Trends in Horticulture (2019) Volume 2 Issue 1
doi:10.24294/th.v2i1.772

ORIGINAL RESEARCH ARTICLE

A novel launch of public-scientist-partnership (PSP) project as engine for conserving natural resource and creating economic prosperity

Jaya R.C. Yadav[1,2]*

*[*1] Program & Department of Human Resources, Amity Business School, Noida, Amity University, Uttar Pradesh, India.*
E-mail: jyadav2@amity.edu
[2] ICAR-Central Soil and Water Conservation Research Center, Ghaziabad, Uttar Pradesh, India.

ABSTRACT

Some developmental projects are created by people-private partnerships (PPP), particularly where recovery is acquirable by levying the users. Such PPPs are successful for construction of roads, bridges, running toilet facilities and conveyance facility in mode of use and pay. Likewise, public-scientist partnerships (PSPs) will be successful, where monitored impacts can be used to derive benefit. But such example cases are not so popular in utilizing new research results and derive benefits from natural resources and enhance productivity. There is a demand for similar partnership projects in research area. In this study modality of the PSP to create boost engine for natural resource conservation and bring economic prosperity is established. A novel PSP launch was synthesized on useful food crop viz. finger millet (*Elusiane corcona* (l)), which has been known since long past, and now is regaining popularity. It was possible to enhance additional annual production of 5.755 million tonnes of finger millet grain, equivalent to additional income of Rs 11,510 crores. Against this the scientist partnership share was 0.49x million tonnes grain and economic equivalency of Rs 992 crores, which was just 7–8%, with same level of input in agriculture. Additional benefits were sustainability of production and resources consecration, reduction of greenhouse gas emission (GHGs), particularly nitrous oxide (N_2O), largely emanating from agriculture and responsible for depletion of ozone layer. The finger millet stiff stem will be useable for production of ply-board filling material that will be innovative building material for housing and infrastructure developments and making furniture

Keywords: Agricultural Productivity; Natural Resources; PPP; Arid and Semiarid Areas; Food Security; Quality of Living

ARTICLE INFO

Received: 4 June 2019
Accepted: 1 July 2019
Available online: 18 July 2019

1. Introduction

Researchers are creating new product, services or both to fulfill the needs of society and country. A crop viz. finger millet (Elusiane carcona L.) had been cultivated equally well in Northern India, but since strong hold of cultivation of rice and wheat, the cultivation of finger millet has shrunk to few southern states, particularly paddy growing or other low crop yielding states. But public interest is again getting revived as awareness of quality food is building up in the present days. Earlier eating choice of consuming as sole food made from finger millet is now picking up as fascinating reformed blended food of people with health conscious. Thus, in order to facilitate availability, curb steep rise of price and climatic compulsion favoring cultivation, the finger millet is proving as a stake for food production in arid and semi-arid areas.

The finger millet is intensively cultivated during rainy season in almost 12 states of India. An innovative scientific technology has been

developed by nitrogen cycle management named RACY (Land and water smart)—SIFM (System of intensification of finger millet), which has capability of enhancing land equivalent ratio (LER) over 3.77 to 3.88 and is applicable under varying situations. This technology is highly suitable for arid and semiarid areas.

The implementation and adoption of any new research is hampered for demand of popularization, making input available, imparting knowhow and funding the project. In the industrial sectors, finance is arranged by several financial arrangement viz. by issuing bonds, government loans and specially donor agencies viz. FAO and alike international funding agencies. Large public projects have been undertaken under the Public-Private Partnerships (PPPs) and investments get recovered in due course of time by imposing toll tax etc. But, because of climatic uncertainty, uncontrollable situation and involvement of risk and lack of confidence of success, the Public-Scientist Partnerships (PSPs) are not common. Governments strive to sort-out arrangements for launching crop insurance schemes that also demand premium money at first hand, creating additional financial burden at the time when farmers are investing on high-cost inputs of seeds, fertilizers, irrigation and insect pest management. There is no established set norm/ modality of launching of such Public-Scientist Partnership projects, on popular and familiar lines of Public-Private Partnership (PPPs). The research needs for successful crop and enhancing productivity has been completed to almost 80 of research need indicated by the Government of India[1]. This innovative production technology was ready to be launched softly by Public-Scientist Partnership (PSP) mode. But, norms and operations of the PSPs are not adequately worked out for launch of such projects.

Among various value additions, use and build-up of natural resource acquires first and foremost priority. In this endeavor, agricultural research is a profound activity as it fulfils basic human need of food and eliminates hunger. The research results are popularized through field demonstrations, where the technology adoption is very slow. Under this situation PSP can be very effective, fast, and free of any financial burden and creating new way or working mechanism. Thus, PSP may enable public and nations to derive enormous benefit from agricultural research, where large gentry involve as beneficiaries. The objective of the present study was to establish norms of function by demonstrating potential productivity and economic gain by sharing a pinch of gross production and profit to such new techno-commercial ventures.

2. Materials and method

2.1 The scope and opportunity

The cultivation of finger millet occupies substantial hectarage in Karnataka Uttarakhand, Maharastra, Erstwhile Andhra Pradesh, Tamil Nadu and Orissa, in descending order. The scenario of productivity is different viz. maximum in Tamil Nadu > Karnataka > Uttarakhand > Andhra Pradesh. In the southern states of India, the finger millet is cultivated to supplement iron, calcium and other mineral nutrition of food. Special food preparation ranges from house hold preparations to industrially processed foods such as pasta and macaroni (**Figure 1**) are being prepared, that display versatility of food from the finger millet.

Figure 1. Different foods preparations from finger millet grains at house hold and industry levels.

The minor millets, particularly finger millet can be grown with suitable land and water management practice viz. RACY Nature Agriculture[2–4]. The components of conservation practices are uniquely innovated which are different from the those recommended in the Status Report[1]. General overview of recommendation is helpful to understand and appreciate the new innovative technology of production of finger millet.

Table 1. Statistical details of production of finger millet in India

State	Area		Production	Productivity, Kg/ha
	Season	Area, 1,000 ha.	Production, in 1,000 Tonnes	
Erstwhile Andhra Pradesh	Rainy season	46.8 (3.6)	52.8 (2.6)	1,128
Bihar	Rainy season	10.6 (0.8)	8.6 (0.4)	811
Chhattisgarh	Rainy season	8.5 (0.7)	2.3 (0.1)	269
Gujarat	Rainy season	18.2 (1.4)	15.2 (0.7)	835
Jharkhand	Rainy season	11.3 (0.9)	6.5 (0.3)	577
Karnataka	All seasons	781.4 (60.1)	1,412.6 (69.2)	1,808
Maharastra	**Rainy season**	**124.8 (9.6)**	**122.6 (6.0)**	**982**
Orissa	Rainy season	67.7 (4.8	40.7 (2.0)	648
Tamilnadu	**Rainy season**	**84.9 (6.5)**	**180.9 (8.9)**	**2,130**
Uttarakhand	Rainy season	129.6 (10.0)	175.9 (8.6)	1,357
West Bengal	Rainy season	11.5 (0.9)	13.1 (0.6)	1,138
Others	Rainy season	9.4 (0.7)	9.58 (0.5)	1,011
All India	**Rainy season**	**1,299.7**	**2,040.7**	**1,570**

NB: Figures in the parenthesis indicate % share to all India.
Source: Directorate of Economics and Statistics, DAC. GOI, Data based on Status Note GOI, 2014[1].

The finger millet is cultivated in all seasons in Karnataka covering almost 60% of total area under finger millet. However, the maximum productivity (yield T/ha) is in Tamilnadu (2.13 T/ha) followed by second in Karnatka (1.8 T/ha) and third Uttarakhand (1.357 T/ha) against country's average productivity (1.57 T/ha). The lowest productivity comes in Chhattisgarh < Jharkhand < Orissa (2.69, 5.77 and 6.48 T/ha, respectively) (**Table 1**). Thus, there exist vast potential, opportunities and challenges in developing innovative technology for production of finger millet in India and world agriculture. The productivity of finger millet is low in Ethiopia (1.502 T/ha), a Highland country from where cultivation of finger millet spread worldwide[5]. It is a staple food in Amhara region, mainly east Gojjam and Awi zones. It is also grown in Kenya, Nigeria and many other continents in Africa as a food crop smothering hunger stress during droughts[5]. The food situation under aberrant weather condition demand sustainable food production worldwide, where the finger millet stands as a unique food crop.

2.2 The technology

The production technology comprises selection crops, cropping pattern, manures and fertilizer, bed configuration planting and seeding, ultimate green irrigation, zero weeding, integrated plant protection measures, harvest, crop processing, draying and post-harvest cultivation as generation IV (4G) technology. These technology components are unique stage of development[6–8] that involves quantum mechanics in agriculture. That means the modus operand of cultural practices. The modus operandi is fixed and the research requires optimization of doses of inputs. Hence the technology is perfect in many ways and it is supported by irrotational mechanics. Earlier studies in this direction had been only on creation of raised bed and furrows but other aspects viz. enforcement of green chemistry was not created. Thus, earlier non-sustainable system has now been mad fully sustainable and productive. Hence the production system was made ready for adoption by the stake holders in the designated districts where finger millets are being cultivated.

The unified system comprises new eco-agriculture for zero weeding, intra row cropping, inter cropping, inter cropping and opportunity cropping which operate in any finger millet field simultaneously and produce benefits simultaneously of high land equivalent ratios ranging from 3.77 to 3.88. With this LER the total enhanced yield productivity vis-a-vis existing productivity are acquired and dis-

played in **Figure 2**. Thus, although the variation exists in the yields in different states, the yield differences are remarkable due to technology impact. There exists scope for makeup of yield by fortification of production factors.

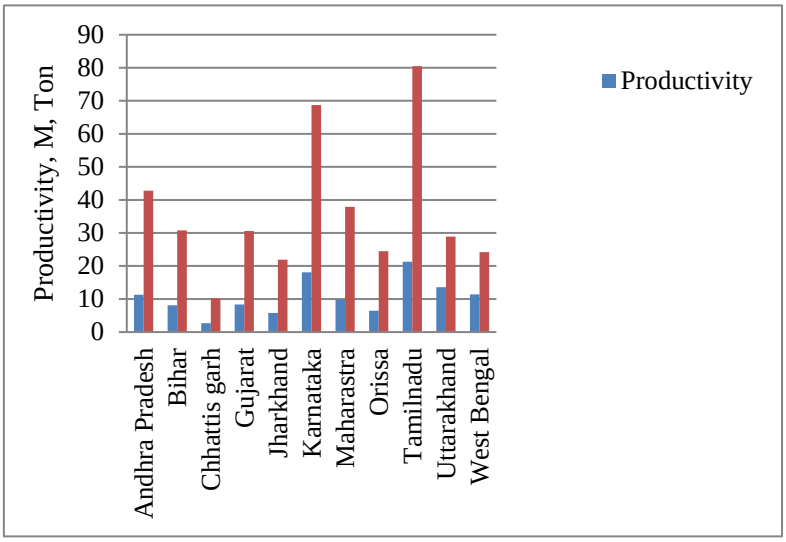


Figure 2. Enhancement in yield of finger millet in different states by technological intervention.

In this research system, intensification of minor millets (SIMM) was developed which produces reasonably high yield with scanty rainfall. The earlier research results sufficiently established workability of technology and created enhancement of land equivalent ratios (LER). The scientific endeavor on the management of nitrogen cycle towards harnessing benefits for creating entrepreneurship[7] enabled the creation of this venture. This novel system alleviates food shortage and starvation that will be insurance for getting relief from famine like situations.

Table 2. Enhancing productivity of finger millet by RACY-SIFM PSP project

S. No.	Main crops	Established LER
1	Finger Millet (Control)	1.0
2	Finger Millet Based+	3.80
3	Pigeon pea Based+	3.80
4	Pigeon pea Base++	3.87
5	Sesame Based++	3.70
6	Castor Based++	3.88
7	Castor Based+	3.77

*: Based on study of Yadav *et al.*[9] and Yadav[10].
**: Based on study of Prakash *et al.*[11,12].
+: Based on innovative assessment of data of Midya *et al.*[13].
++: Based on review results of data inferences of Yadav[10].

The RACY-SIMM intensification of minor millet named RACY NATURE-SIMM COMBO as 4G technology for upland agriculture i.e., areas where paddy cannot be cultivated. The RACY-SIMM will facilitate producing nutrient-rich food grain to be processed for marketing and sale. The RACY-SIFM COMBO will also facilitate sanitation by way of providing construction material for sanitation setup's housing, employment, enhancement of GDP and conservation of biodiversity etc. It will fulfill the aforesaid needs and stand as the most scientifically advanced innovation, the Sun agricultural technology[8] to enlighten arid and semiarid areas worldwide (**Table 2**).

The scientist has accomplished almost 83% of research needs of minor millet (**Table 3**) in his research endeavor RACY-SIMM COMBO and RACY SIFM COMBO[4]. Among the minor millets, finger millet is the main crop, which is a grain full of calcium, iron and minerals and free from problem of gluten. The finger millet originated from high land country of Ethiopia, North East Africa[5]. It is also known as Njera in some African countries, but in Ethiopia and Eritrea, another gramini crop teff (*Ergrostis teff*) is used as base material for preparation of injera. The injera is mainly continental food in both the highland countries. Yadav and Chaudhary[8] displayed a unique technology for production to consumption of the teff. This study and the innovative application of nitrogen cycle[7] enabled the creation of vast potential for enhancing LER in production of the finger millet. Like the teff, finger millet is qualitatively useful, but with still

higher productivity and manageable potential than the teff, which is mere grass and with low yield potential. The enhancement in production will enable to export the food commodity and earn foreign exchange, which will enhance national economy.

Table 3. Accomplishment of research needs as prescribed by the Directorate of minor millets, government of India

S. No.	ICAR prescribed research needs	RACY-SIFM accomplishments	Remark
1	Biotic and abiotic stresses	Ameliorated	*
2	Specific germ plasm	Not endeavored	
3	High yielding varieties	Not endeavored	
4	Manures and fertilizers	Scientifically decisive amendments devised	*
5	Bed configuration	Raised bed and furrow, created with scientific support	*
6	Transplanting	30 cm × 10 cm	*
7	Intra and inter cropping	Details given in text	*
8	Eco-seeding	New innovative tech developed	*
9	Ultimate irrigation	New innovative practice developed	*
10	Moisture, nutrient and crop management options available	All developed as quantum mechanics	*
11	Disease out breaks of new diseases	Organic IPM	*
12	Row proportions for remunerative inter	Decided as per nitrogen cycle management	*
13	Harvesting	Selective, manual	*
14	Post-harvest cultivation	Developed as a nitrogen cycle management	*
15	Fine tuning of the available machinery	Can be possible by mechanic's assistance	*
16	Transfer of technology	Modus operandi devised PSP new system of technology application developed.	*
17	Training of small-scale entrepreneurs	Training module and new selective product developed	*
	Total	Accomplished	15/17 = 88 = 88%

*: Yes—accomplished

2.3 Sustainability of the Technology

The technology characteristics and capability were analyzed in terms of 17 indices viz. climatic, production prospecting, need of tools and plant, conservation of resources, improvement of land nutrient etc. It was fully displayed that RACY-SIFM[4] makes production of finger millet possible from zero under drought condition to very high productivity. The yield of finger millet is lower than that of higher yielding crops viz. paddy and wheat. Thus, RACY SIFM is a technology that facilitates acquiring confidence in productivity under any weather condition, of course during rainy season in most of the states cultivating finger millet. Unlike the other states, in Karnatka, the finger millet is cultivated in all three season namely, rainy season, winter season and short summer season**.**

2.4 The PSP application mode

Normally, research results are demonstrated to the farmers, which creates slow pace of adoption. Some projects are launched by applying the technology and enable the government to acquire benefits and allow agreed share to the project implementer. The public-private partnership is one mode of bringing development and makes use of resources. For a new technology produced by research application public-scientist partnership (PSP) should be best option, as it takes into account compensating intellectual property right of technology

2.5 Norms for partnership

As evident from the fore going details, the technology has potential to enhance the LER up to 3.88. The level of enhancement in yield over the yield established by the government of India on the Directorate of minor millet vide the status note and level depicted in **Figure 2**, the negotiating compensation percentages can be worked out. In this new modality the negotiation is proposed at enhancement levels of 1 LER, 2 LER. 3 LER and 3.8 LERs (**Table 4**).

Table 4. Proposed norms of sharing benefits under the PSP project

S. No	Enhancement			
Up to LER	Net gain of LER	Cumulative gain	% share of PSP	
1	1.0	0	0	0
2	2.0	1.0	1.0	5
3	3.0	1.0	2.0	7
4	3.8	0.8	2.8	10

2.6 Monitoring mechanism

The PSP will conduct orientation training for the policy makers, executive implementing and launch field demonstration in some selected zones of the state who wishes to launch this PSP production enhancement plan (**Figure 3**). The scientific PSP launching states will engage field demonstrator and care takers who will be counterpart for the supervising persons from the state side. The intermittent field visit, photo graphs and the final harvest will be recorded as proof of enhancement and share of compensation will be fixed as per norms agreed upon vide **Table 4.** The PSP launching scientist will provide operations chart for his implementing personnel and new machines. The seed money will be provided by the state to facilitate the launch of the project that will be adjustable in due course for settlement of bills.

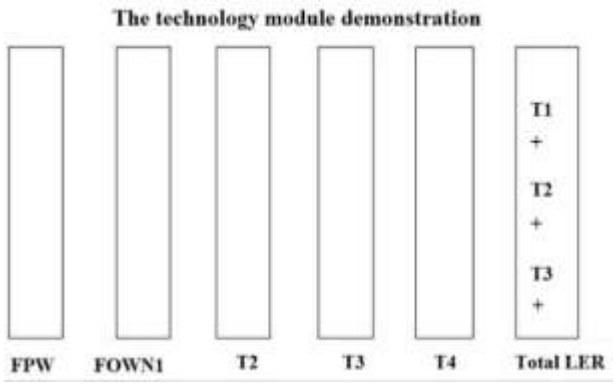


Figure 3. Experimental plot for monitoring of enhancement in yield and deciding LER for share accounting.
FPW: farmers practice fully weeded
FONW1: Farmers practice no weeding
T1: Eco-sowing for zero weeding
T2: LER supplementation I
T3: LER supplementation II
T4: Opportunity LER supplementation III

$$LER = Yc \times Pc/Pce \quad (1)$$

$$\text{Total LER} = \text{LER T1} + \text{LER T2} + \text{LER T3} + \text{LER T4} \quad (2)$$

Where:

Yc: Yield of any crop, q

Pc: Price of the commodity, Money/q

Pce: Price of the commodity equivalent required, money unit/q.

The state government will be assisted in conducting assessment of innovative technology adoption by the stake holders in production of the finger millet.

2.7 The negotiation of the share

Since it is a technology innovated by the scientist, different from one being practiced, it has capability to enhance yield over and above the yield established and being harvested by the states. The stake holders think that they have reached at the acme of production level and they are cultivating at the best way of cultivation. In this innovative technology, it is possible to apply potential technology and the growers will cultivate under the technological guidance of the PSP. The production and resulting economy will create new niche in agriculture. Therefore, only small fraction of the resulting profit will be given as intelligentsia development compensation. Since agriculture is season sensitive and the productivity is highly dependent on it, there will always be need for soft negotiation to let the project function for three seasons. This period will provide ample opportunity to establish the utility, efficacy of production technology. It is hoped that this PSP launch fulfills the need for extra extension and farmers will get fully equipped with knowledge for adopting the new technology. Thus, an agreement for three consecutive seasons will be effective period for the PSP duration. There is scope for negotiation for both the states and the PSP implementer. This has to be agreed upon in soft dialogue and make the project get launched. In addition to the net gains the project will open scope for several other benefits which will be taken up in the Result and Discussion part of the study

2.8 Memorandum of understanding

The memorandum of understanding (MOU) is a widely accepted norm for written agreement that safeguards the interest of the implementing state government and PSP implementing scientist. The MOU will be a bond for conductance and sharing profit as per agreed norm and avoid any escape by the state government once the technology packet is disclosed and demonstrated. This MOU is signed by the highest bosses and accepted by the followers. Any difference of opinion or change in MOU needs

to be amicably resolved. The PSP contract will continue for three cropping seasons. It is expected that the objective of effective introduction and demonstration of the innovative technology will get fulfilled. When a project is successfully completed, there will be several opportunities for further developments of joint entrepreneurships.

3. Result

3.1 Accomplishments of the various impact indicators of the technology

The RACY-SRI COMBO included detailed description of 17 impact indicators and inherent advantages that emerge from the practice RACY-SIMM[2], the indices enumerated revealed the crop weather resilience, linkage, food security, present and posterity, universal application, premises adoptability, erosion control, primary and secondary natural resources use, quality improvement, technology surpassing, correctability, livelihood supporting, TP need resilient, adoption resilience, GDP prone, social security, and green technology. The RACY-SIFM is at par effective with the RACY NATURE-SRI COMBO[4]. In general, the agriculture in arid and semiarid area is becoming uncertain and fail to produce yield. The RACY-SIFM technology produces crop for certain.

3.2 Enhancement of productivity and economic growth

Detailed state with growth in relation to enhancement in growths at technology producing LER 1, 2, 3, and 3.8 for individual slot and the cumulative values are given in **Table 4.**

3.2.1 Enhancement of production of finger millet

Table 5 demonstrates the enhancing production by public-scientific partnership—A case study of finger millet in India, which will form the first reference in convincing the executives of the states to carry out cultivation of finger millets. This technology does not exist in any state for the present; hence it merits acceptance and adoption as a measure towards transforming new era of agriculture in the states. This will surpass the earlier development on green revolution in India. The PSP is the fastest novel way of agricultural transformation, and enable people to harness and get benefited by the new innovation on basic need of the developing country as well as enhancing physical quality of living [PQLI][14] for the developed country as well. Thus, PSP will be a novel way of fast transformation of world agriculture, as established by study of Yadav and Chaudhary[8]. It is clear from **Table 5** that, finger millet is cultivated in Andhra Pradesh, Chhattisgarh, Jharkhand, and Orissa, where crop productivity is low. Most of the land in Uttaranchal and West Bengal is low productive soil. The research and developments have not made any breakthrough on production technology for intensification, at least on lines parallel to that have been accomplished for rice and wheat, hence the yields are relatively low.

It is also apparent (**Figure 1**) that consumption of finger millet is largely made product from sole grain of finger millet. In the past poor digestibility of food prepared from sole grain of finger millet, became cause of dislike for the consumers, its industrial processing and nutritional quality is rendering it regain popularity and liking. The demand and consumption scenario will be rising sharply; hence finger millet will be costly and scarce commodity. In order to get out of difficult situation of shortage of this food commodity, it will be ideal to apply innovative technology and harness natural resources and build economy for states, nation and country and the public. This novel launch of the PSP will emerge as a unique creation in this direction of prosperity of food, environment, price control and relief giving, reducing adverse impact of drought in changing scenario of climate. The technology has capability to enhance yield by 3.8 fold (LER 3.8) and above (**Table 2**)

The enhancement in yield equal to LER 1 is taken as assured yield and there will not be any compensation/share for the PSP. Detailed norms are indicated in **Table 4**. Enhancement in yield over LER 2 is designated as increase and only 5% of the enhancement is taken as share of PSP. Further increase in range of LER 3 is designated as very high increase and the PSP share will be 7%. The increase

in yield > LER 3.0 will be an exemplary increase and the share of the PSP will be 10%. (**Table 4**). The computational details are given in **Table 5**. Additional production is yield at LER 3.8 minus the basic yield (Tonnes) multiplied by the area under finger millet in states. The shares of the PSP were accordingly calculated as share of cumulative yield in Tonnes per ha multiplied by the area under the crop. This share is converted as percentage of total production. This percentage shares comes in range of 6–8 %.

Table 5. Detailed splits of sub heads and gain of production of finger millet to all states

State	Area, 1,000 ha	Base yield, q/ha, LER 1.0, assured	LER 2, increase	LER 3.0, very high increase	LER 3.8, share, exemplary	Company sharpest/ha			Additional yield/ha × area under crop in state, 106 T	PSP share at LER 3.8, %
						LER 2 5%	LER 3 7%	LER 3.8 10%		
Erstwhile Andhra Pradesh	46.8 (3.6)	1.128	2.3	3.4	4.28	0.0566* 0.0566** 0.00255***	0.077 -1336 0.0057	0.088 0.2216 0.01037	0.1475	7
Bihar	10.6 (0.8)	0.811	1.6	2.4	3.08	0.04* 0.04** 0.00042***	0.056 0.096 00107	0.06 0.156 0.00165	0.02985	6.9
Chhattisgarh	8.5 (0.7)	0.269	0.5	0.8	1.02	0.0135 0.0135 0.00011	0.0189 0.0324 0.00043	0.025 0.0574 0.00048	0.0061	7.8
Gujarat	18.2 (1.4)	0.835	1.7	2.5	3.06	0.0419 0.0419 0.00076	0.0595 0.1014 0.00019	0.062 0.1634 0.00297	0.0423	7
Jharkhand	11.3 (0.9)	0.577	1.2	1.7	2.19	0.02885 0.02885 0.000326	0.042 0.07085 0.00088	0.049 0.1185 0.00134	0.01828	7
Karnataka	781.4 (60.1)	1.808	3.6	5.4	6.87	0.09 0.09 0.07	0.126 0.216 00.17	0.147 0.363 0.2868	3.967	7
Maharastra	124.8 (9.6)	0.982	1.9	3.0	3.79	0.0491 0.0491 0.006	0.0685 0.1176 0.0147	0.079 1966 0.0245	0.36167	7
Orissa	67.7 (4.8)	-648	1.2	1.9	2.45	0.0325 0.0325 0.0022	0.042 0.0755 0.00511	0.055 0.1305 0.0088	0.1222	7
Tamil Nadu	84.9 (6.5)	2.13	4.2	6.33	8.05	0.105 0.105 0.21	0.147 0.252 00.428	0.172 0.424 0.848	0.5026	7
Uttarakhand	129.6 (10)	1.357	2.7	4.0	5.15	0.068 0.068 0.009	0.095 0.163 0.021	0.109 0.272 0.03525	0.4916	7
West Bengal	11.5 (0.9)	1.138	2.3	3.4	4.3	0.0560 0.0560 0.00065	0.0805 0.1405 0.001616	0.11 0.254 0.0029	0.03847	7.6
Others	9.4 (0.7)	1.011	2.0	3/0	3.84	0.0505 0.0505 0.00047	0.0707 0.1212 0.00139	0.082 0.2032 0.00191	0.0266	7
All India	1299.7	1.57	3.1	4.8	5.99	0.0785 0.0785 0.063	0.1095 0.1880 0.2442	0.109 0.2970 0.3858	5.7416	6.7

PSPs gain for production increase; ** PSPs gain cumulative T; *** PSPS Economic share
Total gain to the country 5,755,000 Tonnes
$5{,}755{,}000 \times 20{,}000 = 115{,}100 \times 10^6$
$496{,}000 \times 20{,}000 = 9{,}920 \times 10^6$

The maximum production comes from Karnatka (3.967 M T), followed by second from Tamil Nadu (0.5026 M T), Uttaranchal (0.4916 M T) and Maharastra (0.36176 M T.) The global production in the India comes to be 5.7416 M T. On the other hand, the minimum production of finger millet was in Chhattisgarh < Jharkhand < Bihar < (.0061, .01828 and .02985, respectively). Thus, these states require detailed study about why yield of finger millet is so poor. It seems there has been crunch of innovative technology for finger millet production. Green revolution dominance of high

value production technology and yields rendered the finger millet still remain as least preferred food. But this crop will stand as means of livelihood support. Hence it needs some technological revolution. In such situation the scientific expertise should explore factor of hindrance and ways of improvement on consultancy basis, if agreed upon by the state administration.

Figure 4 depicts the status of production of finger millet. The states in **Table 5** are all cultivating finger millet. The Major states are Karnataka, Tamil Nadu, Uttarakhand and Mahrastra. The compensation shares of the PSP are given in **Table 5**. The PSP shares range between 6 and 8%.

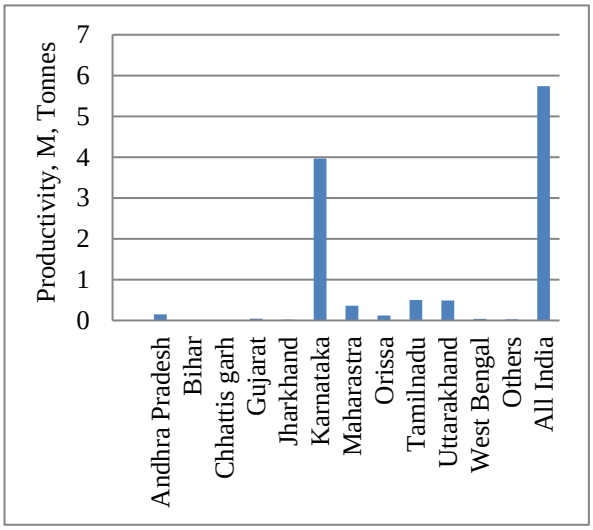


Figure 4. Total production in different states with technological interventions.

3.2.2 The resulting economic gains

The price of finger millet is very high and it is difficult to find in local market. It is available in Malls at price not less than Rs 80/kg. Taking the pragmatic view and farmers selling ability, a selling price of Rs 20/kg i.e., Rs 20,000/tonne is adopted for computing the economic gain that will be generating by the PSP. The same price norm was applied to compute the economic share of the PSP. At the state level overall economic gain from the PSP was Rs 11,510 crores and the share of the PSP Rs 992 crores in one crop season. Depending on the resulting yield will emerge by field monitoring, there will be adjustment in the share of PSP and the overall economy of India. This PSP norm will serve an example for entire world agriculture. As indicated in the production section, the share of economic return to PSP will remain the same as earlier.

3.2.3 Priority phasing for launch of PSP

Having knowledge of total potential of productivity and equivalent monetary gain at state level as well as for India as a whole, it becomes imperative to take appraisal of the grouping of the states for the novel launch of PSP for finger millet cultivation.

In the Priority I only four states are selected which have high production potential viz. Karnataka, Tamil Nadu, Uttaranchal and Maharastra. Among all these four states under the priority I, Karnataka acquires almost 60% of production share of India. That means this is a number I states with high potential. Karnataka state share is Rs 7,934 crores and PSP share Rs 573 crores. Similarly, Tamil Nadu acquires Rs 1,005 crores and PSP Rs 72 crores. Uttarakhand economic gain will be Rs 983 crores and PSP share 71 crores. For Maharastra, the economic gain will be Rs 723 crores and PSP share Rs 49 crores. The total economic gain from launch of technology by the PSP would result in Rs 10,458 crores and PSP share Rs 765 crores. These economic returns correspond almost 91% and 77% to India's production and PSP shares, respectively.

It is logical to think and give value to the potential technologies that will need care and attention to enhance yield in states where yield productivity levels have already acquired high plateaus. To break these plateaus, the technology implementation will require careful application of inputs to break the yield barriers and create new plateaus. Therefore, in this stride the compensation levels are increase by small fraction vide column 7 (**Table 6**.)

The states which fall in the category of priority II are states namely, Andhra Pradesh, Orissa, Gujarat, West Bengal and Bihar resulting in total economic gain of Rs 468 crores and PSP share of Rs 74 crores. This segment corresponds to 4% and 0.65–1%.

The shares emerging in column 6 showed some discrepancy in summing up % share of the states. The shares were adjusted in accordance with the global revenue and PSP share as displayed in column 7. The priority I segment occupies Rs 898

Crores, Priority segment II 87 crores and priority segment III 5.2 crores.

Table 6. Priority of implementing the PSP launch for finger millet in potential states of India

Phase	S. No.	States	Prod, million T	Share of PSP, million T	Share, %	Negotiated share, %	Economic gain, Rs, crores	PSP's share, Rs crores
1	2	3	4	5	6	7	8	9
I. First	1	Karnataka	3.967	0.2868	7.2	7.86	7,934	673
priority	2	Tamil Nadu	0.5026	0.03559	7	7.65	1,005	85
	3	Uttarakhand	0.4916	0.03525	7	7.65	983.2	83
	4	Maharastra	0.36167	0.0245	7	7.65	723.2	58
		Total	50.4329	0.38214	7	7.77	10,458	898
	5	Erstwhile Andhra Pradesh	0.14705	0.212	7	8.2	294	49
II. Second	6	Orissa	0.1222	0.0088	7	8.2	242	21
priority	7	Gujarat	0.0416	0.0025	6	7	92	5.9
	8	West Bengal	0.03847	0.0029	6	7	74	7
	9	Bihar	0.02985	0.0016594	6	9.4	59.7	3.5
		Subtotal					468	87
III. Third	10	Jharkhand	0.01828	0.00134	7	8.2	36.6	3.5
priority	11	Chhatisgarh,	0.0061	0.00046	7	8.2	12.2	1.1
	12	Others	0.0266	0.00019	7	8.2	53	0.47
		Sub TotaL					102	5.2
							11,018	990
	13	All India	5.755	.495	8.6	8.6	11,510	990

The currency equivalency 1 US$ = INR 65 (approx.) March, 2016.
5,755,000 × 20,000 = 115,100 × 10^6 (11,510 Crores).
496,000 × 20,000 = 9,9 20 × 10^6 (992 crores)

Figure 4 presents unified view of the economic gain and share of the PSP launch. It is becoming clear that PSP launch can be profitably implemented in priority segments I and segment II. Thus, the present study has substantiated feasibility of PSP launch in agriculture for food security, sustainability and PQLI practicing developed countries.

Figure 5 presents comparative gains of production million tonnes and economic gain of country and the PSP for easy comprehensions for academics, executives and policy makers. It is apparent that the gain is tremendous and the share of the PSP is very minimum (<10%). Thus, it is the most profitable avenue for productivity and economic development in India and world agriculture. This justifies launch of PSP as a supremacy over other ventures.

Once the priority of launch has been decided, further inner details of economic gain in Priority (A) is displayed in **Figure 6.** The maximum (91%) appears in Priority I, 8.7 in Priority II and 0.7% in Priority III. Further insight of contribution fromdifferent states are displayed in B (**Figure 7**). The state preference for launch of PSP is Karnataka > Tamil Nadu > Uttaranchal > Maharastra. Thus, this study has fulfilled objective set at initial stage. The status note[1] contains names of the districts where

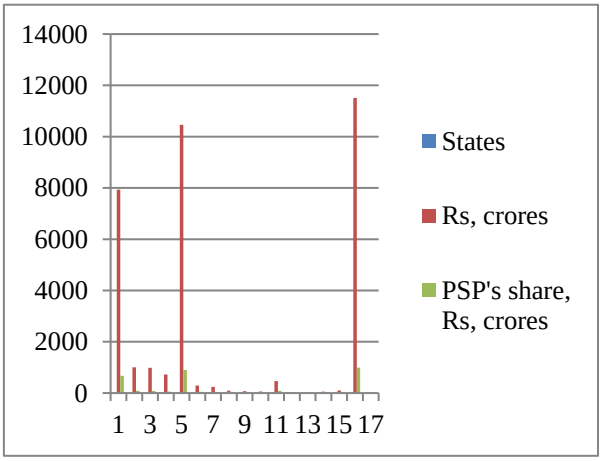
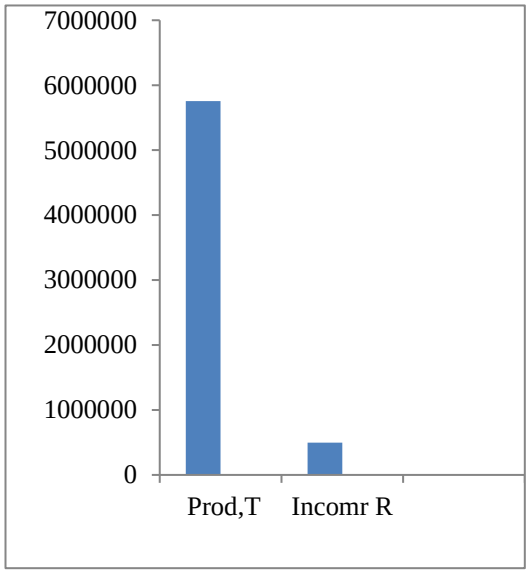
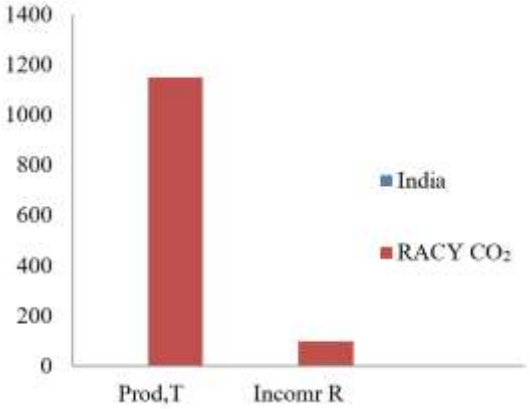


Figure 5. Distribution of economic gains and PSP's share due to launch of RACY-SIFM PSP project in India.
Note: 1–4 states constituting Priority I 5, Total of Priority I; 6–10 priority segment II, 11 total of priority segment II and 12–15 priority segment III and 16–17 all India economic gains and PSP's share.



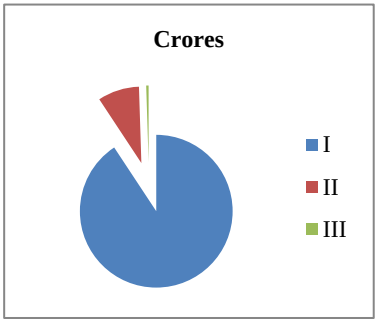
A. Production, Tonne



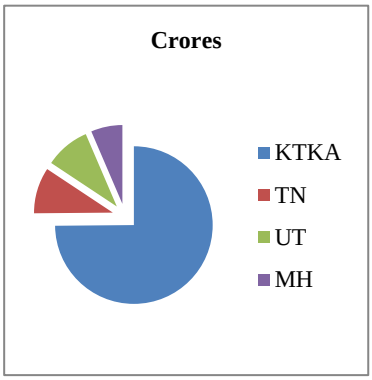
B. Income Crore Rs

Figure 6. Overall comparative production and income gain to India and RACY PSP, due to novel PSP launch.

cultivation is taken by large proportion of the farmers. The finger millet farmers are largely poor farmers, improvement in production potential and resulting economic gain will be real social upliftment welfare in states. This new three level IPR novel technology will be a boon for India in particular and any nation in general. The technology once disseminated will spread by its impact that will transform world agriculture to new elevated niche with nutrient rich production. Many cropping practices such as tobacco cultivation is becoming new issue of agitation in Andhra Pradesh[15]. This RACY-SIFM COMBO is a novel launch for livelihood support in such distress situations. The RACY SIFM COMBO PSP is an alternative for replace undesirable cultivation of tobacco and bring social justice with innovative technology of finger millet. Andhra Pradesh is cultivating finger millet, but it has no impact due to lack of novel technology. The RACY SIFM will enable economy at par with the tobacco in a few years. Thus, bringing social and livelihood add compulsion for launch of PSP in Guntur district of Andhra Pradesh.



A. Priority segment



B. Contribution of states in priority segment I

Figure 7. PSP's Share in different priority segment of Priority launch and states in priority I.

3.3 Allied additional benefits

The technology implementation under the PSP will enhance productivity, and economic gains for the country and the PSP share. It also provides additional benefits of making flourishing of diversity of production, which is displayed in **Table 7**. The launch of this innovative technology-based PSP will induce sufficiency of cereals, pulse and oilseeds in the state. It will form a new style of promoting adoption of innovative technology for the user groups. It is a new dimension of ongoing agricultural extension. It requires creating favorable environment in any given state to launch the PSP projects and create production and economy. The successful launch and implementation will produce eagerness among farmers to start again cultivation of finger millet that will promote self-revival of food security.

Table 7. Production of other food commodities

S. No.	Cropping systems	Cereals	Pulses	Oilseeds	Other, Cash
1	Finger Millet (Control)	FM	-	-	-
2	Finger Millet+ GG, +BY	FM, BY	GG	-	
3	Pigeon pea + GG + FM	FM, BY	PP, GG	-	
4	Pigeon pea + GG + BY	BY	PP, GG		
5	Sisme + GG, +FM	FM	GG	SI	
6	Castor +GG +FM	FM	GG	Ca	
7	Castor +FM,	FM	GG	Ca	Csh++
=	Mission mode productions*	C++	P++	O++	Csh++

BY: Barn yard; Ca: Castor; FM: Finger millet; GG: Green gram; PP: Pigeon pea; Si: Sisme *Showing new way of missions on production of different cereals, oil seeds, and pulses.
C++: Cereal production mission
P++: Pulse production mission
O++: Oil production mission
Csh++: Cash crop production mission

4. Discussion

The study has substantiated and demonstrated the novel mode of launching innovative technology RACY-SIFM in India for production of finger millet grain and resulting economic gains by the PSP project. The novelty of this study rests in the innovative and prospecting technology and launch of adoption promoting innovative PSP project in lieu of slow progress established by the extension services. The extension specialists remain only on field demonstrations and other means of popularization. In the PSP mode the implementation has been created parallel to the form of other sectors of PPP models of developing public welfare projects, which overcome several hurdles of implementations.

The RACY-SIFM has accomplished 83% of research needs prescribed by apex research establishment viz. ICAR, hence it reduces time, scientific time and money on one hand and makes an innovative technology ready to implementation at any time from now. There is no extra manpower, machines, input and expenditure for implementation in any given state. Earlier study on utility on Business Process Out sourcing (BPO) revealed that it will be the most economical way of facilitating agricultural practices[16]. The PSP is a further improved way of a technology launch for complete package implementation. It is a step ahead for launch of total technology towards bringing food security, sustainability, resources use and facilitating biodiversity etc. in any state in India and abroad. The food is a universal demand so this venture makes sufficiency of availability of finger millet and other commodities of food.

It is clear that due to low digestibility of food grains, people's preferences went low and cultivation of finger millet shrunk to only few states in India. But health consciousness is again developing fascination for consumption of finger millet in daily life, owing to the protein with low carbohydrates and minerals viz. calcium and iron. Recently, a new fact has come to the knowledge of this researcher that special pancake made with flour of finger millet is fed with butter milk to the persons suffering from asthma, after giving curing dose of a peculiar Indian fruit (*Bhela)*, at sub-urban setting at Dhobaha near Handia, district Allahabad in eastern India. This is at par a popular remedy and cure of asthma, launched by Hyderabad fish techniques in India. This fact suffices experimental requirement of technology launch. The PSP is capable enough to launch and harness the benefit. The success will add experience for new projects in time to come. Thus, a new beginning was made in this Technology by PSP launch that will come in way to transform new technology and enforcing adoption for harnessing the benefits from research.

It needs to be brought out that the technology capsule RACY-SIFM is developed by enforcement of quantum mechanics (i.e., a fixed mode) and bestowed by irrotational dynamics, which is highly suitable for all sites, ecosystems, with and without irrigation. The technology encompasses best mode of land and water management and combination of plant physiological innovation, on lines similar to the RACY-SRI COMBO[3]. Since the finger millet had become a food commodity of lesser preference, people preference got reduced for cultivation and so

had been thrust on research and development. The status note did prescribe long list of research needs, which will take decades to accomplish and acquire research lessons and again similar time for popularization of the technology. The scientific endeavor[3,4] accomplished almost 83% of visualized research needs, even far more appropriate than what had been envisioned vide the national report[1]. Thus, this research has become example of eliminating wilderness and creating fixed module agriculture. This has created an intellectual property right (IPR) of the research scientist.

The new mode of project launch named as RACY-SIFM PSP, is a further innovative way of implementing innovative technology module for enhancing productivity and economic gains. Thus, vast benefit can be created for states undertaking large scale production of finger millet. Such four states viz. Karnatka, Tamil Nadu, Uttarakhand and Maharastra, were identified for launch of the RACY-SIFM PSP. The second priority group of the state can be brought under this launch after initiation of the launch under Priority I. The priority group III does not sufficiently prompt the PSP launch, instead it can be taken up under technology popularization by usual course of application of extension methods. Both the situations of PSP and conventional extension of innovation for user adoption will provide opportunity to conduct evaluation to find ways for transforming agriculture in to new generation. Thus, technology application mode is another step towards IPR. Since no national funds have been spent on this innovative tow stage IPRs, it will be an intelligent way to opt and promote its implementation by merely parting with share <10% and create state wealth >90%, with same level of input in agriculture.

The technology and RACY-PSP launch creates sufficiency of food for both subsistence striving and PQLI practices countries. Thus, it is a technology safeguarding global interest for fulfilling important need of food, The demand of the finger millet grain is likely to increase in time to come (**Figure 1**). This demand may generate need for import from outside. But this food grain is not sufficiently cultivated in world agriculture. Hence, there is no possibility of importing from outside to keep control on rise in price of grain finger millet. It will be a wise step to adopt novel launch of the RACY-SIFM COMBO PSP to produce large volume of finger millet for house hold consumption, selling to market and export to earn foreign exchange. As indicated, the crop finger millet originated from Ethiopia and Eritrea, both highland countries in north East Africa, is cultivated with low yield. There has been crunch of technology. It will be possible to extend the RACY-SIFM PSP and cereal continent of fulfilling their need and export to the rest part of the world. The consumption of finger millet will enable overcome diseases related to calcium and iron deficiency, in general. The grain will supplement new realization of the fact that FOOD IS MEDICINE.

The technology facilitates nutrient building and is eco-friendly, hence it will be coping with eco-friendly agriculture. It is a technology that copes up with moisture stressful situation, usual characteristic of arid and semi-arid condition The finger millet grain will be food and cash generating crop for poor farming communities for house hold consumption as well as industrial uses. There is no problem of sale, always in great demand, can be stored to safeguard hunger and remains free from insect pest attack in storage. This rejected crop will become wonderful crop for cultivation in world agriculture. The innovative technology and new launch of PSP have merits of double IPR. It needs realization, appreciation and reward that will accelerate world gentry to adopt and launch RACY-SIFM PSP.

Recently, a scenario is coming up in Andhra Pradesh, where farmers had been cultivating tobacco for cigarette in Guntur district. This finger millet cultivation can become an alternative for free tobacco cultivation in India. In this situation RACY-SIFM COMBO-based PSP will be a great relieving alternative to create new avenue for restoring and safeguarding livelihood of such lots of farmers. Andhra Pradesh already started cultivating finger millet. The Guntur district can be brought as a special case in Priority I as it is under burning issue of the farmers representation and appeal to the

Government[14,17]. Thus, RACY-SIFM COMBO PSP will become an effective way of bringing security of livelihood in India and abroad. This is a beginning of novel launch, whose success will equip the world with technological PSP to bring new prosperous world with respect to nutritious food security and economy by sharing a pinch of emerging profit.

The technology had been sufficiently experimented, insight developed and new synthesis created. All needed aspects of the technology have been accomplished by the scientist. Its implementation is at par with the PPP projects, where feasibility reports serve as basis for justifying acceptance, funding and implementation. This RACY-SIFM COMBO is a fully established research based on scientific innovative technology, which attracts equal weightage and merit for implementation. Hence, it should be accepted as new implementation free from skepticism of past experience.

5. Creating conducive condition favorable for PSP implementation

The PSP launch is a mission mode implementation. There do exist regular concern departments, which do implement regular ongoing programs. The RACY-SIFM is a new innovative technology, which involves cost of technology IPR and implementation. In spite of all these facts, the PSP will produce commodity and economic gain at very minimal sharing of the additional income. It will be a boon for the Priority I segment states viz. Karnaataka, Tamil Nadu, Uttarakhand and Maharastra. These states should create and provide environment conduce for implementation of the technology for duration of three years. The state machineries should cooperate in implementation and help to monitor progress that would be necessary for assessment of yield enhancement. Honest and cooperative working will bring prosperity in the states under the PSP. The new livelihood safeguard is appearing new challenging issue to be addressed. The MOU should be signed and publicized to let people know about this technology mission launch in the state and people get fully be informed about it.

6. Conclusion

The present study has created novel dual IPR technology and soft way of RCY-SIFM COMBO launch by Public-Scientist-Partnership (PSP) for enhancing production of finger millet, a forgotten crop, but now regaining prominence and economic gain for promising states under Priority I and Priority II in India. As a special case Guntur district of Andhra Pradesh, where tobacco farmers are skeptical for their livelihood, can also be included in this novel PSP launch with different justification of social and livelihood security. The technology will enhance production of 5.755 million tonnes in all 12 states and across India. The corresponding financial gain will be Rs 11,510 crores, at moderate cost of sale of finger millet (Rs 20,000/T). The corresponding shares of PSP implementation would be 0.465 million tonnes finger millet grain and equivalent monetary gain of Rs 990 crores. Thus, the RACY-SIFM COMBO will provide implementing states with enormous food production and equivalent economic gains, which otherwise will not come with usual course of technological development and application. The RACY-SIFM COMBO is an innovative joint technology capsule and PSP is an additional novel way of technology enabled benefit harnessing method. This PSP project will produce several other benefits for the implementing states in particular and country in general.

Conflict of interest

The authors declare that they have no conflict of interest.

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