is perhaps the best option available to farmers, particularly the small and marginal farmers, to promote community-led agricultural growth, while managing soil and water resources more sustainably and even enhancing their future productive capacity.

WHAT IS SRI?

System of Rice Intensification, known as SRI - i.e. Systèmede Riziculture Intensive in French and la Sistema Intensivode Cultivo Arrocero (SICA) in Spanish - is a climate-smart, agro-ecological methodology for increasing the productivity of rice and more recently other crops by changing the management of plants, soil, water and nutrients.

Until 1990, the impression was that rice crops yield better only under flooded conditions. Recent reports from International Water Management Institute, Colombo, have suggested, however, that continuous submergence is not essential for obtaining higher rice yields. Further, experiences from studies on SRI in China and India during the last decade have conclusively demonstrated that unflooded soil is preferable for rice plants to grow well and yield better than under conventional method of continuous shallow submergence. SRI which is relatively a new methodology involves a set of practices that integrate management of plant, soil, water and nutrients. The potential of SRI is fully realized when all the five important practices are adopted together. According to Dr. Norman Uphoff, Professor Cornell University, USA and leading campaigner of SRI, this transformative and innovative technology was borne out of personal experience of Fr. Henry de Laulanié while living and working in Madagascar, and not as a development of scientific research. The method has spread to more than 50 countries and is replete with many success stories. At the same time, scientific research has clarified the agronomic and microbiological mechanisms responsible for the observed crop responses under SRI.

Outline of SRI practice

The System of Rice Intensification (SRI), developed in Madagascar in 1980s basically refers to a particular set of practices which improve plant vigour, robustness, and yield. It is an innovation in rice production systems that raise the productivity of the land, labour, water and capital invested in cultivation. It can produce more paddy output with less external inputs. Furthermore, SRI is environment-friendly and can be adapted to any type of rice variety (local variety, HYV, hybrid variety), also to rain-fed upland rice Cultivation. SRI is an innovation based on knowledge, rather than on purchased external inputs and materials.

SRI is a concept encompassing the following practices.

- Transplant young seedlings, 8-12 days old (at the 2-3 leaf stage), to preserve their potential for tillering and rooting ability.
- Transplant at wider spacing, usually best at 25 cm x 25 cm in square planting. Transplant single seedlings in each hill taking care to minimize trauma for roots.
- Less use of chemicals (fertilizer, pesticide, insecticide, herbicide), and preference for use of organic manures, vermi-compost and FYM.
- Less water use by applying wet-dry cycles of irrigation to sustain soil moisture but without continuous flooding.
- Use of cono-weeder to aerate the soil as well as control weeds.

Lately, the SRI concept is being applied to other crops as well, viz. wheat, sugarcane, millet. It is continuously evolving in terms of its application of the concept to other crops.

The Principles of SRI

SRI, which is a relatively new methodology, involves a set of practices for plant, soil, water and nutrient management. It is a counter-intuitive technology in the sense that it tries to change traditional practices especially with respect to water management that have existed for thousands of years. The greatest potential of SRI is seen when the important practices are adopted together.

The SRI principles that underlie SRI practices are more important than the practices themselves.

Rice is not an aquatic plant. Although rice can survive when growing under flooded (hypoxic) conditions, it does not really thrive in such a soil environment.

- Under continuous submergence, most of the rice plant's roots remain in the top 10-20 cm of soil, and most have degenerated by the start of the plant's reproductive phase. SRI roots can go down into the soil 40-50 cm.
- Rice seedlings lose much of their growth potential when transplanted beyond about 15 days of age. This potential is preserved by early transplanting in conjunction with other SRI practices.
- It is important to avoid trauma to seedlings, and especially to their roots, during transplanting. Stresses such as from the seedlings' roots drying out will delay the resumption of plant growth after transplanting and reduce total tillering and root development.
- Wider spacing of plants leads to greater root growth and accompanying tillering, provided that other favorable conditions for growth such as soil aeration are provided. With intact root systems, there is a positive correlation between tillering and grain filling.
- Soil aeration and organic matter create beneficial conditions for plant root growth and for consequent plant vigour and health. This results from having greater abundance and diversity of microbial life in the soil, helping plants resist pest and disease damage.

Difference from Traditional Practice

Parameter	System of Rice Intensification	Traditional Rice Cultivation
Age of Seedlings	Young seedlings are transplanted at 8-12 days old. Seedlings are carefully lifted from the nursery and transported to fields in baskets or on trays for immediate transplanting. Seeding rate: 5-7 kg/hectare	Older seedlings are transplanted at 21-45 days of age. Soil is shaken from roots; and seedlings are bundled and transported to fields. Bundles are often left in the open for days. Seeding rate: 50-75 kg/hectare
Number of seedlings	1-2 seedlings per hill are transplanted with shallow depth (1-2 cm) into soils that are not flooded. Roots are carefully positioned just under the soil surface to avoid trauma to the roots, thereby avoiding "transplant shock."	3-4 seedlings (even 6-8) are clumped and pressed deep into flooded soils, resulting in closely competing seedlings with inverted root tips and anaerobic soil conditions.
Spacing of plants	Wider spacing, with hills 20-30 cm apart, set out in a square or matrix pattern to facilitate moving through the field with a weeder, and to expose plants fully to the sunlight.	Close spacing with hills 10-15 cm apart, either in rows or more typically with random spacing.
Water management	Non-flooded aerobic soil conditions with intermittent irrigation. Where possible, controlled inflow of water, or alternate wetting and drying during the growth period; just 1-2 cm of water on fields after the plants flower.	Continuous flooding of paddy fields with 5-15 cm of water throughout the growing cycle.
Soil fertilisation	Organic matter is preferred to the extent feasible but may be complemented with synthetic fertilisers to meet deficiencies. Combinations can be used to ensure appropriate soil: plant nutrient balance.	Inorganic synthetic fertiliser is applied, largely replacing the application of organic matter, which enhances soil structure and functioning.
Weed and pest control	Cono-weeder puts weeds back into the soil to enrich organic content and aerate the topsoil at the same time. Integrated Pest Management (IPM) practices are encouraged. SRI plants are generally more resistant to pests and diseases and therefore they require less chemical protection.	Weeding is done by manual weeding or by herbicide applications; Cono-weeders cannot be used in randomly planted fields. IPM is sometimes practiced, but pesticides are usually applied preemptively or as needed.

EVOLUTION OF SRI

SRI's origin dates back to the early 1980s, after Fr. Henri de Laulanié, a French Jesuit priest and agronomist living in Madagascar, experimented over many years with various components of the rice system, including reduced irrigation water application, planting single and young seedlings with wider spacing, among others. Laulanié created a local non-profit organization called Tefy Saina, dedicated to aiding rural Malagasy communities, which collaborated in the mid 1990's, with a project of Cornell University's International Institute for Food, Agriculture and Development (CIIFAD).

After learning about SRI, Cornell's project evaluated SRI's efficacy, and after three years of trials became convinced of its utility. Since 1997, a small group at Cornell began sharing experimental and farmer-based results internationally. A large international network of SRI practitioners and researchers has developed since then, adapting SRI methods to a variety of rice-growing systems around the world. In 2010, the SRI International Network and Resources Center (SRI-Rice) was established at Cornell University to improve the advancement and sharing of scientific and practical knowledge about SRI, and to support global networking of SRI practitioners and researchers.

The evidence of the benefits of SRI practices has been seen in dozens of countries, with increased production from both improved and local rice varieties. As of January 2017, SRI has been validated in almost 60 countries in Africa, Asia, the Middle East, Central and South America, and the Caribbean, with an estimated 10-20 million farmers applying and benefiting from the SRI methodology. While SRI has been largely a civil society innovation, embraced by hundreds of national and local-level NGOs as well as many international NGOs and institutions, the governments of Cambodia, China, India, Indonesia, and Vietnam—where over two-thirds of the world's rice is produced—have given explicit endorsement of SRI methods in their national food security programmes.

SRI in India

At 44.6 million ha, India has the largest area under rice cultivation in the world and ranks second in production next to China. Rice is the staple food, and its demand is ever-increasing in India. Rice is grown in 564 districts spread across states and Union Territories of the country. In India, about 1.7 million farmers are estimated to have adopted the technique on more than 1 million hectares across 300 districts so far. Bihar, Tamil Nadu and Tripura are the leading states for adoption of SRI, but many others are following suit. Today, SRI is known to all rice-growing states in India. SRI is also being adapted to rainfed conditions.

With World Bank assistance, farmers in Tamil Nadu have already applied SRI methods to over 600,000 hectares of rice land, with average water savings of 40%. Although developed for transplanted irrigated rice production, SRI concepts and methods are being extended to direct-seeded and to rain-fed (unirrigated) rice cropping systems, and increasingly to other crops. With World Bank support, the Jeevika program in Bihar state has brought SRI methods for improving rice and other crops to over 500,000 households. The National Bank for Agriculture and Rural Development (NABARD) has promoted SRI in 13 prominent rice-growing states in India through grant support to farmers towards cost of markers, weeder and organic inputs under 175 projects, resulting in coverage of 142,000 farmers, adopting SRI in 36,935 ha across project states. The Tata Trusts have extended SRI opportunities to over 200,000 households in seven states.

Once policymakers and donor organisations are made more aware of the full potential of SRI methods, necessary policy and institutional changes to support appropriate SRI research, extension and production initiatives can be accelerated. Present funding levels are negligible compared with public and private sector investments devoted to genetic improvement and external chemical inputs. Moreover, many of these programme necessarily take many years to move innovations from laboratories to farmers' fields.

BENEFITS & IMPACTS

SRI methods have the following benefits and impacts, in general, compared to conventional methods of paddy cultivation:

- *Positive yield attributes*: 60-80% higher grain yield and 50-75% straw yield
- *Low water requirement of paddy:* Reduction in water requirement by 25-50%
- *Reduces pressure on land:* Higher productivity (40-80%)
- *Low seed requirement:* Only 5-8 kg/ha seed required, compared to 80 kg in traditional system
- *Low inorganic fertiliser use:* Dependence on green manure reduces use of inorganic fertilisers
- *Low pesticide use:* Owing to low plant density, more penetration of sunlight and aeration of the field results in low incidences of disease and pests
- *Greenhouse gas emission:* Methane gas emission is less because of lack of standing water on the field
- *Improved grain quality:* More grain & less chaff, so higher milling out-turn from paddy
- *Grain ripening is quicker:* Grain ripening is 7-10 days sooner
- *Improved food security:* Higher productivity from small holdings
- *Low labour requirement:* In long run, labour requirements are reduced
- *Reduced production costs:* With increased output and reduced costs (10-20%), farmers' net income is likely to increase
- *Better drought coping:* Owing to low seed rate, staggered nursery is feasible in the event of unfavourable monsoon; deeper root systems give crop more resilience

The various benefits accruing out of SRI can be grouped into three broad categories, i.e. Benefits for Rural Households, Benefits for Countries, and Benefits for the Planet.

Nature of Benefits	Impact	Outcome
Benefits for Rural Households	• More rice production from same area of land • Higher incomes/ lower costs • Less use of water • Reduced dependency on purchased inputs • Enhanced natural resource base and genetic diversity • Reduced risk and vulnerability	Improved farm family well-being
Benefits for Countries	• Improved food security for the nation • Improved rural livelihoods • Water freed up from rice sector for other crops, people, natural systems • Budget savings on food imports, energy, new water project and fertilizer subsidies • Improved soil and water quality • Less vulnerability from genetic uniformity • More resilient, productive rural communities	Improved public well-being
Potential Benefits for the Planet	• Less pressure to convert remaining forest land to agriculture • Reductions in global poverty • Enhanced ecosystem services involved in regulating water, soil, climate • Reductions in Greenhouse Gases • Reduced environmental degradation • Less loss of plant and animal biodiversity from soil and water pollution • Reduced flashpoints for conflict over food, water, land	

PACKAGE OF PRACTICES

Bed Preparation

The bed should be 4 feet wide. The length can vary depending on the need and space available. Two kgs seed would be needed for transplanting one acre. For raising these seedlings, a nursery bed of 400 sq. ft. would be required. Depending upon convenience, a single bed or several smaller beds (say, 4 beds of 4 x 25 feet) can be prepared. As the roots of 10-12 day old seedlings can grow up to 30 inches, it is necessary to prepare raised beds of 5-6 inches in height.

- 1st layer: 1 inch of well-decomposed FYM
- 2nd layer: 1½ inch of soil
- 3rd layer: 1 inch of well-decomposed FYM
- 4th layer: 2½ inches of soil

All these layers should be thoroughly mixed. Make a channel around the nursery bed for drainage. To prevent the wet soil from sliding down, the bed should be made secure on all sides with wooden planks, bamboos or any other suitable material.

Seed Sorting and Selection

In SRI, only two kilogram seeds are required for planting in one-acre field. In order to separate out the healthy seeds from less robust ones, seed selection is done using a 20 percent brine solution. The seed is immersed in this brine. The healthiest seeds settle down and the lighter ones float on the surface of the water, so they can be removed. The seeds which settle down are collected for further treatment.

Seed Treatment

The healthier seeds are taken out from the solution and are washed with water three times so that the salt acquired from the brine solution is flushed off the surface of the seeds. Then the seeds are spread on a jute sack. A fungicide power (containing 50% Carbendazim) is sprinkled on the seeds, at a rate of two grams per kg of seed, and then is mixed thoroughly so that a white coat is formed on the surface of the seeds. These seeds mixed with Bavistin are covered with another jute sack and kept for 24-36 hours under shade for sprouting. These sprouted seeds are spread thinly so that individual seedlings can be separated from the others at the time of transplantation.

Seed Germination

Soak the paddy seed for 12 hours. Transfer the soaked seed into a gunny bag or make a heap and cover it with gunny cloth. Leave it for 24 hours. In this time, the seed germinates. You can observe the white root or radicle emerging from the seed. This seed is used for sowing on the nursery bed. If sowing is delayed, the roots will grow and get matted together, making it difficult to sow the seeds with wider spacing.

Seed Broadcasting

To ensure uniform broadcasting, make the seed into 4 equal parts. Broadcast each part separately one after the other on a quarter of the nursery bed. Two seeds should be separated by a distance of about one seed length. It is better to broadcast the seeds in the evenings for less rapid evaporation of moisture.

Covering the Seed:

Cover the seed with a thin layer of well-decomposed FYM or dry soil. Even paddy straw can be used for this purpose. It also protects seeds from being eaten away by birds and ants. When straw is used as a layer, it should be removed after the appearance of the shoot.

Watering the Beds

Depending upon the need, the bed should be watered daily in the morning and evening. The water should be gently sprinkled over the bed. One can use a garden rose can for this purpose. When pots are used for watering, use one hand to break the force of the water. The nursery can be watered also by letting water into the canal surrounding the nursery bed.

Nursery Raising by 'Mat' Method

The nursery is raised on polythene sheets or empty fertiliser bags. A metal or wooden frame with four compartments is used. The dimensions of the frame are 1 x 0.5 metres, each compartment measure 0.125 sq. metres. Nursery bed of 4 cm thickness is prepared using well-decomposed FYM and soil. Broadcast seeds on the bed and cover it with mud. After watering the nursery bed, the frame can be removed and reused. For the first 5 days, the beds are watered using rose can 2-3 times, every day, depending on the need. Later, the nursery can be watered by letting in water into the canal around the nursery bed.

Preparation of Main Field

Preparation of the main field is the same as in conventional method. If the field is dry-ploughed, puddling by tractor can be avoided. In black soils, the field should be ploughed and made ready during summer. The field should be watered and transplanted. This way it would be easy to operate the weeder later. When puddling by tractor is not done, the weeder will not get stuck, and less energy will be required to run the weeder. The field should be level, and there should be no standing water while transplanting.

Use of Marker

Transplanting, following spacing of 10x10 inches between plants and rows can be done in many ways:

i. Using a rope and tying a knot or a stick marked at every 10 inches. Using this rope as a guide, transplant one row after the other.

ii. There are markers made out of wood as well as iron. There are bar markers which have to be drawn in perpendicular directions to form a grid, and

iii. Roller markers which form a grid at one go. The paddy seedling has to be transplanted where the vertical and horizontal lines meet. The roller marker can give 8 grids at a time. For the rows to be straight it is ideal that a rope be tied along the length of the field and the marker is drawn along the rope. After pulling the marker once, i.e. for every 2 metres, it is ideal to leave a 12-13 inch path. Tie a rope as a guide and draw the marker again along the rope.

Transplanting from Nursery

Young, 10-12 day seedlings are transplanted in SRI method. Adequate care should be taken to transplant the seedling without experiencing any 'shock'. The nursery is uprooted in chunks and transported to the main field. The seedlings are transplanted along with the soil. The seedling is taken along with the soil. The seedlings should not be damaged either during the uprooting or transplanting in the main field. Family members are often more skilful and careful in transplantation.

Method of Transplanting

In the conventional method, seedlings are transplanted by putting them into the soil using the middle and the pointing fingers. With this method, the root takes a 'U' turn, so that the root tips are pointing upwards. Thus the root tip takes time to turn downward again and get established in the soil. In SRI method, the seedlings are transplanted shallow, about 1 inch deep, with the roots forming an 'L' shape. Start at 1 inch above the intersection of the horizontal and vertical lines and gently pull down using the pointing finger. The seedling is taken along with the soil using the thumb and pointing finger. As a result, the seedling can resume its downward growth quickly and grows healthy. The field should be lightly irrigated either on the same day or the day after transplantation. Initially, SRI method requires 10-15 persons to transplant one acre. Once the farmers gain experience, it can be completed with fewer persons.

Wide Spacing

Wide spacing is important in SRI method. Usually the row-to-row distance and within a row, plant-to-plant distance should be 10 x 10 inches (25 x 25 cms). With this spacing there would be 16 plants per sq. metre with SRI method. If there is any doubt regarding the survival of plants, two plants can be transplanted per hill. In the conventional method, 33-40 hills are transplanted per sq. metre with 4-5 plants per hill. If soil is fertile, wider spacing can be better.

Weed Management

As there is no standing water in SRI method, weeds would be more. Instead of weeding manually and throwing the weeds outside the plot, there are several advantages from turning the weeds into the soil by using an implement (weeder). Weeds are useful for the soil as organic manure. Use the weeder between the 10th and 20th day after transplantation, the earlier the better. The weeding problem is addressed to a large extent with this effort. If the weeder is used again on 20th, 30th and/or 40th days after transplantation, there will be more aeration to the plant roots, resulting in their healthy growth. As the plant is strong and healthy, the number of tillers would be more. Weeder should be moved front and back between every two rows. Start using the weeder, when the weeds are small, i.e., on the 10th day after transplantation. If the crop is tender or weeds are less, weeding can be done manually. By using the weeder, the first advantage is the control of weeds and also adding organic matter to the soil. Further, the soil gets aerated and the roots are more exposed to air. This results in profuse growth of diverse soil microorganisms which make more nutrients available to the plant.

Water Management

In the SRI method, irrigation water is provided so as to only wet the soil, not inundate it. The field should be irrigated again when the soil develops hairline cracks. Depending upon the soil and the environment conditions, the frequency of irrigation should be decided. For instance, with heavy clay soils, the soil should not be allowed to dry out as they become very hard. When the soil is not flooded, the roots of the paddy plant grow healthily and deep in all directions. Root growth is extensive also due to the wide spacing. As the field is intermittently irrigated and dried, the microorganisms will make nutrients available to the plant. A day before using the weeder, the field should be lightly irrigated. After the weeding, under no circumstances should the water be drained out of the field. If this water is drained, nutrients will be lost from the field. After the panicle initiation stage until maturity, about one inch of water should be maintained in the field. The water can be removed after 70% of the grains get hardened, or 10 days before harvest. If the plot is uneven, water will stagnate at low points and the field will dry up at high points. If irrigation water is to be used efficiently, then the plots should be small and levelled. Instead of letting in the water until it reaches the end of the field, it may be stopped (depending upon the local conditions) after ¾ of the field is irrigated. The water automatically spreads to the entire field. If any excess water is to be drained out of the field, it may be used to raise vegetables in a small plot at the end of the field.

Pest & Disease Management

Wider spacing and use of organic manures for SRI results in healthy growth of the plants and incidence of the pests and diseases is naturally low. According to research in 2005-06 in Vietnam, occurrence of four major disease/pests (sheath blight, leaf blight, small leaf folder, brown plant hopper) for SRI paddy compared with conventional cultivation paddy was 45% in the spring season cropping and 29% in the summer season cropping. Though SRI paddy has more resistance against disease/pests compared with the conventional type of paddy cultivation, there is no difference in the type of disease/pests which may likely affect the crop. When disease/pests occur, it is recommended to take immediate action to eliminate them based on advice of local extension officer and, if necessary, information from "Rice Knowledge Bank of IRRI" <http://www.knowledgebank.irri.org/rice.htm>.

The uniqueness of organic SRI lies in not using the chemical pesticides. The pests can be managed by using some organic concoctions (MOL: microorganism local) either as a preventive measure or as and when needed. Each country has some ideas to prepare MOL. "Amrit Jalam" developed in India is one of such MOL.

"Amrit Jalam"

Required materials:

- Cow urine - (1) litre
- Cow dung - (1) kilogram
- Jaggery (coconut tree sap) - 250 gm
- Water (chlorine free) - 10 litre

Preparation and Use:

Mix all the above materials in a plastic container or an earthen pot. Let them ferment for 24 hours. Dilute this with water in the ratio of 1:10. Filter the solution using a fine cloth. This can be used for spraying. Amrit Jalam can be stored for a period of 30 days.

However it has to be stirred daily. When urea is used, the plants grow succulently and or easily susceptible to pests and diseases. When Amrit Jalam is sprayed, it not only gives nitrogen to the plants but also repels harmful insects and micro-organisms.

Soil Fertility Management

The organic matter is food for soil microorganisms. When the soil is alive with microorganisms then the nutrients needed for the plant would be readily available. When soil is rich with microorganisms then the plant grows healthily, develops resistance to pests and diseases and yields higher. Thus methods of improving the soil fertility should be taken up. Application of farm yard manure/compost (10-20 ton/ha) and/or green manure is recommended. Quality of compost should be checked carefully.

Harvesting

Harvesting is the process of collecting the mature rice crop from the field. Paddy harvesting activity includes cutting, stacking, handling, threshing, cleaning, and hauling. It is important to apply good harvesting methods to be able to (1) maximize grain yield, and (2) minimize grain damage and quality deterioration.

Harvesting can be done manually using sickles and knives, or mechanically with the use of threshers or combine harvesters. Regardless of the method, good grain quality should be preserved during harvest operations, and harvest losses are kept to minimum.

Key actions for proper harvesting are:

- To harvest at right time with the right moisture content;
- To avoid delays in threshing after harvesting;
- To use proper machine settings when using a threshing machine;
- To clean the grains properly after threshing; and,
- To dry the grains immediately after threshing

LESSONS FROM SRI

The System of Rice Intensification (SRI) was identified as an intervention in the three coastal talukas of Sindhudurg district of Maharashtra under the UNDP-GEF Project on "Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in Sindhudurg District, Maharashtra State", considering the sustainable dimensions of the production system; its reduced dependence on inorganic fertilizers and pesticides resulting in lesser eutrophication and pollution of coastal ecosystem; its drought-coping mechanism and adaptability to withstand vagaries of climate change; as well as its ability to mitigate GHG emission on account of reduced emission of methane compared to traditional paddy cultivation practices. Its attributes related to reduced pressure on land, water and power as well as its improved yield characteristics and better return to farmers are other features which have led the project authorities to consider supporting a pilot project to demonstrate its benefits to the farmers in the three coastal talukas of Sindhudurg (viz. Vengurla, Malvan & Devgad). The pilot project was implemented by a CSO, i.e., Mayem Panlot Sangh (MPS), Mayem, Sindhudurg.

In all, 268 farmers were introduced to SRI technique over three farming seasons during 2014-2015, covering 85 acres. More than 2500 farmers were exposed to the farming technique under the pilot project. The potential beneficiaries were selected through conduct of village-level meetings, group discussions, and field visits to demonstrations units. The pilot project covered 23 farmers during Kharif 2014, another 245 farmers during Rabi 2014-15. The paddy farming in the district comprises of traditional system of paddy cultivation and the '*Charsutri*' (improved package of practice) advocated by the Konkan Krishi Vidyapith, Dapoli. The broad agronomic practices of both the systems, along with SRI have been captured in the table below.

Three different agronomic practices of paddy cultivation

Particulars	Traditional	Charsutri' presently advocated	SRI	% increase / decrease SRI over Traditional	% increase / decrease SRI over Charsutri
Seed Rate (kg/ha)	80	15-20	8	9	10
Age of seedling	25-30	25-Oct	15-Sep	16-Sep	17-Sep
Nursery Area M2 /Ha	1000	250	100	-900	-150
Spacing (cm)	Random	25 x 15	25 x 25	26 x 25	27 x 25
No. of seedling per hill	4-Mar	2-Jan	1	2	3
Plant population (lakh plant/ha)	12	2.66	1.6	-650	-66.25
Average grain yield (q/ha)	35	45	65	85.7	44.4
Cultivation Cost (Rs/ Ha)	22392	28000	20018	-11.9	-39.9
Income (Rs/ Ha) @ Rs. 9/kg	27070	40500	45118	66.7	11.4
Profit (Rs/Ha)	4678	12500	25100	436.6	100.8

Scaling-Up of SRI in All Eight Talukas of Sindhudurg

The results of the pilot project on SRI in the three talukas viz. Malvan, Vengurla and Devgad during 2014-15, had prompted the District authorities to consider scaling-up the activity in all eight talukas of Sindhudurg and accordingly, in consultation with District Agriculture office, a programme was drawn up to cover 1000 acre of paddy area under SRI in the District. In order to reach out to all the eight talukas in a short span of time and carry out demonstration as well as selection of farmers and their capacity building, a NGO viz. DILASA Janavikas Pratisthan from Aurangabad, was engaged. The agency with active support from the District Agriculture office and Agricultural Technology Management Agency (ATMA), could implement the programme in 526 acres of paddy area, involving 1035 beneficiaries, during Kharif 2016. Although the programme involved 1,035 beneficiaries covering 526 acres, the harvest data could be recorded from 70 SRI plots covering 43.9 acres and 68 control plots covering 18.6 acres, following traditional practices of paddy cultivation (refer table below). The agency will be covering the remaining programme during Rabi 2016-17.

Taluka (Sub-division)	SRI / Control plot	No. of Plots sampled	Crop Area (Guntha)	Crop Area (in Acre)	No. of Tillers/ Hill#	No. of Grains / Panicle	Weight of 100 grain (gm)	Grain Yield (gm / M^2)	Straw Yield (Kg/ M^2)	Increase in No. of tillers / hill (%)	Increase in No. of grains/ Panicle (%)	Increase in Grain yield (%)	Increase in Straw yield (%)
Malvan	SRI	10	380	9.5	31.9	192.8	3.1	777.4	2.4	102.2	26.7	28.5	17.0
Malvan	Control	10	69	1.725	15.8	152.2	1.9	605	2.0				
Devgad	SRI	10	198	4.95	20.7	249.8	3.15	887.5	1.975	168.8	55.1	57.69	22.3
Devgad	Control	10	161	4.025	7.7	161.1	2.35	562.8	1.615				
Vengurla	SRI	10	370	9.25	27.7	177.9	3.03	651.4	2.72	57.8	18.4	3.09	9.6
Vengurla	Control	9	95	2.375	17.6	150.2	2.72	631.9	2.48				
Kudal	SRI	10	150	3.75	31.1	188.3	2.9	608.6	1.68	104.3	16.2	19.10	16.5
Kudal	Control	9	52	1.3	15.2	162	2.17	511	1.44				
Sawantwadi	SRI	8	310	7.75	30.63	225	2.76	633.75	1.53	89.9	15.3	23.15	18.9
Sawantwadi	Control	8	115	2.875	16.13	195.1	2.21	514.63	1.29				
Kankavli	SRI	10	110	2.75	29.2	180.6	2.49	622.30	1.34	60.4	13.4	-2	24.3
Kankavli	Control	10	60	1.5	18.2	159.2	2.13	635.00	1.08				
Dodamarg	SRI	6	97	2.425	22	325.17	2.50	714.33	1.24	175.0	75.9	48.05	7.3
Dodamarg	Control	6	97	2.425	8	184.83	1.50	482.50	1.16				
Vaibhavwadi	SRI	6	141	3.525	29.33	172.33	2.93	616.67	1.50	72.5	16.0	10.71	29.8
Vaibhavwadi	Control	6	95	2.375	17	148.5	2.20	557.00	1.16				
G. Total	**SRI**	**70**	**1756**	**43.9**	**27.8**	**214.0**	**2.9**	**689.0**	**1.8**	**92.6**	**30.4**	**23.54**	**17.3**
G. Total	**Control**	**68**	**744**	**18.6**	**14.4**	**164.2**	**2.2**	**562.5**	**1.5**				

The results indicate a 92.6 % increase in tillering, a 30% increase in grains/panicle, a 23.5% increase in grain yield, and 17.3% increase in straw yield over that when following traditional practices.

Way Forward

Experiences from studies on SRI in China and Sri Lanka during the last decade have conclusively demonstrated that unflooded soil is better for rice plant to grow well and yield more than under conventional method of continuous shallow submergence. SRI which is relatively a new methodology involves a set of practices that integrate management of plant, soil, water and nutrients. The potential of SRI is fully realized when all the five important practices are adopted together. SRI is relevant under the GoI-UNDP-GEF Sindhudurg Project in the context of reduction in eutrophication of coastal waters and pollution due to low level of use of chemical fertilizers and pesticides. Following SRI, emission of greenhouse gas (methane) is 60% less and that of water use is 40% less compared to traditional practices. In traditional method, the CH_4 emission is higher, i.e. 0.050 tons per ha, while in SRI method it is reduced by up to 0.033 tons per ha. The system is drought-resilient and offers adaptation to erratic and delayed monsoon due to low seed rate, which is 10% of seed used for paddy following conventional practices. Owing to low seed requirement, the farmer can go for a second or even a third nursery in the event of delayed monsoon with progressively shorter-duration varieties.

Rice being a staple food of Konkan region and the principal field crop, which is likely to be impacted by any sea level rise or global climate change, the System of Rice Intensification (SRI) will be an important agricultural intervention for the Konkan region in particular and other rice-growing areas of Maharashtra in general, towards climate-proofed agriculture while reducing the coast of cultivation as well as improving the productivity of rice. Thus there exists a good potential for introduction of the new technique of SRI in Maharashtra in dealing with food security, reducing pressure on land & water resources as well as adaptation to climate change and its mitigation.

SRI & CLIMATE CHANGE

The vulnerability of rice cultivation to Climate Change is a matter of utmost concern to the Indian farmers, policy makers, planners, financial institutions, meteorological departments and all agencies connected with agricultural research and development. The delay in arrival of monsoon, shortfall in rain, excess of rainfall, drought, flood and cyclone are various climate related factors which dictate the agricultural scenario of the country and the economy of the country revolves round this single annual event i.e. monsoon.

Changes in climate will affect rice production and thus have an impact on food security. It has been estimated (IWMI 2007) that for every 1ºC rise in mean temperature, there is a corresponding 7% decline in rice yield. The International Food Policy Research Institute calculates a 12-14% decline in world rice production by 2050 due to the effects of climate change.

Beyond increasing yields, SRI offers major benefits that have significant climate implications in terms of adaptation to climate change as well as mitigation of climate change. The benefits on both these accounts may be as follows.

Adaptation to Climate Change

1. Improved drought resistance:

- SRI plants thrive with 30-50% less irrigation water per land area, due to deeper, larger, less senescing root systems
- Reduced competition among plants creates stronger plants above and below ground
- Organic matter-enriched soils able to store more water and furnish nutrients

2. Higher pest and disease resistance:

- Stronger and healthier plants
- Less humidity in the plant canopy

3. Greater resistance toward rain and wind damage from storms:

- Thicker tillers, deeper roots, wider spacing
- Increased uptake of silicon into leaves and tillers from soil that has aerobic conditions

Reduced lodging – 10% lodging vs. 55% under conventional cultivation methods

Mitigation

Expansion of carbon sinks:

- SRI rice plants sequester more carbon – higher grain and straw yield, and more root biomass
- Increased soil organic matter through SRI practices that improve the soil with more organic matter application and increased root exudates
- Associated agro-ecological practices sequester carbon, such as green manure production, integration with agroforestry, surface mulch applications, etc.
- Reduced carbon footprint due to less use of agrochemicals (including the manufacturing, and shipping of fertilizer)

Reduced greenhouse gas (GHG) emissions from paddy soils

- Methane (CH_4) is reduced by between 22% and 64%, as soils are maintained under mostly aerobic conditions
- Nitrous oxide (N_2O) is only slightly increased or sometimes reduced as use of N fertilizers is reduced; N_20 increases do not offset CH_4 reductions, so global warming potential (GWP) is reduced
- Total GWP from flooded rice paddies is reduced by 20-30% or even higher.

SRI Reduces Emission of Methane	SRI Can Reduce Nitrogen Fertilizer Use
Of the three main greenhouse gases—carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)—most attention has so far focused on CO_2 emissions because the volumes involved are the largest. However, molecule for molecule, methane has 23-25 times more and nitrous oxide 310 times more impact on warming of the atmosphere than CO_2. Methane released from agricultural activities largely comes from inundated rice fields and ruminant animals, which together produce almost half of human-induced methane. Methane is produced by anaerobic microbes in soils that are deprived of oxygen by continuous flooding. Making paddy soils intermittently and mostly aerobic substantially reduces methane emissions. One study by the China Academy of Sciences calculated that methane emissions would be reduced by almost one-third annually if all of the continuously flooded rice fields were drained at least once during the growing season and rice straw was returned to the soil in the off season.	Modern agriculture depends on manufactured synthetic fertilizers to sustain crop yields, especially inorganic nitrogen (N) fertilizers. The use of N fertilizers has increased almost 20-fold over the last 50 years (Glass 2003), becoming a major contributor of N_2O emissions and also to nitric acid, which causes acid rain. About half of all N fertilizer is used in maize, rice, and wheat production, with about 16% applied to rice. Only 30-50% of N fertilizer applied to crops is actually taken up by them, and when applied under flooded conditions, losses into the environment can be as high as 60%. High levels of nitrogen pollute drinking water sources with nitrate accumulations and can harm fish and marine ecosystems. If current trends continue, it would result in a doubling of nitrogen released into the atmosphere. By applying organic matter to improve soil texture and the soil biota, and by improving nutrient use efficiency farmers are able to reduce their N fertilizer use and costs with SRI methods. Whether SRI practices are either fully organic or combine organic and inorganic N sources, both result in reduced overall GHG emissions associated with overuse, manufacturing and long distance transport of chemical fertilizers.

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CASE STUDY

Dilasa Janvikas Pratisthan has documented the various benefits of SRI on the environment by conducting a survey of famers who have adopted the SRI method of rice cultivation in Sindhudurg. The following results were found:

Revival of Native Species

The study revealed that farmers have started cultivating native varieties in a comparatively large scale under the SRI method. From the survey conducted among farmers who are growing native varieties under SRI, it was found that the availability of seeds is one of the main constraints for its cultivation. It was also found that native varieties cultivated using the traditional method of paddy cultivation gives significantly lesser yield than hybrid varieties, which was the main reason for farmers preferring hybrid varieties of rice over the native varieties. However, as the SRI method requires lesser seed input than the traditional method while also providing a higher yield, the two main constraints for cultivation of native species were addressed in SRI.

The study revealed that farmers are cultivating local varieties like Sonfala, Dodik, Walay, Sorti, Bela, Patni, Yelkar etc under the SRI method of cultivation. It was observed that more than 50 acres of land has been cultivated using these varieties in the SRI method of cultivation, which is a very positive sign for revival of the native varieties. In one case, a farmer who cultivated Sonfala using both SRI and traditional method for comparative purposes, got a yield of 50 Kg/ guntha under SRI, but only 29 Kg/guntha under non-SRI.

Overall Impact on Biodiversity

The reduction in use of chemical fertilizers is one of the main benefits of SRI method of cultivation. From the study, it was found that there is an overall reduction of 58.37% in the use of chemical fertilizers. Under the SRI method of cultivation a reduction of 237 Kg of chemical fertilizers per ha was observed. So by promoting SRI method even in half of the total rice area (the area under rice cultivation in Sindhudurg district is 74,157 ha) it is possible to reduce the chemical fertilizers to the tune of 8.7 million Kg per season! Considering the fact that the fertiliser use efficiency is only around 30-35%, especially with fertilisers like urea, a major portion of the fertilisers drain to the rivers and other water bodies, creating a negative impact on the coastal and marine ecosystem. Therefore, the reduction possible by following SRI method of cultivation can have a widespread positive impact on the environment. It was also observed that there has been an increase in the use of organic manure (21.12%). The reduction in the use of fertilisers and increase in the use of organic manure will also help improve the soil health and the microbial activities in the soil.

Water saving and reduction in emission of methane

The water requirement under SRI is almost 50 % less than that of the other method. Therefore, adoption of SRI method saves a large amount of water which can be used for other purposes. The alternate wetting and drying is also known to reduce the amount of methane gas emission from the rice fields. Methane is a greenhouse gas, which has been scientifically proven to be a contributing factor to Global Warming. The reduction in emission of methane is therefore an added benefit towards protecting our environment.

भात उत्पादन वाढीची ‘श्री’ पध्दत

प्रास्ताविक

भात उत्पादनाच्याबाबत भारत हा दुसऱ्या क्रमांकाचा मोठा देश आहे. तथापि, भारताची वाढती लोकसंख्या आणि पौष्टिक अन्नाचा तुटवडा भरून काढण्यासाठी भाताचे उत्पादन वाढण्याची आवश्यकता आहे. गेल्या काही वर्षात मोठ्या प्रमाणात हवामान बदल होत आहे. पाण्याचे दुर्भिक्ष्य, खते, बियाणे आणि कीटकनाशके यांच्या वाढत्या किमती, नापिकी, दुष्काळ यामुळे भातामध्ये उत्पादन वाढ हे एक आव्हानच आहे. या पार्श्वभुमीवर शास्त्रज्ञांनी शोधलेली भात उत्पादनवाढीची **'श्री'** पध्दत ही शाश्वत शेतीसाठी अत्यंत उपयुक्त आहे.

श्री (एसआरआय - सिस्टीम ऑफ राईस इंटेन्सिफिकेशन) म्हणजे रोपे, माती, पाणी, पोषकघटक यांच्या व्यवस्थापनात बदल करून भात उत्पादन वाढ करणारी पध्दत आहे. साधारणपणे १९९० सालापर्यंत आणि अजूनही अशी समजूत आहे की, भरगच्च पाण्यामध्ये भाताचे पीक चांगले येते. परंतु, कोलंबो येथील वॉटर मॅनेजमेंट इंस्टिट्युटने असा निष्कर्ष काढला की, भाताचे उत्पादन वाढण्यासाठी भरगच्च पाण्याची आवश्यकता नाही. चीन, श्रीलंका या देशात झालेल्या संशोधनाने दाखवून दिले की, भरगच्च पाण्याच्या जमिनीपेक्षा पाणी न साचणारी जमीन भात रोपाच्या जोमदार वाढीसाठी अत्यंत उत्कृष्ट आहे. श्री ही नव्याने विकसित झालेली पध्दत असून त्यात काही सूत्रांचा अवलंब करावयाचा आहे. विशेषतः भाताची रोपे, माती, पाणी आणि पोषक घटक यांच्या एकत्रित व्यवस्थापनावर यात भर दिलेला आहे.

मादागास्कर येथील सुप्रसिध्द मृदातज्ञ आणि धर्मोपदेशक हेन्री डे लाऊलानी यांनी १९८० मध्ये प्रचंड संशोधन करून ही पध्दत शोधून काढली. त्यांना आलेल्या प्रत्यक्ष अनुभवातून ही पध्दत विकसित केल्यामुळे अनेक देशात तिचा प्रसार झाला. सध्या ५० पेक्षा जास्त देशात श्री पध्दतीचा प्रसार झाला आहे आणि शेतकऱ्यांचे भाताचे उत्पादन प्रचंड वाढले आहे. आठ ते दहा दशलक्ष शेतकऱ्यांनी या पध्दतीचा फायदा घेतला आहे. एकंदरीत श्री पध्दतीमध्ये शेतकऱ्यांनी पारंपरिक लागवड पध्दतीत बदल करून एक आचरण प्रणालीचा अवलंब करायचा आहे. त्यामुळे रोपाचे आरोग्य तसेच उत्पादन या दोन्हींमध्ये सुधारणा होते.

भारतात भात लागवडीचे क्षेत्र ४४.६ दशलक्ष हेक्टर आहे. चीननंतर भारत हा भात उत्पादनासाठी दुसऱ्या क्रमांकाचा देश आहे. भाताची मागणी दिवसेंदिवस वाढत आहे. भारतात १.७ दशलक्ष शेतकऱ्यांनी १ दशलक्ष हेक्टरवर ही पध्दत राबविली आहे. देशातल्या एकूण ३०० जिल्ह्यांमध्ये हा कार्यक्रम राबविला जातो. तामिळनाडू व त्रिपुरा ही दोन राज्ये त्यात आघाडीवर आहे. जिथे पाऊस फारसा पडत नाही अशा कोरडवाहू क्षेत्रातही भाताची लागवड केली जाते. राष्ट्रीय कृषी विकास बँकेने श्री कार्यक्रमास पाठबळ देऊन १३ राज्यातील १ लाख ४२ हजार शेतकऱ्यांपर्यंत हा कार्यक्रम नेऊन पोहोचवला आहे. ३६,९३५ हेक्टर क्षेत्रावर श्री पध्दतीचे यश दिसून आले आहे.

श्री पध्दतीमुळे शेतकऱ्यांचे उत्पादन तर वाढतेच तसेच रासायनिक खतांची २५ टक्के, पाण्याची ४० टक्के गरज कमी होऊन भाताच्या काडाचे उत्पादन ५०-७० टक्क्यांनी वाढते. श्री पध्दतीमुळे अन्न सुरक्षितता राखण्यास मदत होऊन जनावरांच्या चाऱ्याची गरज परिणामकारकपणे पूर्ण होते. भारतात भाताची लागवड मान्सूनवर अवलंबून आहे. तथापि, गेल्या काही वर्षात लहरी आणि अनियमित पावसामुळे अन्नधान्याच्या एकूणच उत्पन्नावर परिणाम झाला आहे. परंतु, भात उत्पादनवाढीच्या श्री पध्दतीमुळे छोट्या आणि मध्यम शेतकऱ्यांना भात उत्पादनवाढीसाठी उत्तम पर्याय मिळाला आहे.

भात उत्पादनवाढीची 'श्री' पध्दत

भात उत्पादनाची श्री पध्दत ही एक नाविन्यपुर्ण पध्दत असून त्यामध्ये भाताची रोपे, माती, पाणी, पोषकद्रव्ये यांचे योग्य पध्दतीने व्यवस्थापन केले जाते हे आपण मागे पाहिले आहे. यात बियाणे, खते, कीटकनाशके यांचा कमीत-कमी वापर करून यात उत्पादन वाढविले जाते. हे करत असताना पर्यावरणाला धक्का पोहोचत नाही. तसेच भाताच्या कोणत्याही जातीसाठी ही पध्दत आपण वापरू शकतो. या पध्दतीची थोडक्यात वैशिष्ट्ये खालीलप्रमाणे.

१) **कमी दिवसांच्या रोपांची लागवड -** दोन ते तीन पाने असलेली आठ ते बारा दिवसांची रोपे लागवडीसाठी वापरली जातात.

२) **रोपांमधील जास्त अंतर** - २५ x २५ से.मी. आकाराच्या चौकोनात रोपांची लागवड केली जाते.

३) **रसायनांचा कमीत-कमी वापर** - खते, कीटकनाशके, फवारणीची औषधे याऐवजी सेंद्रीय खतांचा वापर. उदा. गांडुळखत, शेणखत इ.

४) **पाण्याचा कमीत-कमी वापर.**

५) **कोनोवीडरचा वापर** - हवा खेळती राहण्यासाठी आणि तण काढण्यासाठी कोनोवीडरचा (हातकोळपे) वापर.

श्री पध्दतीचे फायदे

परंपरागत भात लागवड पध्दतीपेक्षा श्री पध्दतीचे अनेक फायदे आहेत ते खालीलप्रमाणे.

१) **उत्पादनात वाढः** ६० ते ८० टक्के उत्पादनात वाढ होते. तसेच ५० ते ७५ टक्के जास्त प्रमाणात भाताची काडे मिळतात.

२) **पाण्याची बचतः** २५ ते ५० टक्के कमी पाणी लागते त्यामुळे पाण्याची बचत होते.

३) **जमिनीवरील ताण कमी होतोः** ४० ते ८० टक्के उत्पादनक्षमता वाढते.

४) **कमी बियाणेः** हेक्टरी फक्त ८ किलो बियाणे लागते. परंपरागत पध्दतीत ८० किलो बियाणे लागते.

५) **रासायनिक खतांचा कमी वापरः** हिरवळीची खते, कंपोस्ट खते यामुळे रासायनिक खतांच्या वापराचे प्रमाणे कमी होते.

६) **कीटकनाशकांचा कमी वापरः** रोपांची लागवड विरळ असल्याने सुर्यप्रकाश, हवा खेळती राहते त्यामुळे कीड आणि रोगांचे प्रमाण कमी होते.

७) मिथेन गॅसचे प्रमाण कमी होतेः

८) धान्याची गुणवत्ता वाढते.

९) **धान्य लवकर परिपक्व होतेः** ७ ते १० दिवस आधीच धान्य कापणीवर येते.

१०) **अन्नसुरक्षिततेत सुधारणाः** कमी जागेत जास्त उत्पादन घेता येते.

११) कमी मजुरांची आवश्यकता पडते.

१२) **उत्पादन खर्च कमी होतोः** उत्पादन खर्चात १० ते २० टक्के बचत झाल्याने शेतकऱ्याचे उत्पन्न वाढते.

१३) **दुष्काळाला प्रतिकार करण्याची क्षमताः** प्रतिकूल पावसाच्या परिस्थितीतही या पध्दतीमुळे रोपांद्वारे दुष्काळाला प्रतिकार केला जातो.

श्री पध्दत आणि परंपरागत पध्दत यातील फरक

अ.क्र.	मुद्दे	श्री पध्दत	पारंपरिक पध्दत
१	रोपाचे वय	* १० ते १२ दिवसांच्या रोपाची लागवड केली जाते. * रोपवाटीकेतून बास्केटद्वारे रोपे काळजीपूर्वक शेतात आणली जातात आणि लगेच लागवड केली जाते. * हेक्टरी फक्त ५ ते ७ किलो बियाणे लागते.	* २१ ते ४० दिवसांच्या रोपांची लागवड केली जाते. * रोपांच्या जुड्या बांधून शेतात नेल्या जातात. रोपे बराच वेळ उघड्यावर पडून असतात. * हेक्टरी ५० ते ७५ किलो बियाणे लागते.
२	रोपांची संख्या	* १ ते २ रोपे उंचवट्यावर मातीच्या वरच्या थरात लावली जातात. * रोपांना धक्का बसत नाही	* ३ ते ४ रोपे (काही वेळा ६ ते ८) एकत्र करून, दाबून, जमिनीत खोलवर, पाणथळ जागेत लावतात. * रोपे जवळ लावल्याने दाटी होते आणि त्यांच्यात स्पर्धा होऊन मुळे वरच्या दिशेने वाढतात.
३	रोपातील अंतर	* रोपांची लागवड २० ते ३० से.मी. अंतरावर चौरसात केली जाते. * कोनोवीडर चालवायला पुरेशी जागा मिळते. * रोपांना भरपूर सूर्यप्रकाश मिळतो.	* रोपांची लागवड १० ते १५ से.मी. अंतरावर किंवा रांगेत किंवा कमी-जास्त अंतरावर केली जाते.
४	पाणी व्यवस्थापन	* पाणी अधून-मधून दिले जाते. * शक्य असल्यास पाणी कमी दिले जाते. पाणी देणे, सुकवणे याप्रकारे आलटून-पालटून पाणी दिले जाते.	* पूर्ण वाढ होईपर्यंत शेतात सतत १० ते १५ से.मी. पाणी साचलेले आवश्यक असते.

		* पीक वाढीच्या काळात १ ते २ से.मी. पाणी जमिनीवर असणे आवश्यक असते.	
५	जमिनीची सुपिकता	* सेंद्रीय खतांचा जास्त वापर * आवश्यकतेनुसार योग्य प्रमाणात रासायनिक खतांची जोड देऊन पोषक घटकांचा समतोल साधला जातो. त्यामुळे जमिनीची सुपीकता टिकून राहते.	* रासायनिक खतांचा जास्त वापरामुळे जमिनीचे आरोग्य बिघडते.
६	तण आणि कीड नियंत्रण	* कोनोवीडरचा वापर करून काढलेले तण परत मातीत गाडले जाते. त्यामुळे जमिनीच्या सुपीकतेत तसेच भुसभुशीतपणात वाढ होते. * एकात्मिक कीड नियंत्रणाचा अवलंब केला जातो. * श्री पध्दतीत रोपांमध्ये कीड आणि रोगप्रतिकारशक्ती जास्त असल्याने रासायनिक औषधांची कमी गरज पडते.	* तण हाताने काढले जाते किंवा तण नाशकाचा वापर केला जातो. * कमी-जास्त अंतरावर लावलेल्या रोपांमध्ये कोनोवीडर चालत नाही. * एकात्मिक कीड नियंत्रणाचा क्वचितच अवलंब केला जातो. * कीटकनाशकांचा वेळेच्या आधीच किंवा आवश्यकतेनुसार उपयोग केला जातो.

श्री पध्दतीने भात लागवड

१) वाफा तयार करणे :-

या पध्दतीमध्ये वाफा विशिष्ट पध्दतीने तयार करावा लागतो. तो ४ फूट रुंद असावा, वाफ्याची लांबी ही गरजेनुसार आणि उपलब्ध जागेनुसार असावी. १ एकर जमिनीत लागवड करण्यासाठी २ किलो बियाणांची आवश्यकता असते. या बियाणांची रोपे तयार करण्यासाठी ४०० चौरस फूट जागा गरजेची असते. जागेच्या उपलब्धतेनुसार एकच किंवा जास्त वाफे तयार केले जातात. (उदा. ४ x २५ फूटाचे ४ वाफे) १० - १२ दिवसामध्ये रोपांची मुळे ३० इंच पर्यंत वाढू शकतात त्यामुळे वाफ्याची उंची ५-६ इंच असावी.

१ ला थर - १ इंच पूर्ण कुजलेले शेणखत
२ रा थर - १ १/२ इंच माती
३ रा थर - १ इंच पूर्ण कुजलेले शेणखत
४ था थर - २ १/२ इंच माती

हे सगळे थर नीट एकत्र करावे. त्याच्या बाजूने पाण्याचा निचरा होण्यासाठी एक छोटा चर/नाली काढावी. मधली माती चरामध्ये येऊ नये म्हणून बांबू किंवा लाकडाचा वापर करून ते नीट बांधून ठेवावे.

२) बियाणाची निवड

श्री पध्दतीमध्ये १ एकर जमिनीत लागवड करण्यासाठी फक्त २ किलोग्राम बियाणे लागते. निरोगी बियाणे निवडण्यासाठी २० टक्के ब्राईन या द्रावणाचा वापर करतात. बियाणे ब्राईनच्या द्रावणात टाकतात. निरोगी बी खाली जाते आणि हलके बी वर तरंगते. जे बी वर तरंगते ते टाकून दिले जाते. कारण, ते लागवडीसाठी उपयुक्त नसते.

३) बीज प्रक्रिया

निरोगी बियाणे द्रावणातून बाहेर काढावे व नंतर ३ वेळा पाण्याने स्वच्छ धुवावे त्यामुळे बियांना लागलेले क्षार निघून जातील व बियाणे स्वच्छ होईल. त्यानंर हे बियाणे ज्यूट च्या कापडावर पसरून ठेवावे. ५० टक्के कार्बेन्डाझाईनचा समावेश असलेली बुरशीनाशक पावडर बियाणांवर शिंपडावी. प्रत्येक १ किलो बियाणांसाठी २ ग्रॅम पावडर आवश्यक असते. बियाणे व्यवस्थित पावडरमध्ये कालवावे. त्यामुळे बियाणांवर एक पांढऱ्या रंगाचा थर जमा होतो. त्यानंतर बाविस्टीन बियाणांमध्ये मिसळून ते जूटच्या पिशवीत भरावे. नंतर २५-३६ तास सावलीत मोड आणण्यासाठी ठेवावे.

४) बियाणांची उगवण

लागवडीपूर्वी भाताचे बी १२ तास पाण्यात भिजवून ठेवावे. त्यानंतर ते बियाणे गोणपाटाच्या पिशवीत भरून किंवा ढिगारा करून त्यावर गोणपाटाची पिशवी झाकून २४ तास ठेवावे. २४ तासानंतर बियाणास पांढरे मोड आलेले दिसतील. हे बियाणे वाफ्यावर टाकण्यासाठी वापरावे. जर या प्रक्रियेला उशीर झाला तर ती सूक्ष्म मुळे एकमेकात अडकतात व नंतर ते वेगळे करणे अवघड जाते.

५) बी टाकणे

सगळीकडे सारखे बी पडावे त्यासाठी बियाणे आधी ४ भागात वेगळे करून घ्यावे. नंतर प्रत्येक भाग वाफ्याच्या एक चतुर्थांश भागात टाकावा. एका नंतर एक अशाप्रकारे बियाणे टाकावे. प्रत्येक दोन बियांमध्ये एका बी चे अंतर असावे. बियाणे शक्यतो संध्याकाळी टाकावे. त्यामुळे बियातील पाण्याचे बाष्पीभवन कमी होते.

६) बी झाकणे

बी झाकण्यासाठी शेणखताचा पातळ थर किंवा कोरडी माती वापरावी किंवा भाताची काडे पण वापरता येतात. यामुळे पक्ष्यांपासून आणि किड्यांपासून बियाणांचे संरक्षण होते. बियाणे अंकुरल्या नंतर भाताची काडे काढून टाकावी.

७) वाफ्याला पाणी देणे

गरजेनुसार दररोज वाफ्याला सकाळी व संध्याकाळी पाणी द्यावे. वाफ्यावर पाणी हलकेच फवारावे. आपण बागेत पाणी देण्यासाठी जी झारी वापरतो ती वापरावी. जेव्हा पाणी भांडयाने दिले जाते तेव्हा एका हाताचा वापरा करावा. वाफ्याच्या बाजूने चारी काढूनही वाफ्याला पाणी देता येते.

८) रोपवाटिका तयार करणे

रोपवाटिका तयार करण्यासाठी खतांच्या रिकाम्या गोण्या किंवा प्लास्टिकचा कागद वापरला जातो. त्यासाठी धातू किंवा लाकडाची चार भाग असलेली चौकट वापरली जाते. त्या चौकटीची मापे १ x ०.५ मीटर असतात त्यातल्या प्रत्येक भाग ०.१२५ चौरस मीटर असतो. ४ से.मी. उंचीचा वाफा तयार केला जातो. त्यासाठी शेणखत आणि मातीचा वापर केला जातो. त्यावर बियाणे टाकले जाते. आणि वरून चिखलाने ते झाकले जाते. पाणी दिल्यानंतर चौकट काढून घेऊन परत वापरता येऊ शकते. पहिले ५ दिवस दिवसातून २-३ वेळा हलके पाणी द्यावे. त्यानंतर रोपवाटिकेच्या बाजूने लहान चारी करून पाणी दिले तरी चालते.

९) मुख्य शेताची तयारी

पारंपारिक पद्धती प्रमाणेच मुख्य शेत तयार केले जाते. जर शेतात कोरडी नांगरणी केली असेल तर शेतात चिखलणी करू नये. जर शेतातील माती काळी असेल तर शेत उन्हाळयामध्ये नांगरून, तयार करून ठेवावे. शेताला पाणी द्यावे त्यामुळे नंतर शेतात कोनोव्हीडर चालविणे सोपे होते. चिखलणी जर ट्रॅक्टरने केली नाही तर कोनोवीडर जमिनीत अडकणार नाही आणि त्याचा वापर करणे सोपे होईल. लागवडीपूर्वी जमीन सपाट करून घ्यावी. रोप लागवडीच्या वेळेस पाणी साचलेले असू नये.

१०) मार्करचा वापर

दोन रोपांमधील आणि दोन ओळींमधील अंतर विशिष्ट पध्दतीने ठेवण्यासाठी काही छोटी साधने वापरली जातात. त्याला मार्कर असे म्हणतात. या मार्करमुळे रोप विशिष्ट जागेत ठराविक अंतरावर पध्दतशीरपणे लावता येते. रोपांची लागवड १० x १० इंचावर करावी. त्यासाठी खालील वेगवेगळया पध्दती वापरतात.

१. दोरीचा वापर करून प्रत्येक १० इंचावर तिला गाठ मारून किंवा खूण करून रोपे लावली जातात. दोरीच्या साहाय्याने अशाप्रकारे रोपे एकानंतर एक रांगेत लावावीत.

२. लाकूड किंवा लोखंडाचा वापर करून मार्कर तयार केले जातात आणि लागवड केली जाते.

३. रोलरचा वापर करून चौकोन आखले जातात आणि प्रत्येक चौकोनाच्या कोपऱ्यावर रोपे लावली जातात. रोलरच्या सहाय्याने एका वेळेस ८ ओळी सुद्धा आखल्या जाऊ शकतात आणि त्यामुळे लागवड करणे सोपे व लवकर होते.

११) रोपवाटिकेतून शेतात रोपे लावणे

श्री पद्धतीमध्ये ८ ते १० दिवसांची रोपे लावली जातात. रोपांना कोणताही धक्का न लागू देता हे काम करावे लागते. रोपवाटिकेतील वाफे मुख्य शेतात काळजीपूर्वक वाहून नेले जावे.

१२) रोप लागवडीची पद्धत

श्री पध्दतीमध्ये १० ते १२ दिवसांची रोपे लावली जातात त्यामुळे नाजुक रोपांची खूप काळजी घ्यावी लागते. पारंपारिक पद्धती मध्ये रोपे अंगठा आणि मधल्या बोटाच्या वापर करून जमिनीत लावली जात. या पद्धतीत मुळांचा आकार 'यु' या इंग्रजी अक्षरासारखा होतो. मुळे वरच्या दिशेने वाढतात. आणि नंतर ती जमिनीच्या खालच्या दिशेने वाढतात आणि स्थिर होतात.

श्री पध्दती मध्ये रोपे मातीच्या वरच्या १ इंच थरात लावली जातात. रोपे जमिनीत ठेऊन फक्त अंगठ्याने ती दाबली जातात. अंगठा आणि पहिल्या बोटाचा वापर करून रोपे जमिनीत १ इंच खाली रोवली जातात. त्यामुळे रोपांची मुळे सहजतेने खालच्या दिशेने इंग्रजी 'एल' आकारात वाढतात. लागवड केल्याच्या दिवशी किंवा त्याच्या दुसऱ्या दिवशी शेताला हलके पाणी द्यावे. सुरवातीला या पद्धतीमध्ये लागवडीसाठी १०-१५ मजुरांची गरज असते पण अनुभवानंतर थोडी माणसे पण हे काम व्यवस्थित करू शकतात.

१३) रोपांमधील जास्त अंतर

श्री पध्दतीमध्ये रोपांच्या दोन ओळींमधील अंतर जास्त असणे खूप महत्वाचे आहे. रोपांच्या दोन ओळींमधील अंतर १० x १० इंच असावे. या लागवडीच्या पध्दतीमुळे एका चौरस मीटर क्षेत्रात १६ रोपे बसतात. रोपे जगण्याची शक्यता जर कमी वाटत असेल तर एका उंचावट्यावर २ रोपे लावावी. पारंपारिक पद्धतीमध्ये एका चौरस मीटर क्षेत्रात ३३-४० रोपे लावतात (एका उंचावट्यावर ४-५ रोपे).

१४) तण व्यवस्थापन

श्री पध्दतीमध्ये शेतात पाणी थांबलेले नसते. त्यामुळे तणांची वाढ जास्त होते. तण हाताने काढून शेताच्या बाहेर टाकण्यापेक्षा तण जमिनीत गाडून टाकल्याने जास्त फायदा होतो. तण काढण्यासाठी हातकोळप्याचा वापर करावा. तणांचा जैविक खत म्हणून वापर होतो. त्यामुळे शेतात तणांची वाढ होऊ दयावी आणि नंतर ते तण जमिनीत गाडून टाकावेत. शेतात रोपांची लागवड केल्यानंतर १० आणि २० दिवसांच्या नंतर तण काढून टाकावेत. जेवढ्या लवकर काढले जातील तेवढा जास्त फायदा होतो. या पद्धती मुळे तणांचा त्रास कमी होतो. जर रोपांच्या लागवडी नंतर २०, ३० आणि ४० व्या दिवशी तण काढले तर जमिनीत हवा खेळती राहते व पिकाची वाढ नीट होते. निरोगी व चांगल्या पिकांच्या वाढीमुळे उत्पन्नात वाढ होते.

हातकोळपे रोपांच्या दोन ओळींमध्ये मागे पुढे फिरवावे. तण लहान असतानाच म्हणजेच लागवडीनंतर १० दिवसांनी हातकोळपे वापरावे. त्याच्या वापरामुळे जमिनीतील तण कमी होतात व जमिनीत जैविक खतांचे प्रमाण वाढते. आणि जमिनीतील हवा खेळती राहते त्यामुळे जमिनीतील सूक्ष्मजीवांचे प्रमाण वाढते. हे सूक्ष्मजीव जमिनीतील पोषक द्रव्ये पिकांना उपलब्ध करून देतात.

१५) पाणी व्यवस्थापन

श्री पध्दतीमध्ये शेत पाण्याने भरले जात नाही. पाणी हे फक्त माती ओली करण्यासाठी पुरवले जाते. या पद्धतीमध्ये पाणी जमिनीवर साठून राहत नाही. जेव्हा जमिनीला सूक्ष्म भेगा पडतील तेव्हाच परत पाणी दिले जाते. माती आणि वातावरणाची परिस्थिती यानुसार सिंचनाची वेळ आणि प्रमाण ठरविले जाते. मातीत जास्त पाणी नसते त्यामुळे मुळांची वाढ निरोगी आणि खोल होते.

रोपांमधील अंतर जास्त असल्यामुळे मुळांची वाढ खोलवर, दाट आणि सर्वदूर होते. शेतजमीन मधूनमधून ओली आणि कोरडी असते त्यामुळे त्यातील सूक्ष्म जीव रोपांना पोषक द्रव्ये सहज उपलब्ध करून देतात. हातकोळपे वापर करण्याच्या आधी एक दिवस शेतात किंचित पाणी असणे आवश्यक आहे. तण काढल्यानंतर शेतातील सगळे पाणी निचरा झाले नाही तर सगळी पोषक द्रव्ये पाण्यावाटे निघून जातात. भाताची ओंबी वाढण्याची सुरुवात झाली की शेतात १ इंच पाणी ठेवले पाहिजे.

जेव्हा ७० टक्के दाणे परिपक्व होतील किंवा कापणीच्या आधी १० दिवस शेतातील पाणी पूर्ण निचरा झाले पाहिजे. जर जमीन उंच-सखल असेल तर खोल भागात पाणी जास्त साठून राहते आणि उंच भागात जमीन कोरडी पडते. लहान व सपाट जमिनीत पाणी नियमितपणे देत येते. स्थानिक परिस्थितीवर आधारित सिंचनाची वेळ आणि प्रमाण ठरवावे. जास्तीचे निचरा होणारे पाणी शेवटी एक लहान प्लॉट मध्ये भाज्या वाढवण्यासाठी वापरले जाऊ शकते.

१६) कीड आणि रोग व्यवस्थापन

श्री पद्धतीमध्ये पिकांमधील जास्त अंतर आणि जैविक खताचा वापर यामुळे पिकाची निरोगी वाढ होते आणि कीड व रोगांचा प्रादुर्भाव नैसर्गिकरित्या कमी होतो. श्री भातशेतीमध्ये जरी रोग आणि कीटकांचा प्रादुर्भाव कमी असला तरीपण रोग आणि कीटकांचे प्रकार सारखेच आहेत. रोग/कीटक प्रदुर्भावावर त्वरित उपाय केले पाहिजे आणि त्यासाठी स्थानिक कृषी विस्तार अधिकार्यांचा सल्ला घ्यावा.आवश्यक माहितीसाठी संपर्क साधा "Rice Knowledge Bank of IRRI" <http://www.knowledgebank.irri.org/rice.htm>.

१७) अमृत पाणी

आवश्यक साहित्यः

गोमूत्र - एक (१) लिटर

शेण - एक (१) किलोग्राम

गूळ (coconut tree sap) - २५० ग्रॅम

पाणी (क्लोरीन मुक्त) - १० लिटर

अमृत जल तयार करण्याची कृतीः

एका प्लास्टिकच्या किंवा मातीच्या भांडयात वरील सर्व साहित्य एकत्र करावे. ते २४ तास आंबायला ठेवा. १:१० या प्रमाणात हे मिश्रण पाण्यात मिसळा. हे फवारणीसाठी वापरले जाऊ शकते. अमृतजल ३० दिवसांसाठी साठवून ठेवता येते. तथापि दररोज याला ढवळावे लागते. अमृतजलाची फवारणी पिकाला फक्त नायट्रोजन देत नाही तर त्यास कीड आणि रोगापासून वाचवण्यासाठी मदत करते.

१८) माती सुपीकतेचे व्यवस्थापन

सेंद्रीय पदार्थ हे मातीतील सूक्ष्मजीवांचे खाद्य आहे. जेव्हा मातीत सूक्ष्मजीवांचे प्रमाण जास्त असते तेव्हा जमिनीतील पोषणद्रव्ये पिकांना तात्काळ उपलब्ध होतात. जेव्हा माती सूक्ष्मजीवांनी समृद्ध असते तेव्हा पिकांची निरोगी वाढ होते आणि पिकांची कीड व रोगांना प्रतिकार करण्याची क्षमता वाढते. अशा प्रकारे जमिनीची सुपीकता सुधारण्याची पद्धती वापरली पाहिजे. शेणखत / कंपोस्ट (१०-२० टन / हेक्टर) आणि / किंवा हिरवळीचे खत वापरण्याची शिफारस केली आहे. खरेदी करण्यात येणारे कंपोस्ट खत काळजीपूर्वक तपासले पाहिजे.

१९) कापणी

शेतातील तयार झालेले भाताचे पीक गोळा करण्याच्या प्रक्रियेला कापणी म्हणतात. भात कापणी प्रक्रियेमध्ये कापणे, रचणे, हाताळणे, मळणी, स्वच्छ करणे आणि तयार भात वाहून नेणे या क्रिया समाविष्ट असतात. धान्य उत्पन्न वाढविण्यासाठी आणि धान्याचे नुकसान व गुणवत्तेचा ऱ्हास कमी करण्यासाठी, योग्य कापणी पद्धत वापरणे खूप गरजेचे असते. पिकांची कापणी माणसांच्या मदतीने विळा, कोयत्याचा वापर करून किंवा यंत्राद्वारेही करता येते. कोणत्याही पद्धतीने कापणी केली तरीपण धान्याची गुणवत्ता जतन केली पाहिजे आणि कापणी दरम्यान होणारे नुकसान पण कमीत कमी ठेवले पाहिजे. पिकांची कापणी करताना खालील गोष्टींची काळजी घ्यावी.

* पिकांची कापणी योग्य वेळी आणि योग्य आर्द्रता असताना करावी.
* कापणी नंतर मळणी कण्यासाठी जास्त विलंब करू नये
* मळणी यंत्र वापरताना योग्य सेटिंग्ज वापरावे
* मळणी नंतर धान्य व्यवस्थित साफ करावे
* मळणी झाल्यानंतर धान्य लगेच सुकवावे

Contact Details of SRI Farmers

Sr No	Names of Farmers	Village	Contact no
1	Laxman Naik	Aasoli, Vengurla	02366-227991
2	Digambar Shankar Kalsekar	Ubhadanda, Vengurla	9423278114
3	Bhatkar Laxman Gawde	Mhapan, Vengurla	9405631581
4	Prasad Parab	Dahibav, Devgad	9422438942
5	Santosh Dalvi	Dahibav, Devgad	9404168627
6	Vishnu Tawade	Hindale, Devgad	9969155802
7	Malti Joshi	Waingani, Malvan	9421263304
8	Gurunath Sawant	Waingani, Malvan	7776957848
9	Sunil Waigankar	Waingani, Malvan	9420822981

'श्री' शेतकऱ्यांच्या संपर्कांची माहिती

अ.क्र.	शेतकऱ्यांची नावे	गाव	संपर्क क्रमांक
1	लक्ष्मण नाईक	आसोळी, वेंगुर्ला	०२३६६-२२७९९१
2	दिगंबर शंकर काळसेकर	उभादांडा, वेंगुर्ला	९४२३२७८११४
3	भाटकर लक्षमन गावडे	म्हापण, वेंगुर्ला	९४०५६३१५८१
4	प्रसाद परब	दहीबाव, देवगड	९४२२४३८९४२
5	संतोष दळवी	दहीबाव, देवगड	९४०४१६८६२७
6	विष्णु तावडे	हिंडले, देवगड	९९६९१५५८०२
7	मालती जोशी	वैंगणी, मालवण	९४२१२६३३०४
8	गुरुनाथ सावंत	वैंगणी, मालवण	७७७६९५७८४८
9	सुनील वैंगणकर	वैंगणी, मालवण	९४२०८२२९८१


FERRARI