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System of Crop Intensification – An Experience with SRI Policies and Perspectives

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Abstract

Indian population growth by 2030 is expected to be 1.515 billion surpassing China with the present trend of reduction in arable land created a challenge on the sustainability of food production system. Countries of Asia, Africa and Latin America due to the population pressure and to safeguard the food security have adopted a system of crop intensification among various crops like wheat, finger millet, sugarcane, mustard, soybean and kidney bean. The system of crop intensification along with new technologies could show crop improvement in the growth of yield during the previous decade (2011-12 to 2021-22) in rice-wheat. There is an evident yield gain particularly in SRI cultivation as reported by many researchers. The technologies of SRI advocate intensive use of some inputs combined with organic components making the plant sturdy for better intake of nutrients. Studies on standardization of the techniques for SCI by repeated experimentation are observed as a lacuna by the present study.

The recent alternatives like using less quantum and more efficient use of water recommended by dry seeded rice techniques in compression with SCI techniques were not tested with ground reality. The changes perceived with the policies related to irrigation, procurement, price policy and trade policy are examined in the present study. Additional areas brought into irrigation were always converted into rice fields. Due to area expansion and also by the potential yield gains by SCI, the whole enhanced production will reach the market for want of marketing. This excessive supply of rice reported by the balance sheet of rice which resulted in price crash, price volatility etc. Curbing the unnecessary area expansion under single mono cropping by diversifying with crops like millets, pulses and oilseeds.

The excessive supply also creates a burden on procurement of grain which necessitates additional storage space public and private and payment burden on Central government as well as agencies like FCI. Instead of MSP as a whole a differential payment approach also can be adopted to reach more farmers and cover volumes of production. Moreover, additional supply may create more exports but the question of virtual water trade arises there resulting in a dilemma to expand exports or not. On the other hand, India being a strong exporter of rice can influence the imports of the exporting counties and flare up the food inflation in the world. All the above discussions favor the controlled and balanced production which may be affected through the SCI *i.e*., achieve the desirable production through reduced area under rice thereby allocating the remaining areas in cultivation of diversified crops. The experiences of rice can be replicated in other crops also.

Introduction

Population policy adopted during the past fifty years from 1970 to 202 resulted in a notable decline in annual rate of population growth in India from 2.2 to 1.0 per cent compared to 1.2 to 0.1 per cent in the US and 2.8 to 0.1 per cent in China. Even this controlled growth could not match with the figures of US and China with an expected population of 1.515 billion, surpassing China 1.416 billion by 2030 creating pressure on increasing productivity per unit area posing a challenge to the existing food production systems (https://www.weforum.org/agenda/2022/08/world-population-countries-india-china-2030).

Per capita arable land in India in 1961 is 0.34 ha which declined to 0.11 ha in 2020 (World Bank, 2020), will be diminishing further by 2030 causing a drastic shrinkage in arable land thrusting on accelerated productivity in all the food crops to augment the need to feed the expected additional population of 0.104 billion.

Productivity of the world's major food crops (rice, maize and wheat) already reached to a stagnation (Deepak *et al.* 2012). Concerns have been expressed two decades ago that rice – wheat system is causing environmental degradation along with stagnation in productivity threatening food security (Agarwal *et al.* 2000). The twin threatening issues were stagnation productivity and increasing population left the policy makers with a challenge of expediting for techniques of more crop per drop and conservation of the natural resources. Due to depleting water resources and soil fertility status, Asia and Africa witnessed crop intensification techniques in the form of System of Rice Intensification (SRI) and extrapolated its experience to other crops like wheat, finger millet, sugarcane, mustard, soybean and kidney bean (Binju *et al.* 2014). During the last two decades the CAGRs for rice yield were estimated to be 1.59 per cent (from 2001-02 to 2010-11) as compared to 1.69 per cent (from 2011-12 to 2021-22). In case of wheat the CAGRs for the above periods were found to be 1.20 and 1.74 per cent for the same periods in India. Part if this varied improvement in growth during second period can be majorly attributed to adoption of crop intensification techniques.

SCI – Gains and Experiences

Asia, Africa and Latin American countries widely adopted System of Crop Intensification (SCI) which promoted more root growth, enhanced soil nutrient intake, optimum plants with less water, fertilizer and seed. SCI in crops like wheat, finger millet, chickpea and maize were tried in different states apart from rice. The package of seed treatment, organic sprays, water management and followed spacing specifications of 25 x 25 cm in rice and 20 X 20 cm in wheat resulted in enhanced yields due to deep root system and better uptake of nutrients enhanced yields.

Probably, due to the practices mentioned above under the system of crop intensification in various crops, there have been yield gains reported by various studies conducted. Among all the crops, rice exhibited higher gain in yields ranging from 50-100 percent and 86 percent reported by two different studies compared to the gains reported for other crops such as wheat, pulses, vegetables, finger millet, chickpea and maize (**Table 1**).

Table 1: Experienced yield gains in India under different studies conducted

Crop/ References	Binju *et al.*	LEISA	Prabhakar *et al.*	Gaurendra *et al.*	Ram *et al.*
	Yield gains due to SCI over conventional method (%)				
Rice	86	-	-	50-100	-
Wheat	72	-	35-67	50	18-67
Pulses	56	-	45	-	50
Oil seeds	50	-	-	-	-
Vegetables	20	-	20	-	-
Finger millet	-	14.7	-	-	60
Chickpea	-	20.3	60	-	-
Maize	-	-	75	-	75
Sugarcane	-	-	40	20-30	80-90

Source: Published articles

It can be inferred that the utilization of resources had been optimum for rice under the system of rice intensification wherein, more experimentation had been done in standardizing the practices to be followed. For other crops the recommended management practices have to be evolved through conducting comparative experiments under conventional and intensified techniques. But, due to the potential gains in yields particularly under rice an amicable balance sheet must be developed by recommending the reduction in rice area under the ground water cultivated scenario, diverting the remaining saved water into other crops in the groups of millets, pulses and oil seeds. The state government should encourage conversion of paddy fields into normal cultivable lands suitable for ID crops. For this, a suitable policy package must be envisaged to promote diversification wherein any subsidies and investment support must be linked with diversification as a pre requisite or mandate.

As per the recent estimates of the *www.agriwatch.com,* 2021 the gap between supply and demand is 32.19 million tones (MT) of excessive supply in India, leads to crash in prices, price volatility and burden of procurement of *kharif* and *rabi* rice.

Irrigation Policy

Last few decades, the accelerated irrigation development has been on priority at macroeconomic level wherein the major, medium and micro irrigation projects were funded by the financial institutions and implemented by various states. Raising the height of existing irrigation dams, desilting of water bodies and construction of lift irrigation projects, were promoted / completed in the southern states such as Maharashtra, Karnataka, Telangana, Andhra Pradesh and Tamil Nadu.

In Telangana with the creation of recent new irrigation facilities (lift irrigation projects-*Kaleshwaram, Palamuru - Rangareddy, Sita Rama and Devadula*) doubled the gross irrigated area from 62.48 lakh acres to 136.86 lakh acres from 2014-15 to 2020-21. This further led to expansion in *kharif* area under rice from 35.37 lakh acres to 104.23 lakh acres during the above said period. It is worth to note that during 2014-15, 56 percent of gross irrigated area was devoted to rice whereas the same was 76 percent in 2020-21. Ensuing discussion not only suggests that rice takes away any additional area created compared to other crops, but also resulted in mono cropping poses a potential threat to crop diversity.

The policy directive should be to encourage other crops in the new areas through proper extension mechanism. This will increase the crop intensity and water use efficiency ensuring crop diversification.

Firm decisions on reduction in area under rice coupled with new systems of crop intensification encompassing various direct seeded rice techniques to sustain the production as it is already in excess as inferred from the earlier discussion is required at present. So, the state and policy makers should consider these facts and protect the farmer from falling in the crisis trap. Due to the accumulation of rice stock in the form of carry forward from past season from the farmer, aggregators, private players and buffer stocks along with the current years enhanced production as a consequence of area expansion, flooding into the market necessitate the unimaginable storage space. So if this is not regularized, there may be persistent price volatility and increased risk to the paddy growing farming community. Moreover, construction of scientific storage space through Public Private Partnership (PPP) such as godowns in rural areas at the regional marketing centers may need to be doubled in Telangana if the production is not controlled and unregulated. Lest, it would result in more post harvest losses due to exposure of stored grain to the nature's extremities. At present, rural godown capacity in Telangana is 65 lakh tons (*Telangana Today, dated 24.11. 2022*)

Further to reiterate the state directive should be encouraging crop and irrigation intensity on one hand and crop diversification on the other hand rather than area expansion in single crop leading to mono cropping threatening the sustainability of the production resources. As a move towards the sustainability research policy should focus on Natural Resource Management (NRM) and environmental issues such as long run experimentation on the release of green house gas emissions. Such data should be documented, stored using the new data warehousing and cloud computing technologies to standardize the climate smart operational guidelines.

Procurement policy

There are centralized and decentralized procurement systems in vogue, wherein centralized procurement of food grains as central pool is undertaken by the FCI or State government agencies. State will hand over the quantity procured to FCI for storage as per GOI allocations and movement of surplus stocks to other states. For the stocks received by FCI, the cost sheet is issued by GOI. Accordingly, payments are made to the states.

Under the decentralized procurement system, state government procures, stores and distributes as per the GOI allocations to TPDS and other welfare schemes within the state. Excess stock procured by state will be handed over to the FCI for the central pool. Fully DCP mode was adopted in Telangana (2014-15) along with few other states. Ever since Telangana adopted DCP system almost direct procurement from FCI ceased in the state and there is no involvement of private players also.

Therefore, the procurement policy facilitates procurement of food grains on behalf of central government wherein FCI procures paddy for central pool offering MSP which is open during the stipulated procurement period. So, they are operated by government agencies at temporary procurement centers and aggregation points which will become operational in consultation with the state government.

Custom milled rice is operated by the state by procuring under state agencies and FCI. Further resultant rice from CMR (Custom Milled Rice) is delivered to state and FCI. Out of this total rice procured, 70 % is lifted by FCI for central pool.

Table 2: Procurement pattern of rice in India vs. Telangana

Year	Telangana Procurement in Central pool LMT (rice)	Y-O-Y Percent increase in Procurement	Average Buffer stocks opening balance central pool India	Share of Telangana in Buffer stock	Telangana Rice production	Percent of procurement to total production	No of farmers benefitted through procurement Telangana	Common rice procurement incidental (Rs./qt.)	Payment of GoI to the DCP rice from Telangana (Approx.) (In Cr.)
2014-15	36.04	-	182.77	19.71	44.4	81.17	NA	2722.21	9810.84
2015-16	15.79	-56.19	140.70	11.22	30.47	51.82	535007	2824.51	4459.90
2016-17	35.96	127.74	170.52	21.08	51.73	69.51	1088312	2967.45	10670.95
2017-18	36.18	0.61	184.55	19.60	62.62	57.78	1077667	2919.92	10564.27
2018-19	51.9	43.45	207.69	24.98	66.7	77.81	1474828	3194.28	16578.31
2019-20	74.54	43.62	254.09	29.33	74.28	100.35	1988630	3258.14	24286.18
2020-21	95.25	27.78	254.68	37.39	102.17	93.23	2164354	3404.02	32423.29
2021-22	79.77	-16.25	254.98	31.28	103.08	77.39	921448	3302.44	26343.56

Note: LMT=Lakh Metric Tones

Source: Ministry of consumer affairs, Food and Public Distribution, GoI

Increased production leads to increased expected procurement by the state and problem of undertaking storage by FCI which is presently carried out by hired storage spaces from CWC, SWCs, State agencies and Private parties. If the balanced production is not targeted based on the demand for consumption and requirement of minimum buffer norms by adopting suitable crop intensification techniques and reducing area under rice, the present storage capacities held by FCI will not suffice which envisages creation of more storage space involving private participation under private entrepreneurs guarantee scheme as stated earlier.

During the last three years the buffer stock maintained by central pool is 254.98 LMT of which 29, 37 and 31 per cent is the share of Telangana in buffer stock and moreover per cent of procurement to the total production was 100, 93 and 77 per cent during 2019-20, 2020-21 and 2021-22 reveals that no farmer is interested to sell his raw rice in the open market.

It is important to note from the table that the per cent of procurement to total production was as high as 100 per cent in 2019-20 and lower side 51.82 per cent in 2015-16. The state governments increase the pressure on the centre to procure maximum production from the state. The burden of the cost sheets of CMR including the incidental charges went up to the Rs. 32,423 Cr. (2021-22) which may become around Rs. 36,000 crores with 10 per cent increase in procurement operations. This is resulting in underplay of the demand and supply forces in the open market, bringing entire rice cultivation into the purview of MSP under price policy covered do not comply with Laissez faire market economy.

Price Policy – An alternative to MSP

The policy of allowing the operation of market forces in the open market transparently with free flow of information has to be implemented through regulated markets which will facilitate the price discovery. Farmers would receive the open market price. At this juncture an altered price policy may be implemented in lieu of the MSP by paying the differential amount between the open market price and MSP to the farmers, a less financial burden to centre and state thereby bringing more farmers into the umbrella of price policy.

Another strategy is to bridge the gap between demand and supply for which due care has to be taken by evolving a mechanism of publishing the balance sheet of rice along with other crops so that advance planning and price

forecast and other market intelligence support can be evolved to advocate and implement production to meet the desired level. Strategically, GoI is giving more importance of declaring high MSP to pulses, oil seeds and millets as shown in Figure 1.

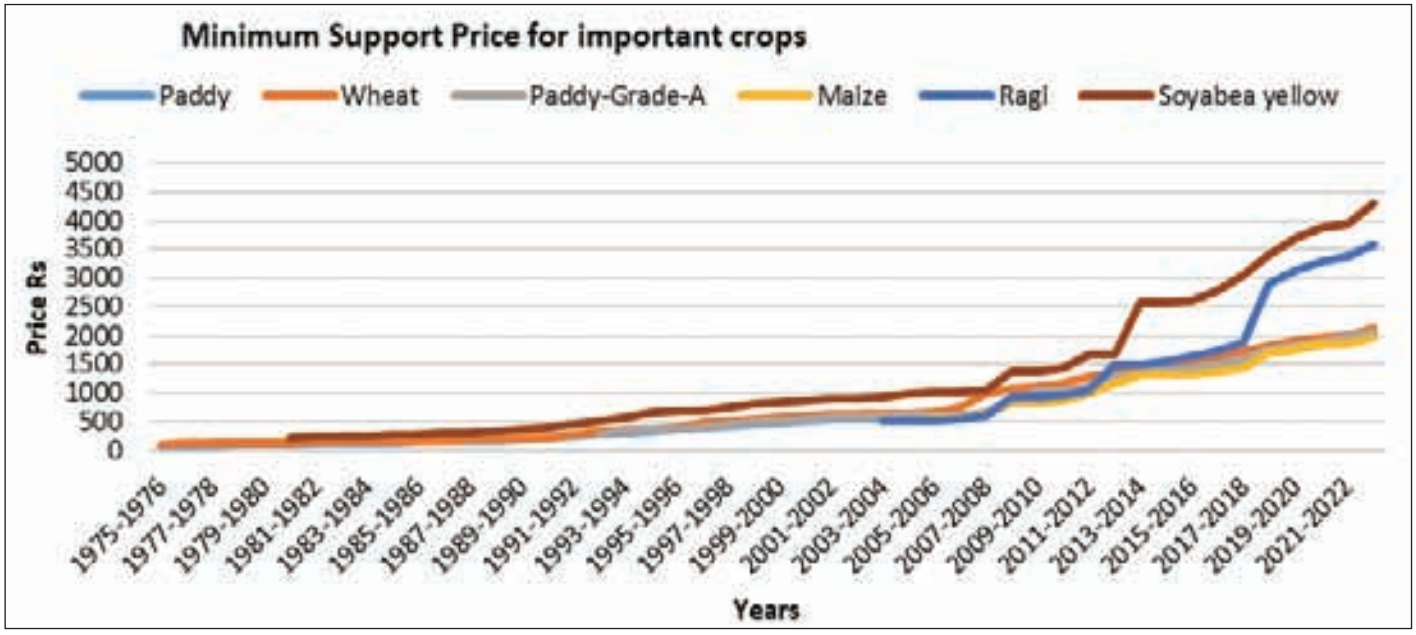

Figure 1: Minimum Support Price of important crops

Source: Directorate of Economics and Statistics, GoI

Table 3: Trade flow of rice in India

Trade flow	Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Exports	Value (million US $)	2296	4073	6128	8169	7906	6380	5316	7076	7347	6800	7980	9624
	Value Growth Y-O-Y	-4.2	77.4	50.4	33.3	-3.2	-19.2	-16.6	33.1	3.8	-7.4	17.3	20.5
Imports	Value (million US $)	0.11	1.18	0.57	1.3	1.6	1.1	0.9	1.6	4.4	11.2	3.3	3.2
	Value Growth Y-O-Y	-29.7	940.9	-51.2	126.1	26.1	-30.8	-17.1	75.0	168.5	153.6	-70.4	-2.4

Source: https://trendeconomy.com/data/h2/India/1006

India exports broken rice, basmati rice, non basmati, rice in husk, husked brown rice, semi milled and wholly milled rice to different courtiers. Broken rice produced in India is mainly used for poultry and cattle feed. Recently, export duty of 20 per cent is imposed on rice in husk, husked rice, semi milled or wholly milled rice, which might lower the prices of rice. Also ban on export of broken rice which is used in poultry feed industry was imposed due to increase in grain exports which is in line with the sustainable development goals of zero hunger. India exports rice to more than 150 countries. Reduction in exports may cause food inflation in other countries. The destinations for rice exports from India are Saudi Arabia, Iran, UAE, Iraq, Kuwait, UK, USA, Yemen, Oman and Canada and for non basmati rice are Benin, Bangladesh, Senegal, South Africa, Liberia, Nepal, Madagascar and Guinea. India imports rice from

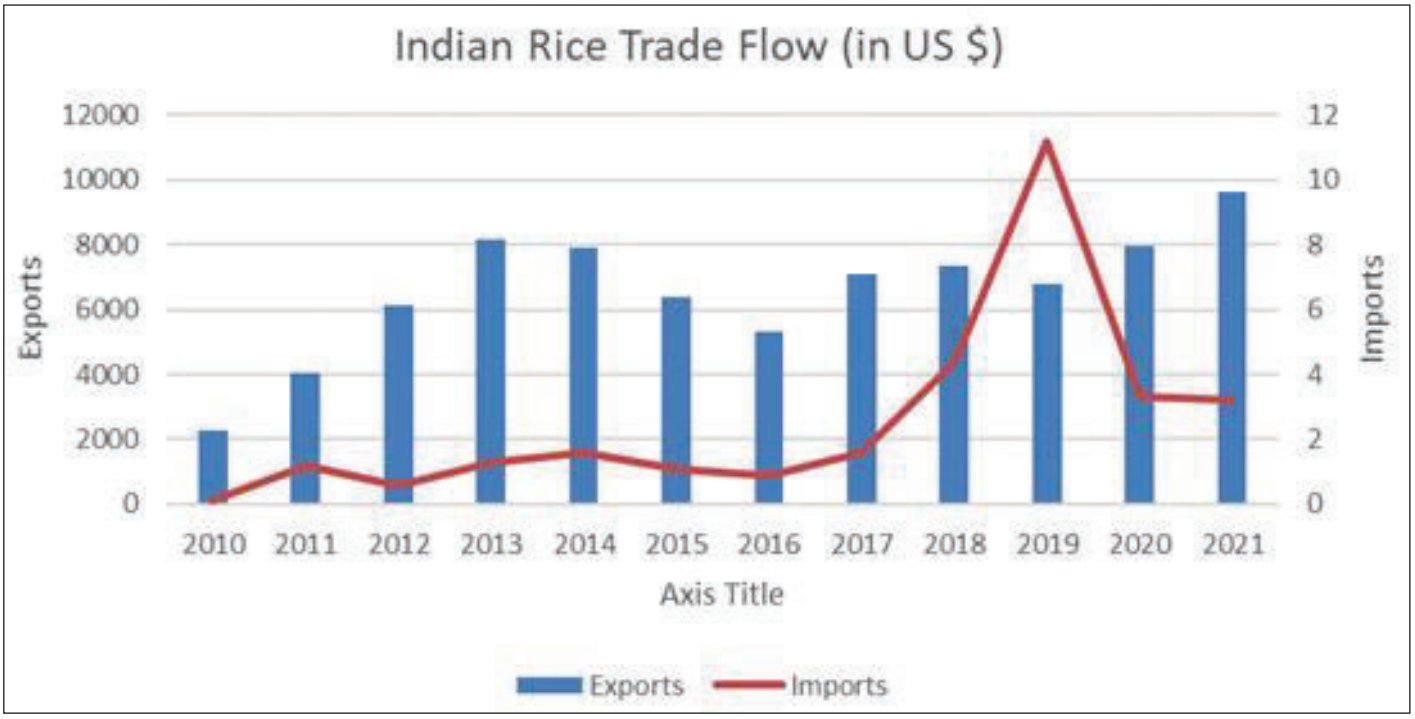

Figure 2: Export and import scenario of rice in India

Thailand, Nepal, Spain, Italy, USA, Russia, Vietnam, Egypt and Oman. Exports in Basmati rice have fallen since last three years due to conversion of basmati acreage into non basmati and due to pesticide residue norms imposed. Nevertheless the Latin American countries opened doors for Indian exports. As discussed earlier, rice exports leads an indirect export of water to other countries.

The phenomenon is called as virtual water trade. The per capita water availability in India is less than a majority of its major importing countries. On the other hand, the export competitors like Thailand and Vietnam better per capita water availability compared to India. In view of all these, wide adoption of water saving techniques like SRI, DSR *etc* are only the possible options.

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