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System of rice intensification in Bihar

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ABSTRACT

Bihar state falls into the "alarming" category of hunger. North parts of the state are prone to flood whereas southern part is drought prone. Paddy is the main staple diet and has the largest crop coverage in the state but productivity of the crop is one of the lowest in the country. So as to deal with food crisis and acute hunger "System of Rice Intensification (SRI)" a new system of cultivation had been introduced in this state. SRI methodology is less quantity of seeds, water, replacing chemical fertilizers partly with organic compost, early maturity and higher yield. Change happens only in increments. This method had huge potential of improving the livelihoods of small and marginal farmers improved earnings from the same unit of land primarily on account of reduced costs.

As per the forecast of UN/FAO, the global food production will need to increase by over 40 per cent by 2030 and 70 per cent by 2050 (FAO, 2009). The India State Hunger Index (ISHI) Study (2008) states that Bihar among other twelve states falls into the "alarming" category of hunger. Improving child nutrition is of utmost urgency in most Indian states and more so for Bihar. The state also need to improve strategies to facilitate inclusive economic growth, ensure food sufficiency, and reduce child mortality.

Bihar has a total geographical area of 93.60 lakh hectares on which it houses a population of 82.9 million, thereby generating a population density of 880 persons per sq. km (Census, 2001). Gross sown area in the State is 79.46 lakh hectares, while net sown area is 56.03 lakh hectares. With around 90 per cent of the total population living in rural areas, agriculture as the primary feeder of rural economy. Thus, agriculture continues to define both the potentialities and constraints to development in Bihar. Based on soil characterization, rainfall, temperature and terrain, four main agro-climatic zones in Bihar have been identified. These are: Zone-I, North Alluvial Plain, Zone-II, north East Alluvial Plain, Zone-III A South East Alluvial Plain and Zone-III B, South West Alluvial Plain, each with its own unique prospects. Agriculture in the state is prone to natural calamity. Whereas the North Bihar districts are affected by the recurrent flood the south Bihar districts are prone to lack of rainfall. Potential wise all three agro climatic zones have vast untapped potential for increasing the productivity of food grain crops. Cropping pattern in dominated by cereals. Rice-wheat cropping system occupies more than 70 per cent of the gross cropped area.

Paddy is the main staple diet of most of the people of the state and also has the largest crop coverage in the state. However, the productivity of the crop is one of the lowest in the country. Skewed landholding, increasing cost of inputs like water, seeds, fertilizers and stagnant or decreasing yield were resulting in less interest in paddy farming more so among small and marginal farmers. 10-15 per cent failure was seen mainly because of late transplanting and unavailability of water. Foodgrain production in Bihar has shown high volatility, but there is a long-term trend of falling production in the State. Cereal production has fallen sharply from 122.29 lakh MT in 2001-02 to 81.12 lakh MT in 2005-06. This fall in production has been accompanied by an almost secular decline in area under cereal production from 70.19 lakh hectares in 1990-91 to 65.87 lakh hectares in 2005-06 (Directorate of Statistics Evaluation, GOB). Larger part of the fall in production and area is explained by the fall in production of and area under rice. The production of paddy in Bihar was 36.4 lakh tones in 2009-10 which increased to 81.87 lakh tones in 2011-12 and 87 lakh tones in 2012-13.

So, as to deal with this serious food crisis and acute hunger "System of Rice Intensification (SRI)" a new system of cultivation had been introduced in this state. Thus introduction of this new system of rice cultivation in the drought prone southern Bihar has the major objective to motivate farmers to adopt it and increase the productivity of rice that ensure food security and increase in household income. SRI emphasizes on altering certain key practices used under the traditional method of rice cultivation. The

technique, originally developed in 1983 by the French Jesuit Father Henri de Laulanié in Madagascar, was spread by Dr. Norman Uphoff, professor at the Cornell International Institute for Food and Agriculture in the late 1990s. SRI method is locally known as Srividhi (meaning method of prosperity), and it was introduced in Bihar four years back. Initially, the farmers of Bihar were hesitent to adopt, but now more and more farmers are taking SRI method of paddy cultivation.

The Indian state of Bihar is planning a large scale campaign targeting millions of farmers to popularize SRI in its efforts to increase paddy rice production in the state by around 15 per cent from around 8.7 million tons in 2012-13 to 10 million tons in 2013-14 (Fig. 1). SRI thrives on reduced availability of water and hence this was worth a try in the low lying fields, called chaur, that are mostly submerged in water three quarters of a year.

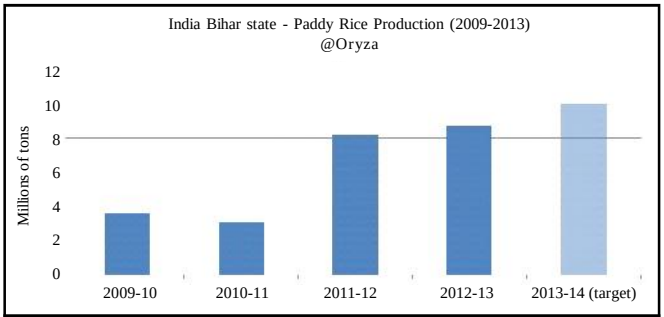

Fig. 1 : Rice production (*Source: Bihar State Government*)

Various technical steps being followed in SRI :

– Seed quality must be good and its treatment also essential as fewer seeds are used. However, HYV variety of seed may not required for SRI as local seeds have shown outstanding results in terms of both quantity and quality.

– *Early transplanting:* The seedling of 8-12 days old (with just two leaves) are transplanted in the field thereby more tillering potential and more root growth.

– *Careful transplanting:* Removing plant from nursery (without shock) with seed, soil and root and careful putting seedlings on the surface of the soils (without pushing seedlings in the soil), to avoid trauma to roots and to minimize transplant shock.

– Planting seedlings singly very carefully and gently rather than in clumps of many seedlings that are often plunged in the soil, inverting root tips;

– Spacing them widely, at least 25 x 25 cm and in some cases even 50 x 50 cm, and in a square pattern rather than in rows, to permit more growth of roots and

Fig. 2: (A) Single seedling with two leaf stage ready for transplanting (B) Mature rice under SRI and traditional method

canopy and to keep all leaves photosynthetically active.

– *Weed management:* It is done with the use of Cono/Mandwa weeder (rotating hoe) that churns the soil. Approximately 2-4 weedings are required before panicle initiation, first weeding is done 10 days after transplanting thereby initiating more root growth, reduced weed competition and better aeration of soil and thus increases productivity by one ton/ha/weeding for each additional weeding after 2 weedings. Higher number of weeding is required to get highest yield.

– *Water management:* Regular applications of water with intermittent dryings are done to keep soil moist but standing water is avoided. The alternating aerobic and anaerobic soil conditions formed thereby promote more root growth and better nutrient availability. Rice field soils should be kept moist rather than continuously saturated, minimizing anaerobic conditions, as this improves root growth and supports the growth and diversity of aerobic soil organisms.

– *Nutrient management:* Apply compost 10 ton/ha in addition to chemical fertilizers. Regarding chemical fertilizers, the phosphorus and potassium should be applied as recommended for a particular area. As far as Nitrogen is concerned, the recommended dose of basal dressing should be applied. The doses of subsequent top dressings should be applied at active tillering and panicle initiation stages. However, it should be decided based on the growth and vigour of the crop. Further, potassium is applied in split-doses for the control of stem borer. Use of organic manures or compost, green manuring plant (dhaincha), vermicompost etc. in SRI plots is done inorder to improve soil quality.

Encouraging characteristics of SRI : SRI requires half the water needed for conventional rice cultivation, would substantially reduce or eliminate the need for chemical fertilizers, would cut seed requirements by 65-70 per cent and yet make rice cultivation more sustainable and

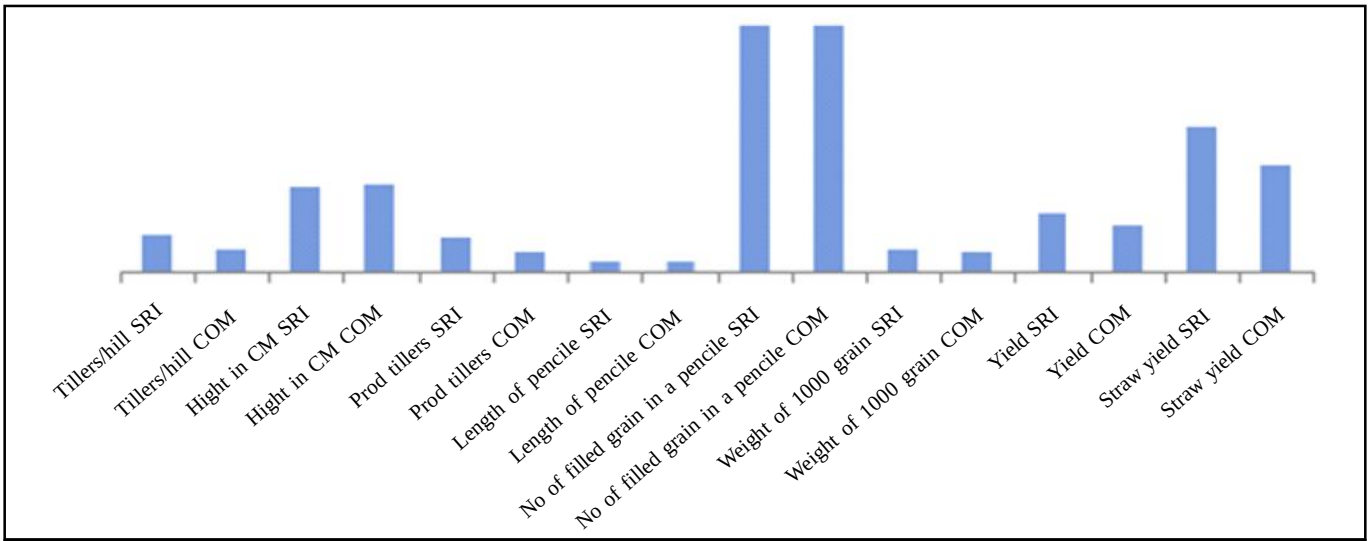

Fig. 3 : Comparison between SRI and COMMON method of cultivation (*Source: BASIX*)

profitable for farmers.

Other remarkable advantages of SRI methods are more number of spiklets per panicle, uniform maturity, head rice recovery is more, early maturity (5-20 days), healthy and resistant plants to major pests and diseases and no competition between rice plant and weeds. Average straw yield per hectare in SRI is 151.36 quintal as compared to 111.69 quintal in conventional method. The average number of productive tillers in case of SRI is 34.40 as compared to 19.41 in case of conventional method (Fig. 3).

The average weight of 1000 grains in case of SRI is 22.48 gram as compared to 21.44 grams in case of conventional method. Yield in case of SRI is 61.57 quintal / hectares as compared to 47.87 quintal / hectares in case of conventional method (Fig. 3). The percentage change in the crop production has been clearly increased by 70 to 133 per cent (Table 1). Economics of rice cultivation clearly indicates a more profit of Rs. 8153/- per acre in SRI method as compared to traditional method (Table 2).

According to reports from Bihar government-confirmed subsequently by the Indian government-Sumant Kumar, a farmer in Darveshpura village in Nalanda district had bested the world record in December 2011 by producing 224 quintals of paddy per hectare using the SRI method as compared with marked record yield of 19.4 tonnes per hectare of hybrid rice by Yuan Longping, a national icon, known as "the father of hybrid rice". The International Rice Research Institute on evaluation of SRI states that "The flexibility in SRI's definition of practices renders SRI a challenge for evaluation and assessment of adoption".

Table 1 : Production (Quintal per hectare) of paddy

	Districts of Bihar		
	Purnia	Nalanda	Gaya
Traditional	35	30	30
SRI	60	70	55
Increase	70%	133%	81%

Source: Bihar Rural Livelihood Promotion Society, Bihar

Table 2 : Economics of rice cultivation

	SRI	Traditional
Cost of cultivation/acre	5,825.5	6,512
Net profit/acre	17,681	9,528
Differences in profit	8,153	

Epilogue : Changing and modifying farming practices is a challenging task. The adoption of SRI by the farmers of Bihar demanded systemic experimentation, collecting and collating learnings, meticulous planning and collaboration with a range of institutions.

SRI cannot be a package but is a dynamic practice, requiring regional variance per temperature, pest types, in terms of water management, etc. This method had huge potential of improving the livelihoods of small and marginal farmers improved earnings from the same unit of land primarily on account of reduced costs. Thus, SRI can be an answer to household food security for marginalized farm households.

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