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# Promotion of SRI-Millet: Reopening a Closed Chapter

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***Abstract*** **– Millets are rich in nutrient content, they requires very little water for their production as compared to other commodity crops currently promoted via various subsidy and privileges. Millets are grown in a wide range of ecological condition require nil or minute irrigation. Millets are drought resistant crop and it can be cultivated round the year. Millets do not require any synthetic fertilizers, mostly household fertilizer is being used. Grown via traditional methods millets act as a secondary crop but it us superior in nutrient content form other food grains such as rice, wheat etc. Pearl millet has high Iron content of 16.9mg/100g as compared to 0.7 mg/100g of rice and 5.3mg/100g of wheat. Similarly millets like Proso has high content of Protein (12.5g/100g), Finger millet has high content of Calcium (344mg/100g), and Foxtail millet has high content of fiber (8g/100g). Pearl millet due to its high content of Iron and Zinc recommended for treatment of diseases like celiac, constipation and other Non-communicable diseases.**

**In advance practices like SRI, millets also show a significant increase of yield near about double or more than that. The research depicts that near about more than double cost savings data found in the millets cultivation under SRI technique with compare of traditional cultivation practices of millets. In tribal heritage the expectation time of a woman has a high necessity of consume millets. The early mentioned high quantity of iron is the main cause of it.**

***Keywords*** **– System of Rice Intensification (SRI), Millets, Nutrition, Food Sufficiency.**

## I. Introduction

Millets are small seeded greases widely grown around the globe as cereal crops. Millets were one of the important cereals, it can grow in hot, dry areas of the world. Millet used to be a major food for sources for millions of people, they are grown mainly in marginal areas. Now it is mostly cultivated as fodder crop under hot, dry conditions on infertile soils. It has high productivity and a short growing season. Millet were indigenous to many parts of India not only as food but also an integral part of cultural part of India. Millets are well adapted to production system characterized by low rainfall. It is a drought resistant crop and can be stored for a long time There are mainly four major types of millets available are Pearl (Bajra), Finger (Nachni), Porso and Foxtail (Rala). Out of all Pearl is highly grown in India followed by Foxtail and Porso. It has been reported that millet has many nutritional and functions. Increase in productivity of rice and wheat on the implementation of green revolution decreases the land under millets. Millet production mainly concentrated in developing countries as Asia, Africa etc.

Nutrient content of millets is mostly more than rice and wheat. They require less or no water for cultivation as compared to water intensive crops like wheat and rice. Millets has high protein, crude fiber, calcium and also rich in micronutrient.

## II. Nutrient Composition of Millet Grain

Nutrient content such as Protein, Fiber, Minerals, Iron and Calcium different kinds of millets is being compared with rice and wheat. Typical millets contain protein, high quality of essential amino acids. Millets generally contains significant amounts of essential amino acids, particularly the sulfur containing amino acids. Millets are higher in fat content than maize, rice, and sorghum.

Millet is gluten-free therefore an excellent option for people suffering from celiac diseases often irritated by the gluten content of wheat and other grains.

Table 1: Chemical composition of millets and cereals per 100 gm (Nagaraj, Basavaraj, & Rao, 2011)

| Crop | Protein (g) | Fiber (g) | Minerals (g) | Iron (mg) | Calcium (mg) |
|---|---|---|---|---|---|
| Rice | 6.8 | 0.2 | 0.6 | 0.7 | 10 |
| Wheat | 11.8 | 1.2 | 1.5 | 5.3 | 41 |
| Pearl Millet | 10.6 | 1.3 | 2.3 | 16.9 | 38 |
| Proso Millet | 12.5 | 2.2 | 1.9 | 0.8 | 31 |
| Finger Millet | 7.3 | 3.6 | 2.7 | 3.9 | 344 |
| Foxtail Millet | 12.3 | 8 | 3.3 | 2.8 | 31 |

The energy content of millet is high as compared to other grains. For eg. Pearl millet is a rich source of energy of order of 361 Kcal/100g, whereas wheat has energy of order 346 Kcal/100g and rice has energy of the order of 345kcal/100g.

## III. Need of Millet Farming and its Potential Health Benefits

Despite numerous qualities, utilization of millets as food is confined to the traditional consumers, particularly the tribal populations. This is mainly due to the non-availability of consumer friendly, ready-to-use/ready-to-eat millet based products as well as less awareness and enthusiasm towards millets. Recently, millets have gained attention and efforts are under way to obtain their convenience and value added processed products. Millets can not only grow in poor soil/climatic conditions, due to their short growing season, these can very well fit into multiple cropping systems under irrigated as well as dry land farming; and provide nutritious grain as well as fodder in a short span. Their prolonged and easy storability under ordinary conditions has accorded them

the status of "famine reserves"; and this feature is of great relevance for India, as our agriculture suffers from the vagaries of monsoon. Traditional methods of cereal processing (popping and flaking) as well as the contemporary ones (roller drying/extrusion cooking) can be successfully employed for preparing various millet based ready-to-eat products. Thus, a variety of extruded millet-cereal-pulse snacks can be prepared commercially for easy availability and wider use. Similarly, millet-cereal-pulse blends can be used in preparing murukus, papads, vadiyan, bhujia, vermicelli, spaghetti, noodles, macaroni, etc. Various millet blends along with wheat can be used for making multi-grain flour, baked products like biscuits, cookies, breads, buns, rusks, cakes and muffins. Sorghum (Jowar) malt is being used for preparing the infant foods. Since extrusion processing lowers the anti-nutritional factors and enhances digestibility of the millets; extruded millet products can be promoted as healthy snacks/ health foods. Partially processed millet products – ready to cook/instant foods, can be made available in the market; due to ease in preparation, these can promote millet consumption and thus, create a demand for these nutritious grains and simultaneously reduce the reliance on staples like rice and wheat.

Chemical composition of millets shown in Table 1, attributed that millets has several health promoting abilities such as Anemia, Constipation, Cancer, Diabetes, Celiac, Diarrhea, Non Communicable Diseases (NCDs) etc. Table 2 shows that how pearl millets act as a positive factor for diet related disorder/deficiency (Nambiar, Dhaduk, Sareen, Shahu, & Desai, 2011).

Table 2: Health benefits of Pearl Millets (Nambiar, Dhaduk, Sareen, Shahu, & Desai, 2011)

| Disease/ Problem | Possible benefit | Positive factor in Pearl Millet |
|---|---|---|
| Anemia | May help in increasing the Hb | High iron content 16.9mg/100g |
| Constipation | Help in dealing with Constipation | High fiber content 1.2g/100g |
| Cancer | Anti-cancer property | Antioxidant property |
| Diabetes | Help in dealing with diabetes | Has low glycemic index of 55 as compared to rice (89) |
| Celiac | Anti-allergic | Gluten free |
| Diarrhea | Probiotic treatment | Lactic acid bacteria |
| NCDs | Inhibits DNA scission | Omega 3 fatty acids, phenolic etc. |

Pearl millet contains high amount of Iron (16.9mg/100g) and Zinc which may help in increasing the Hb levels. It also has anti-cancer property due to presence of antioxidant (Pathak, 2013). Diets high in fiber and antioxidant have been beneficial effect on serum lipid profile and prevent cancer due to high phenolic content of 51.4mg/100g of pearl millets (Nambiar, Dhaduk, Sareen, Shahu, & Desai, 2011). Pearl millet has a very high amylase activity of 10 times more than wheat, predominant in Maltose and D-ribose and low in fructose and glucose levels. Millet was acting as major staple food for many population around the globe where as it is not given such privilege in major staple food purchase list of elite. To promote cultivation and consumption of millets and millets based products the GOI allocate a fund of Rs.300 crores in 2011-12, 175 crores in 2012-13 and 100 cores in 2013-14 budget. This fund is promoted under Rashtriya Krishi Vikas Yojna for Initative for nutritional security through intensive millets promotion (INSIMP). To create a demand, strategies like market driven millets cultivation and technologies to up-scaling and produce millet food products were developed. Nutrition evaluation and safety of selected millets, improvement market strategies and social, policy imperatives were promoted. Employment generation through women through production and marketing of millet based processed food produced by involvement of Self Help Groups (SHGs). They helps in preparing traditional millet based food by teaching quality control measure, packing and labelling for local marketing. Commercialize and promote millet based ready to eat snacks and food through public private partnership. Awareness regarding nutritional, health and environment advantages may be created through known communication strategies.

## IV. SRI and Millet Production

More than 60% of the area in India is cultivated under arid ad semiarid conditions which provide about 40% of the food production (Nagaraj, Basavaraj, & Rao, 2011). Excessive dependence on rice and wheat for food self-sufficiency has not only made food security fragile, but also has shrunken the diversity of food basket. As the types of cereals are limited, food is lack of required nutrient. Millets are rich in nutrient contents which may fulfill the gap of a complete food basket. Millet can be grown in dry as well as rain-fed regions of the country. The annual per capita consumption (PCC) of pearl millet in rural India is decreased by 11.5 PCC kg per year in 1972-73 to 4.6 PCC kg per year in 2004-05. Similarly in urban India PCC decreased from 4 to 1.5 PCC Kg per year from 1972-73 to 2004-05 (Nagaraj, Basavaraj, & Rao, 2011). It is seen that millet cultivation also decreased 34.96 Million tons (MT) in 1975-76 to 22.08 MT in 2005-06. If the production of millets were increased using modern cultivation techniques, increased produce can reached to large population. System of Root Intensification (SRI) is a proven technique which helps in increasing rice production in rain-fed areas. Integrating SRI technique for millet cultivation also shown similar results in Chhattisgarh and Orissa.

Chhattisgarh and Orissa where poor tribal communities make up 60 per cent of the rural population in the state. The major sources of livelihood of the people in the area are agriculture, forestry (timber and non-timber products), and livestock. The average landholding per family is very small only 1–2 hectares (ha), almost all rain-fed, with no irrigation. Households usually have five or six members. Most of the cultivated land is mono-cropped with paddy, with a current average productivity of 2.2 MT/ha. Finger millet is the second major food grain crop in large parts of this state. However, because of the low average

productivity of millet, (one tone/ha), the area under millet cultivation has been decreasing gradually.

Tribal households, especially those that are referred to as the Particularly Vulnerable Tribal Groups (PTGs), continue to cultivate paddy and millet as a main crop they consume millet as a food grain. Considered 'minor' by most agriculturalists, millet has some important uses in the life cycle of PTGs. They use this grain as an essential part of a woman's diet in the advanced stages of pregnancy, because of its high nutritional value. The roti (bread) made from millet is slow to digest and it is believed 'stays in the stomach for longer time,' helping nourish hungry people longer and better. Millet is also usually kept in reserve for the lean period when rice stocks start to diminish.

Under the FRA (Forest Rights Act), the tribes who live near forests were given ownership of the land, which unfortunately is very poor quality. The cultivation of millet, therefore, is a preferred option for PTGs because this crop shows a greater resilience to rainfall variations. Moreover, the prices for millet have gone up fourfold in the last decade, making it a more paying crop. The rise is apparently driven by a demand for millet as an ingredient in poultry feed, for use in the beverage industry and as a nutritious component in the diet for city-dwellers who are suffering from lifestyle diseases such as diabetes and obesity.

Further, millets are rich sources of minerals like iron, calcium, zinc, magnesium, phosphorous and potassium. Ragi (Finger millet) is very rich in calcium; and bajra in iron. These also contain appreciable amounts of dietary fiber and various vitamins (β- Carotene, niacin, vitamin B6 and folic acid); high amounts of lecithin are useful for strengthening the nervous system. Therefore, a regular consumption can help to overcome malnutrition among majority of our Indian population. These have often been called the coarse grains; however, due to their nutritional contributions, these are now being referred as 'nutria-millets/nutria-cereals'.

In Chhattisgarh and Orissa SDTT (Sir Dorabji Tata Trust, Mumbai) with the support of partner NGOs have formed a state consortium to promote the System of Rice Intensification (SRI). Till 2012, the consortium has covered nearly 11,000 families in Chhattisgarh mainly through SRI-paddy. Along with paddy, however, for the last three years the consortium has introduced the SRI method of cultivation of crops such as millet, wheat, mustard and vegetables. In the Rabi season of 2011–12, the consortium received some significant results with SRI-millet, according to the categories of yield.

Table 3: Productivity chart of farmers in Chhattisgarh

| Productivity (MT/ha) | No. of farmers (In CG) | Percentage |
|---|---|---|
| 4–6 MT | 13 | 18.3 |
| 2–4 MT | 58 | 81.7 |
| < 2 MT | 00 | 0 |
| Total | 71 | 100 |

The average productivity of SRI-millet of these 71 farmers as shown in Table 1 was 3.36MT/ha, more than three times the state's average yield. In the last several years, we have seen SRI-millet yields ranging from 2.5–3.5 MT/ha. Motivated by these results, the consortium plans to promote the SRI method for millet with about 500 families in the state during the ongoing kharif season. Along with this, the consortium has extended a hand to help partner NGOs and the farmers they work with in Orissa, to promote SRI-millet in Koraput and Raygada districts. Because of the positive experience, SFMI is inviting demonstrations by our Koraput and Raygada teams in Orissa as well

## V. User manual for SRI Millet Cultivation

The following practices, using the farmers' own locally available seeds, have been appliedto achieve the results mentioned here. The following practices, using the farmers' own locally available seeds, have been applied to achieve the results mentioned here.

### *A. Seed selection, priming and treatment*

There is no preference for any variety of millet seed; however, it is always better to start with newer seeds, rather than use older ones. Some varieties that are used in the area are:

Early-maturing variety—can be used in less productive soils. Birsa Gourav/A404—for better yield (duration 110–115 days)VK 149—drought and disease-resistant (duration 95–100 days)

Seeding rate: 300–400 gm per acre, with a recommendation to prime the seeds. Soak the seeds in water; then mix 2.5 to 3 gm/kg of Carbendazim (Bavistin) with the seeds and leave the mixture for 24 hours. Seed treatment with bijamrita, a natural solution for effective protection against pests, diseases and fungi. Wrap 5 kg of cow dung in a large cloth and bind it with tape. Put it in 20 liters of water for up to 12 hours. Take one liter of water and add 50 gm of lime to it and let it stabilize overnight. The next morning, squeeze out all the liquid in the bundle of cow dung into a bucket, compressing it at least thrice so as to collect a concentration of cow dung. Add a handful of soil to this liquid solution and stir it well. Then add five liters of cow urine or human urine to the solution and add the lime water, stirring all these, making what is called bijamrita. Spread this solution on to the seeds of any crop, treating the seeds well by hand and drying them well, and they are ready for sowing. The micro-organisms and nutrients added this way will make the seedlings that emerge more vigorous.

### *B. Nursery preparation*

Nursery material: Sow the treated seeds in a nursery with a mixture of sand, soil and compost (1:1:1).*Area of nursery for cultivating one acre: 40 sq m. Dimensions of the nursery bed: 1 m, with an appropriate length. The bed should be 9–12 inches above the ground level. Timing off sowing the nursery: First to third week of July.*

Sowing of seeds: Put the seeds at a depth of half an inch and keep a spacing of about three to four inches between the seeds. Care for seeds: Cover the seeds with vermin compost and then sprinkle Jiwamrita (organic manure)

regularly over the nursery to keep the soil functioning well.

Preparing Jiwamrita: Put 10 liters of water in a barrel. Add 5 kg of cow dung and 5 liters of cow urine to the water. Then add: 250 gm of jaggery (raw, unrefined sugar), 250 gm of pulses flour and a handful of soil from the bund of the field or termite soil and stir the solution well. Let it ferment for 48 hours in the shade, after which it is ready for use. To use, add one liter of solution to 20 liters of water. For one acre of land, use 200 liters of solution.

### *C. Field preparation*

Plough the field three times: Two of these should be done within an interval of 8–10 days, during the nursery preparation. Sprinkle Jiwamrita over the field, to moisten the soil and preserve the organic matter. After ploughing, level the field with a wooden leveler.For transplanting, mark lines on the field in a square grid pattern, 12 inches apart, one direction being perpendicular to the gradient; wooden markers can be used for lines.

In transplantation, the plants should be spaced at a distance of 12 x 12 inches.Furrows and ridges can be made on the field's surface with a cycle wheel or a hoe.

### *D. Transplanting using the SRI method*

Spray the nursery with a fungicide Mancozeb 75 per cent W.P. @ 2 gm per litre, four to five days before removing the plants. Transplant the seedlings from the nursery into the main field when 15–25 days old. Before transplanting, irrigate the nursery approximately two hours in advance, to moisten and loosen the soil. This makes the removing of plants easier, in case the soil is dry at that time.

Carefully uproot the seedlings, keeping the soil around the roots intact; if possible, lift out with a trowel or spade because that gives support to the soil and keeps it attached to the roots. Transfer the uprooted seedlings to the main plot within 30 minutes before the roots and soil dry out. The spacing should be 12 x 12 inches. Use a rope to measure.Transplant the seedlings at a shallow depth in the pits; do not press or injure the roots when placing the seedlings at the intersection of the planting lines.

### *E. Weeding and trolling*

Remove any weeds by hoeing with a cycle hoe or with a hand weeder between the rows. This removes unwanted weeds and also aerates the soil, helping the plants to grow faster. This should be done three times at intervals of 10–15 days.Sprinkle Jiwamrita after weeding; mix 1 litre of Jiwamrita with 10 liters of water, instead of using the plain solution. After weeding, move a straight round pole or bamboo over the plants, bending them over gently. This gentle 'trolling', by bending the plants over at the base will stimulate the growth of more tillers from the plant.

### *F. Manure and fertilizers*

Cow dung manure or compost: Two tonnes per acre applied 15–20 days before the July transplanting.Chemical fertilizer: N:P: K (24:20: 12) applying per acre: urea 36 kg, DAP 43 kg, MOP 20 kg. Before preparing the furrow and ridge: 12 kg of urea + 21.5 kg of DAP + 10 kg of MOP. 15–20 days after the transplantation, during the first weeding: 12 kg of urea + 21.5 kg of DAP. 35–40 days after the transplantation during the third (last) weeding: 12 kg of urea + 10 kg of MOP. Micronutrients: Magnesium (20 kg per acre) and calcium (6 kg per acre) or dolomite limestone (40 kg per acre). Apply these micronutrients 20-25 days before the transplantation in the field, or 25-30 days after the transplantation by sprinkling.

### *G. Non-chemical pest and disease management*

Neem solution (for sucking pests and mealy bug):-Add 100 liters of water to a large container along with 5 liters of cow urine. Add 5 kg of cow dung to this. Crush 5 kg of neem leaves, making a pulp. Stir the solution and let it stabilize for 24 hours. Stir this solution twice a day with a stick. Filter the liquid through a cloth and spray the filtered liquid (100 ml added to 5 liters of water) for controlling the above pests.

### *H. Expected yields*

SRI-millet can give yields of 3–4 tons per ha, whereas the yield with the traditional practices is only 0.75-1 tons per ha.Thus, by using the SRI principles with finger millet, the farmers can easily double their yield.A greater increase is possible if the methods are used well.

## VI. CONCLUSION

With the experiment of SFMI, the food security issue of a very vulnerable community that has a very small quantity of paddy or vegetable land has been met. The intensification technique in finger millet, therefore, directly addresses their food sufficiency. In most of the cases, the degraded forest land has been used for millet cultivation. So the poor people with the most low quality land, who are at the bottom of the pyramid, can easily be helped by the intensification technique of millet cultivation.

Summary of needful initiatives:

1) Millet varietal and seed conservation and multiplication programs (farmer and village adoption, FFS, research station programs in PPP mode)
2) Grain bank promotion by women groups in all tribal villages
3) Millets cultivation micro plan and supportive schemes for input supply and cultivation
4) Millets based integrated farming system model development for hilly and dry land farms
5) Comparative studies for soil health, moisture, biomass conservation and per ha nutrient production in millet and non-millet based farming systems
6) Inclusion of millets in PDS and ICDS programs
7) Promotional schemes, MSP, procurement mandis and processing units for millets
8) Recognition and experimentation from medical science should be conducted and published.

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### Kuntal Mukherjee

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- Pradhan, K; Mukherjee Kuntal and Pradhan Soma (2012) Farm Science Centre: Impact and Implication. Lambert Academic Publishing, Germany. ISBN 978-3-659-25958-6
- Pradhan, K. and Mukherjee Kuntal (2012) Revamping the technology dissemination process through Farm Science Centre. Indian Research Journal of Extension Education. 12 (3): 48-52. ISSN 0972-2181 Refereed NAAS rating 3.5

Mr. Kuntal Mukherjee. Till now author has not been awarded by any award.

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He is currently working as Project Associate in Natural Resource Management and Livelihood portfolio in Sir Dorabji Tata Trust &Allied Trusts based in Mumbai. He mostly works for generating livelihood as well as asset creation. He involved in accessing and up-scaling System of Rice Intensification practice via finding correlation between different principles. During his graduation he mostly involved in accessing behavior of construction material under different conditions, design of green and sustainable building via using recycled materials. His key areas are sustainable construction, recycling and reuse of material, rural water supply and integrating programs to generate maximum livelihood.

### Biswanath Sinha

competed his Bachelors of Technology in Agriculture Engineering form University Agriculture and Technology Orissa on 1990. He is pursuing his PhD. in Technology and Development from IIT Bombay.

He currently working as Associate Program Director in Sir Dorabji Tata Trust &Allied Trusts based in Mumbai. In the development sector, in a career spanning about twenty years, worked at grassroots implementation; intermediary support role; capacity building at national level and grant making at national level in the best of Indian organizations. The organisations served are Professional Assistance for Development Action (PRADAN), Society for Promotion of Wastelands Development (SPWD), Sa-Dhan and Sir Dorabji Tata Trust and the Allied Trusts.