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-Editor

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Study on Impact of Mann Ki Baat Programme on Organic and Natural Farming

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ABSTRACT

The study tries to highlight the impact of unique radio programme 'Mann Ki Baat' hosted by Prime Minister of India especially the episodes covered on organic/natural farming. The objective of the study is to assess the impact of Mann Ki Baat programme on three sets of stakeholders' viz. KVK functionaries, farmers and consumers. The paper aims to analyze the extent of awareness, participation, trickledown effect as well as adoption of natural farming practices by farmers. The study covered the selected KVKs based on the substantial involvement in promotion of organic/natural farming covering 10 ATARI zones across the country. The farmers and consumers who have participated directly and indirectly in the episodes of organic/natural farming covered in Mann Ki Baat programme were randomly selected by the selected KVKs. The key finding is that about 92 per cent of the farmers were interested to change the farming practices, 82 per cent have made follow-up visit to learn further, 78 per cent have shared the information with other fellow farmers and about 78 per cent of the farmers were happy to listen to Prime Minister directly on organic/natural farming. Whereas about 88 per cent of the consumers awareness level increased, and 63 percent convinced towards organic / natural farming products after listening to Mann Ki Baat Program. Majority of the KVKs (88%) have organized 1-10 nos of Mann Ki Baat Program both in on campus and off campus. Whatsapp and mobile SMS were used to popularise the Mann Ki Baat program and KVKs have taken various follow up activities to give handholding support to the farmers to adopt organic/natural farming.

Keywords: Mann Ki Baat, Natural Farming, Organic Farming, Farmers Perception, Technology Adoption

Introduction

Radio has been considered as powerful mass communication channel despite of

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rise in social media. In the past two decades, Radio has re-emerged as a popular entertainment medium with introduction of FM channels across the country and introduction of feature and smartphones enabled with radio receivers (Garhwal et al. 2023). In India, a number of radio programmes are focusing on farm information intending to create awareness on the latest technologies and innovations. Since Independence radio has played an instrumental role in building the roadmap of development. For example, Farm and Home programmes of All India Radio (AIR) are broadcast to create awareness to improve the agricultural productivity and quality of the farming community.

Government of India use this important platform for a unique program "Mann Ki Baat" wherein the Prime Minister of India, Shri Narendra Modi connects with common citizens of the country and addresses directly every month on Sundays and also invites suggestions from listeners. The first Mann Ki Baat programme was broadcasted on 3rd October, 2014 and so far 99 episodes were completed. The program can be heard on about 422 radio stations and relay centres with about 40-50 million listeners (Garhwal *et al.* 2023). The programme runs for 20 to 35 minutes on various topics of national and emerging social & governance issues such as social, cultural, economy, energy, defense, education, agriculture, flagship programs and schemes of government and solutions to overcome various development challenges.

This program is gaining popularity not only in India and also got listeners across the globe as the Prime Minister himself is creating mass awareness, spreading knowledge about various initiatives of Government, common concerns/problems associated with every citizens, issues of national concerns and incidents happening across the globe, its consequences to citizens of India and government preparedness to emerging issues etc.

Out of 99 episodes, in 22 episodes, Prime Minister has made considerable mention on Farming sector and Farmers Welfare to motivate the farming community and other stakeholders to drive innovations. In the farm sector, emphasis was given on Integrated farming covering Animal Husbandry, Horticulture and Fisheries; Modern Technologies in efficient irrigation through Micro Irrigation, Solar Pumps, Climate Resilient Agriculture; Agri Infrastructure Fund, Farm Credit, Soil Health Cards, Fasal Beema Yojana, PM Kisan Yojana, Kisan TV, Kisan Mela, Farmer Rights and Wellbeing, Land Act, Recent advancements in Agriculture covering disease resistant seeds, Artificial Intelligence in farming and use of machineries; Organic & Natural Farming and better access to markets, minimizing middleman, better storage facilities and value addition of crops etc. PM has covered a diverse and wide-range of topics in various episodes of Mann Ki Baat within farming sector.

Though the Green Revolution has brought several benefits, its negative impact on soil, water, and other natural resources management is debilitating. This is coupled with the risks of climate change in agriculture making Indian agriculture more vulnerable. FAO specified that due to soil degradation, only 60 harvesting years are left (FAO, 2016). In view of this, Government of India is promoting Organic and Natural farming to make the agriculture more sustainable.

Considering the importance of Natural Farming, The National Institute of Agricultural Extension Management (MANAGE) has been designated as the Nodal Organization and Knowledge Repository for promotion of Natural Farming by the Ministry of Agriculture and Farmers Welfare, GoI. In view of this, MANAGE is taking efforts in promotion of natural farming in terms of creating a large scale awareness programs to Gram pradhans across the country on natural farming, development of master trainers, preparation of study material etc. MANAGE organized 1009 Awarenss programmes covering 56,808 Gram Pradhans across India and developed 665 Master Trainers on natural Farming. PM's Mann Ki Baat episodes on Organic Farming greatly motivated farmers, extension professionals, KVK scientists and comman citizen in the country. Many studies indicates that Mann Ki Baat show has positively impacted the Indian Citizens. Out of 22 episodes on agricultural issues, two episodes of Mann Ki Baat programs organized during 29th November 2015 & 25th December, 2022, have focused on organic/natural farming and their importance. In view of this, the study has been undertaken to assess the impact of Mann Ki Baat episodes covered on organic/natural farming on the farmers and consumers with the following objectives:

- To analyze the socio-economic characteristics of farmers and consumers attended the episodes of Mann Ki Baat program focused on organic/natural farming
- To assess the level of participation, interest created and adoption of organic/natural farming practices by the farmers after listening to Mann Ki Baat program
- To analyze the consumers perception of organic/natural foods after listening to Mann Ki Baat program
- To understand the role of Krishi Vigyan Kendras (KVKs) in creation of awareness and promotion organic/natural farming through Mann Ki Baat program at farmers and consumers level and
- To document overall perception of farmers about Mann Ki Baat program

Methodology

Research Design: The study was conducted by adopting "Ex-post- facto" research design.

Selection of Respondents and Sampling Procedure: The episodes on agriculture and farm sector might have influenced the key stakeholders such as Farmers, Consumers and Extension professionals of Krishi Vigyan Kendra (KVK) who facilitated the Mann Ki Baat in driving innovations and sustainable practices at KVK as well as at farmers' level. Hence, KVK functionaries, Farmers and Consumers were selected as respondents.

Selection of KVKs: From a total number of 731 KVKs, a sample size of 171 KVKs were purposively selected who are working extensively on organic and natural farming by covering the 10 ATARI zones to represent various agro-climatic regions across the country.

SI. No	Zones	States/UTs	KVKs	Farmers	Consumers
1	Zone I Ludhiana	3	29	201	203
2	Zone II Jodhpur	3	7	139	144
3	Zone III Kanpur	1	8	80	29
4	Zone IV Patna	2	11	202	89
5	Zone V Kolkata	3	18	61	49
6	Zone VII Umiam	5	16	77	22
7	Zone VIII Pune	3	7	164	118
8	Zone IX Jabalpur	2	27	219	206
9	Zone X Hyderabad	3	32	143	123
10	Zone XI Bengaluru	3	16	112	20
	Total	**28**	**171**	**1398**	**1003**

Selection of farmers: A total sample of 1398 farmers who have directly or indirectly participated in Mann Ki Baat representing various agro ecological zones were selected.

Selection of Consumers: A total of 1003 consumers were selected who have either participated in on campus or off campus programs of KVKs and were interested in Organic/ Natural farming products.

Data collection: Data was collected by KVK Scientists from KVK Professionals, Farmers and Consumers by using a pre-structured interview schedule through google form. The data collected by KVK Scientists includes both quantitative and qualitative information. The data was analyzed with frequency and percentage analysis.

Result and Discussion

I. The socio-economic characteristic analysis of the farmers and consumers reveals the following results.

i. Age: A perusal of Table - 1 revealed that more than half of the Farmers who participated in Mann Ki Baat belongs to Middle Age category (56.51%) followed by Old Age category (36.05%) and Young farmers (7.44%) respectively. The same trend was observed in the Consumers wherein majority of them were middle age category (58.42%). This may be due to the fact that the young generation is migrating to urban area for lucrative jobs and currently middle and old age farmers are relatively engaged more in agriculture and allied activities. Hence, the episode of Mann Ki Baat is related to organic/natural farming might have attracted the middle and old age category of farmers.

ii. Gender: The data also indicates that 87.05 per cent of Farmers who participated in Mann Ki Baat programme were Male and remaining (12.95%) belongs to Female category. The same pattern was observed in Consumers where 86.24 per cent are Male category. This may be due to the fact that though majority of the farm activities are undertaken by women farmers, their participation in extension and other capacity building programmes is relatively less. Hence, extension functionaries may motivate women farmers to participate in the Mann Ki Baat Programs.

Table: 1 Details of Profile characteristics of Farmers and Consumers attended the Mann Ki Baat program episodes on organic/natural farming

SI. No.	Particulars/ Variables	Farmers (N=1398)		Consumers (N=1003)	
		F	%	F	%
i	**Age**				
	Young (<30 years)	104	7.44	80	7.98
	Middle (30-50 years)	790	56.51	586	58.42
	Old (>50years)	504	36.05	337	33.60

ii	**Gender**				
	Male	1217	87.05	865	86.24
	Female	181	12.95	138	13.66
iii	**Education level**				
	Illiterate	69	4.94	36	3.59
	Primary School (1st – 4th std.)	254	18.17	195	19.44
	Matriculation (5-10th)	352	25.18	248	24.73
	Secondary School / SSC / +2 level	335	23.96	235	23.43
	Graduate and above	388	27.75	289	28.81
iv	**Family size**				
	Upto 4 members (Small)	430	30.76	331	33.00
	5-9 members (Medium)	898	64.23	617	61.52
	Above 10 members (Large)	70	5.01	55	5.48
v	**Land holding (in ha):**				
	Marginal (Below 1 ha)	352	25.18	342	34.10
	Small (1-2 ha)	410	29.33	271	27.02
	Medium (2-4 ha)	365	26.11	227	22.63
	Semi medium (4-10 ha)	216	15.45	126	12.56
	Big (Above 10 ha)	55	3.93	37	3.69

vi	**Farming Type****				
	Irrigated land (ha)	1220	87.27	819	81.66
	Rainfed land (ha)	715	51.14	445	44.37
vii	**Annual income**				
	< Rs. 1.0 Lakh	291	20.82	201	20.04
	Rs.1.0 to 2.0 Lakh	492	35.19	339	33.80
	> Rs.2.0 Lakh	534	38.20	396	39.48
	Not disclosed	81	5.79	67	6.68

*F= Frequency, ** Multiple Response

iii. Education level: It is apparent from table that the comparative analysis of farmers and consumers revealed that 27.75 of farmers and 28.81 per cent of consumers participated in Mann Ki Baat were educated upto graduate level and above followed by 25.18 per cent of farmers and 24.73 per cent of consumers were educated upto matriculation level. It was observed that only meagre number (4.94 % of farmers) and (3.59 % of consumers) were illiterate. This shows a very positive sign that the educated farmers as well as consumers were participated in Mann Ki Baat programme. Due their educational background they can understand the Prime Minister's message and also share among their fellow members. It can lead to trigger trickle-down effect to disseminate quality information quickly among the social system.

iv. Family Size: It is clear from the table that 64.23 per cent of farmers and 61.52 percent of consumers belongs to medium family size, and on average 5 per cent of total farmers and consumers belongs to large family. As per reports of National Family Health Survey (2019-20), the average size of household is 4.8. Moreover strong family networks are oriented for carrying out their traditional vocation. It is in line with the National Family Health Survey that that majority of farmers as well as consumers who participated in Mann Ki Baat programme belonged to medium family size of having 5-9 family members.

v. Land Holding: It is evident from the table that small, medium and marginal categories of farmers, more or less equally participated in the Mann Ki Baat

program (ie 29.33 percent of small farmers, 26.11 per cent medium farmers and 25.18 per cent of marginal farmers). However, only 15.45 per cent were semi-medium farmers and 3.93 per cent of participants were big farmers. Whereas, in case of consumers 34.10 per cent were marginal land holders, followed by 27.02 per cent of small land holders and 22.63 per cent of medium land holders. As per agricultural census 2015-16, the average size of land holding in India is 1.08 ha. Nearly 86.08 per cent of farmers participated falls into small and medium farmer's category.

vi. Farming Type: Nearly 87.27 per cent of farmers who participated in Mann Ki Baat programme episodes related to natural/ organic farming were having irrigated land and 51.14 per cent were having rainfed land. Similarly, 81.66 per cent of consumers were having irrigated land and 44.37 per cent of them were having rainfed land. Irrigated farmers may be having more interest to learn from Mann Baat to increase the farm income as there is more scope in irrigated area than the rainfed area

vii. Annual Income: Nearly 38.20 per cent of farmers who participated in Mann Ki Baat programme episode related to natural/ organic farming were having annual income above Rs 2.00 lakhs followed by 35.19 per cent with the annual income ranging from Rs.1.00 to 2.00 lakhs and 20.82 per cent of farmers were having less than Rs.1.0 lakh. Similarly, around 39.48 per cent of consumers were having more than Rs.2.0 lakh of annual income followed by 33.80 per cent of them are earning Rs.1.00 to 2.00 lakhs and 20.04 per cent of them having annual income of less than Rs1.0 lakh.

II. Source of income by Farmers and Consumers

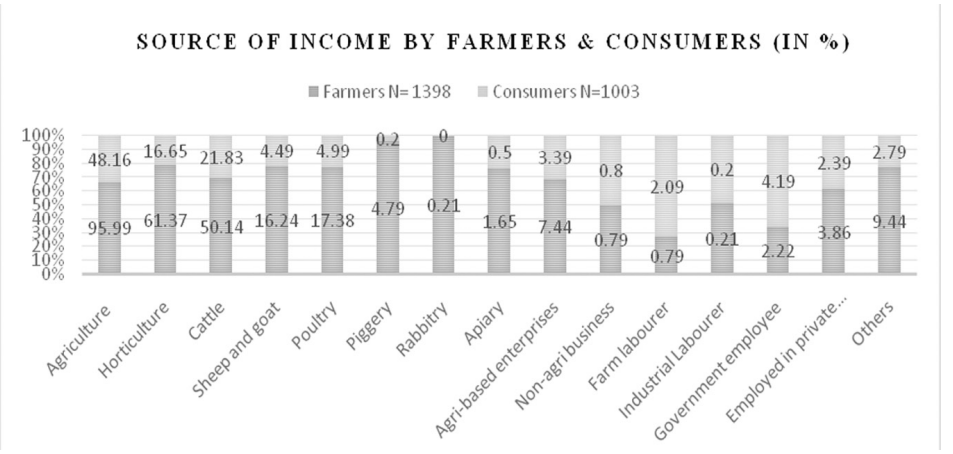

Fig 1: Source of Income by Farmers and Consumers

A perusal of Fig -1 revealed that the farmers participated in Mann Ki Baat programme episodes are having multiples sources of income such as agriculture, horticulture, cattle, sheep/goat, poultry, agribased entrepreneurs, agricultural labourers etc. It is evident from the study that nearly 96 per cent of them had agriculture as a source of income followed by 61.37 per cent from horticulture, 50.14 per cent from cattle, 17.38 per cent from poultry, 16.24 per cent from sheep and goat and the rest of them were having income from other sources (30.61%). In case of consumers who participated in Mann Ki Baat programme, (48.16%) had their source of income from agriculture, 21.83 per cent of them had source of income from cattle and 16.65 per cent from horticulture sector.

This might be due to the fact that farming in India is a combination of agriculture, horticulture combined with animal husbandry including poultry, fisheries and the integration of various enterprises are still prevalent in the country. India ranks first in cattle population, 2nd in goat population, 3rd in sheep population and 3rd in egg production. Prime Minister's emphasis on Integrated Farming System in Mann Ki Baat Programs have attracted all sections of farming community who have their livelihood in agri and allied sectors.

III. Source of Information for Farmers and Consumers

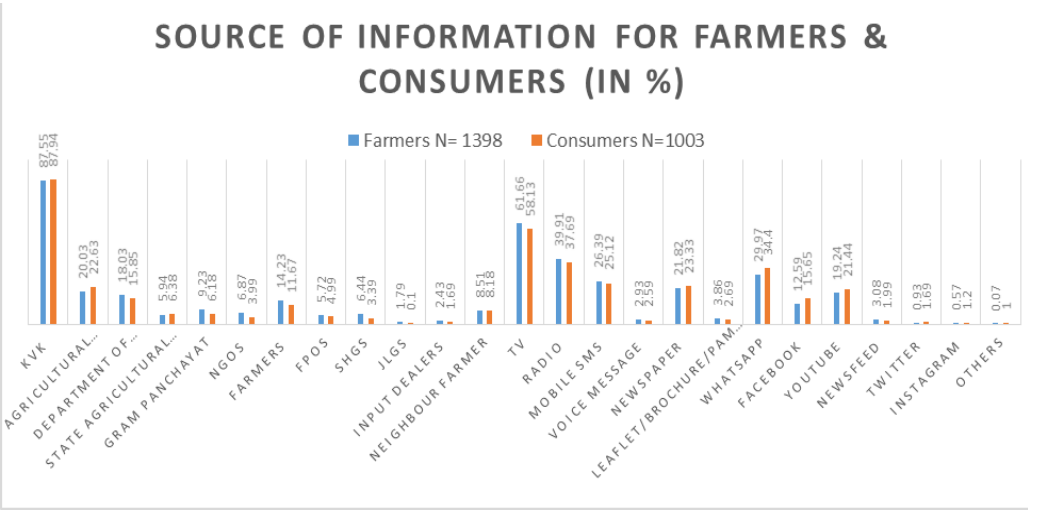

Fig 2: Source of Information by Farmers and Consumers

Fig 2 reveals that main source of information about the Mann Ki Baat program for farmers and consumers were KVKs. It is a known fact that KVKs were involved and facilitated the Mann Ki Baat programs at district level and mobilized the

farmers as well as consumers both for on-campus and at off-campus programs. Hence, nearly 88 per cent of farmers and consumers' have received information from KVKs about the Mann Ki Baat followed by 61.66 per cent from TV, 39.91 per cent from radio, 29.97 per cent from whatsapp, 21.82 per cent from newspaper. Nearly 66.38 per cent of farmers and 76.37 per cent of consumers relied on social media. It indicates that both mass media and social media also played an important role in dissemination of details of various episodes of Mann Ki Baat in advance to facilitate both farmers and consumers to participate the program. Considerable number of farmers (20.03 %) also got information from Agricultural Technology Management Agency (ATMA), 18.03 per cent from department of agriculture and 5.94 per cent from SAUs and so on. This is a clear indication that extension functionaries, academician and researchers were also popularizing and motivating the farmers and other stakeholders to participate in the Mann Ki Baat program. Almost similar trend was observed in consumers also. It clearly indicates that the grass root level organisations such as KVK, ATMA and agri & allied departments, due to their proximity, connectivity and reliability, they could reach a large number farmers and to take the unique program of Mann Ki Baat to every nook and corner of the country. Naturally, TV, Radio and Social media also played a significant role in popularizing the Mann Ki Baat program due to their reach and internet penetrations.

Table -2: Details of Farmers participation in Mann Ki Baat program **(N=1398)**

SI. No.	Particulars	Frequency	Percentage
1	**No. of times participated in Mann Ki Baat program**		
	1-10 times	805	57.58
	11-25 times	342	24.46
	26-50 times	153	10.94
	> 50 times	98	7.01
2	**Distance travelled to attend the Mann Ki Baat programme**		
	Up to 5 KM	921	65.88
	06 to 10 KM	123	8.80
	11 to 15 KM	101	7.22
	16 to 20 KM	96	6.87
	21-25 KM	73	5.22
	>25 KM	84	6.01

Table 2 indicates that more than half of the sample size has participated 1-10 times in Mann KI Baat program followed by 11-25 times by one fourth of the sample. Only 7 per cent of the sample has attended the program by more than 50 times. Increasing trend of farmers participation in Mann Ki Baat programme is an implication upon farmer's positive attitude towards episodes of organic/ natural farming. Repeated participation of the farmers may be due to the fact that the speaker is a Prominent Personality, Content may be relevant to their real life situations, continuous extension support and awareness programmes encourage them to participate in various episodes.

It is also important to notice that about 66 per cent of the farmers have travelled upto 5km to attend the program. It can be understood from the results that farmers have travelled more than 25 km as well (6%) to participate in the Mann Ki Baat Program. This indicates that the program is successful due to the interest of farmers, irrespective of the distance farmers located

IV. Impact of Mann Ki Baat on Adoption of Organic/natural farming

It is interesting to learn from the table - 3 that large majority of the farmers (91.70 %) are interested to adopt to the farming practices towards organic/ natural farming after attending Mann Ki Baat Programmes. This may be due to the reasons that majority might have convinced about health and emerging market potentials for the organic/natural produces locally and globally.

As more than three fourth of the farmers are educated, 62 per cent of them have noted the points during Mann Ki Baat Program. Farmers (68%) have also raised questions during / after the Mann Ki Program to KVK scientists related to organic / natural farming such as use of beejamrit and jeevamrit, low input farming for sustainable development, straw management, waapsa, mulching, application of biofertilizers safalatha ki kahaani, integrated farming systems, soil health benefits, etc.

The follow-up visits to KVKs were also made by the farmers (81.83%) after Mann Ki Baat Program to get further information on organic / natural farming due to the enthusiasm in learning about the subject.

Technology diffusion is very important to up-scale the adoption and about 78 per cent of the farmers have indicated that they have shared the information on benefits of organic / natural farming to other farmers after listening to Mann Ki Baat Program. Importance was given to organic farming, natural farming inputs, nutritional value of natural farming produces, PM's thoughts on natural farming practices including the benefits to soil health and environment.

The results indicate that 85 per cent of the farmers have adopted partially/

fully organic/natural farming practices such as beejamrit and jeevamrit, vermi compost, mulching etc. And about 70 per cent of farmers have continued the adoption of organic or natural farming practices such as mixed cropping, vermicompost, application of neem extract, application of panchagavya, mulching, and organic vegetable cultivation.

Farmers (74%) also received support related to organic or natural farming from the departments through various schemes and programs such as drum of 200 litres for preparation of bio-stimulants, vermi bags, subsidy on seeds, technical support, earthworms and other microbial inoculum literature, etc.

Table - 3: Impact on Farmers on Adoption of organic/natural farming practices after listening to Mann Ki Baat program **(N=1398)**

SI. No.	Particulars	Frequency	Percentage
1	Interest created among the farmers to change the Farming Practices towards organic/natural farming after attending Mann Ki Baat Programmes	1282	91.70
2	No. of farmers noted down the points during the Mann Ki Baat Program	867	62.02
3	No. of farmers raised Questions during / after the Mann Ki Baat Program to KVK scientists related to organic/natural farming	955	68.31
4	No. of farmers made Follow up visits to KVK after Mann Ki Baat Program to get information on organic/natural farming	1144	81.83
5	No. of farmers shared the Information on organic/ natural farming to other farmers after listening to Mann Ki Baat Program	1094	78.25
6	No. of farmers Adopted organic/natural farming practices after the Mann Ki Baat Programmes	1190	85.12
7	No. of farmers continued the adoption of organic/ natural farming practices	980	70.10
8	No. of farmers received Departmental supports related to organic/natural farming	1028	73.53
9	No. of farmers Satisfied with the benefits of organic/ natural farming	846	60.51
10	No. of farmers expressed Happiness to Listen to Prime Minister directly on local issues	1088	77.83

It is also evident from the table that about 60 per cent of farmers were satisfied with the benefits of organic/ natural farming in terms of sustainability in production, improvement in soil health, increased organic carbon content in soil, reduction in input cost, chemical free and quality products, etc.It is highly appreciable that farmers (78%) have expressed their happiness to listen to Prime Minister directly on local issues.

V. Impact of Mann Ki Baat program on consumers behaviour

The results from Consumers have highlighted that 93 per cent of them have participated in Mann Ki Baat programme on organic/natural farming Products (Table 4). Consumers have participated in Mann Ki Baat program at KVK (46%) and from own places (53%). Consumers (88%) have also reported that the awareness on organic/natural farming after listening to Mann Ki Baat was enhanced. The consumers also expressed favourable attitude (67 %) and nearly 63 per cent were convinced towards organic/natural farming after listening to Mann Ki Baat program. Further, 85 per cent have reported that they have passed on Prime Minister's message among their family members, friends, neighbors during various occasions which lead to trickledown effect of Mann Ki Baat program on organic/ natural farming. This may be due to the fact that the participants are not only the farmers, but also from FPO/FPC, Farmers club, etc. Hence, they had enough opportunity to discuss among the members of the farmers collectives.

Table - 4: Impact of Mann Ki Baat program on Consumers with regard to Organic / Natural Farming / Products

(N=1003)

SI. No.	Particulars	Frequency	Percentage
1	**Participation in Mann Ki Baat program**		
	a. Participation in Mann Ki Baat program at KVK	466	46.46
	b. Participation in Mann Ki Baat program at Own place	537	53.54
2	Increase in awareness on organic/natural farming after listening to Mann Ki Baat	882	87.94
3	Favourable attitude towards organic/ natural farming after listening to Mann Ki Baat program	674	67.20
4	Conviction towards organic/ Natural Farming after listening to Mann Ki Baat program	632	63.01

5	Trickledown effect of Mann Ki Baat program on organic/natural farming	766	76.37
6	**Opinion on Organic / Natural Farming products**		
A	**Price of Organic / Natural Farming products**		
	Very high not Affordable	177	17.65
	Slightly high, Affordable	669	66.70
	Normal price	143	14.26
	Cheaper	14	1.40
B	**Quality of organic/natural farming products**		
	Best	375	37.39
	Good	578	57.63
	Normal	50	4.99
C	**Availability of organic/natural farming products**		
	Easily available	261	26.02
	Not available	15	1.50
	Rare commodity	189	18.84
	Sparsely available	538	53.64
D	**Taste of organic/natural farming products**		
	Best	399	39.78
	Good	564	56.23
	Normal	40	3.99
E	**Family members response towards organic/natural farming products**		
	Positive	886	88.33
	Negative	4	0.40
	Neutral	113	11.27
F	**Extent of shift in consumption towards organic/natural farming products**		
	No Change	121	12.06
	Less than 25%	548	54.64
	25-50%	252	25.12
	More than 50%	82	8.18
G	**Impact on health of organic/natural farming products**		
	Improved	861	85.84
	No Change	142	14.16

Majority of respondents (66.70%) opined that price of organic/natural farming products is slightly high yet affordable. Only 17.65 per cent opined that the price is very high and not affordable. Consumers (57.6%) also indicated that quality of natural/organic farming produce is good and that quality is best (37%). Whereas, regarding the availability of organic/natural products, 53.64 per cent told that it is sparsely available and 26 per cent reported it is easily available. The taste of organic/natural farming produce is also opined to be good (56 %) and the taste of organic produce was best (39.7%). It was also heartening to understand that 88.33 per cent were having positive response towards organic/ natural farming products. The study reveals that 54.64 per cent of participants have shifted their consumption pattern towards organic/natural farming produce to the extent of less than 25 per cent of their total consumption and 8 per cent of consumers have shifted their consumption to organic and natural produce to the extent of more than 50 per cent. It is promising to observe that 86 per cent indicated that there is a positive impact on health on consumption of organic/natural farming produce. As there is a positive feedback about the quality, taste and health benefits about organic/natural products this may lead to increase in demand for organic/natural products among the consumers. The emphasis by Prime Minister during the Mann Ki Baat program on organic/natural farming coupled with various flagship programs such as Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development for North Eastern Region (MOVCDNER), Bharatiya Prakritik Krishi Padhati (BPKP), National Mission on Natural Farming, Capital Investment Subsidy Scheme (CISS) under Soil Health Management Scheme, National Food Security Mission (NFSM) etc and extension support will encourage the farmers and consumers to shift gradually towards organic/natural farming and products.

VI. Challenges in adoption of Organic/Natural Farming

Adoption of organic/natural farming also face some challenges as pointed by farmers (Table 5). Some of the important challenges expressed by the farmers are that there is less premium price for organic/natural farming produce (89.7%), followed by tedious weed, pest and disease management (82 %), yield is not satisfactory (74.6%), conversion period of organic/natural farming is lengthy (69 %), no scientific package of practices under organic/natural farming (68 %), and preparation and maintenance of inputs is difficult (66 %). Farmers also indicated that organic/natural farming is labour intensive (64%), hybrids are not performing better under organic/natural farming (51%) and 42 per cent expressed that there is a lack of awareness among people.

Table -5: Challenges faced by Farmers on Adoption of Organic/Natural farming practices

(N=1398)

Sl. No.	Challenges faced during the adoption of organic/ natural farming	Frequency	Percentage
1	Non availability of organic/natural inputs	648	46.35
2	Hybrids are not performing better under organic/natural farming	712	50.93
3	Yield is not satisfactory	1043	74.61
4	Natural Farming is labour intensives	895	64.02
5	Tedious weed, pest and disease management	1146	81.97
6	No scientific package of practices under organic/natural farming	950	67.95
7	Less premium price for organic/natural farming produce	1255	89.77
8	Preparation and maintenance of inputs is difficult	921	65.88
9	Conversion period of organic/natural farming is lengthy	965	69.03
10	Lack of awareness among people	588	42.06

*Multiple Response

VII. Programs conducted by KVKs in promotion of Organic/Natural farming

KVKs have conducted Mann Ki Baat programs both as On-campus and Off-Campus. KVKs have conducted Mann Ki Baat programs ranging from 1-10 nos (87.4%), followed by 11-20 programs (8.4%). About 3.00 per cent of KVKs have conducted Mann Ki Baat programs ranging from 21-30 nos as both on and off-campus. The KVK professionals is of the view that allocation of adequate funds may help them to organize more number of such programmes. Farmers in some of the southern states were finding it difficult to understand Hindi language and hence, through technological interventions the content may be translated broad casted especially in non-Hindi speaking states on real time basis to make the program more effective.

Table - 6: Details of programs conducted by KVKs in promotion of Organic/ Natural Farming after Mann Ki Baat program

(N= 171 KVKs)

SI. No.	Particulars	On campus (Nos)		Off campus (Nos)		Total	
		F	%	F	%	F	%
1	**Number of Mann Ki Baat programs organized**						
	1-10	147	85.96	152	88.89	299	87.43
	11-20	21	12.28	8	4.68	29	8.48
	21-30	2	1.17	8	4.68	10	2.92
	>30	1	0.58	3	1.75	4	1.17

* F= Frequency

Table - 7 indicated that KVKs have used various communication channels for Publicizing Mann Ki Baat programmes. Among various channels, the prominent channel used was WhatsApp which is accounted for 83 per cent followed by mobile SMS (74.27%), TV (50.29 %), and Radio (46.20%) and so on for publicizing Mann Ki Baat programme. As most of the farmers were networked through whatsapp groups by most of the KVKs and hence, social media has continued to played a vital role in the dissemination of information. Hence, extension functionaries are wisely making use of social media for timely dissemination of appropriate technology to the stakeholders.

Table - 7: Details of Communication Channels used by KVKs for Publicising Mann Ki Baat program

(N= 171 KVKs)

Sl. No.	Sources of publicity	No. of KVKs	Percentage
1	TV	86	50.29
2	Radio	79	46.20
3	Mobile SMS	127	74.27
4	e-Newspaper	29	16.96
5	WhatsApp	142	83.04
6	Facebook	66	38.60
7	YouTube	48	28.07
8	Newsfeed	13	7.60
9	Twitter	34	19.88

10	Instagram	14	8.19
11	Newspaper	68	39.77
12	Leaflet/ brochure/ pamphlet	43	25.15
13	Circulars	22	12.87
14	Flyers	14	8.19
15	Others	53	30.99

*Multiple Response

A detailed view of Table-8 revealed that participation of Individual Farmers in Mann Ki Baat programme is ranked first followed by innovative/progressive farmers, Self-help groups, Village level leaders, Farmer Interest Groups, Krishi Sakhi/Pashu Sakhi/Community Resource Person, Commodity Interest Groups (CIGs), Farmer Clubs and Youth Clubs etc

The study indicates that in addition to the individual farmers, many participants have represented from the farmers collectives. This is an encouraging sign that the diffusion of the Prime Ministers' message will be faster as they are likely to share among the group members. The extension professional may encourage to participate more such representatives of various farmers collectives for wider out reach.

Table – 8 : Details of Farmer/Farmers groups' participation in Mann Ki Baat programs in the episodes related to Organic/Natural Farming

(N= 171 KVKs)

Sl.No	Farmer/ Farmers Group	Number	Rank
1	Individual farmers	103970	1
2	Innovative/Progressive Farmers	8451	2
3	Self Help Groups (SHGs)	7647	3
4	Village Level Leaders (e.g. Sarpanch/Pradhan, Ward Member/MLA, etc.)	3689	4
5	Farmer Interest Groups (FIG)	3658	5
6	Krishi Sakhi/Pashu Sakhi / Community Resource Person	3338	6
7	Farmer Producer Organization /Company	3090	7
8	Commodity Interest Groups (CIGs)	1272	8
9	Farmer Clubs	1053	9
10	Youth Clubs	718	10
11	Others	22	11

A perusal of Table - 9 revealed that all most all the KVKs have undertaken many follow up activities in the post Mann Ki Baat Programs. About 90 per cent of KVKs had conducted Awareness programs on the topics raised by Prime Minister in the Mann Ki Baat Programme. Subsequently, 86.55 per cent of KVKs had distributed literature related to Organic/Natural Farming during or after Mann Ki Baat Programme. About 83 per cent of KVKs have addressed the queries raised by farmers and 78.36 per cent of KVKs had initiated new programs by KVKs on Organic/Natural Farming after Mann Ki Baat Programme. Also, 57.85 per cent of KVKs had re-oriented the existing programmes to suit the message of Mann Ki Baat program. Around 44 per cent of KVKs had documented success stories based on Mann Ki Baat message.

Table - 9: Follow Up activities taken up by KVKs in promotion of Organic/ Natural Farming after Mann Ki Baat program

(N= 171 KVKs)

SI. No	Particulars	Number	Percentage
1	Number of KVKs conducted Awareness programs on the topics raised by Prime Minister in the Mann Ki Baat Programme	154	90.06
2	Number of KVKs addressed the Queries raised by farmers	142	83.04
3	Distribution of literature by KVKs on Organic/Natural Farming during or after Mann Ki Baat Programme	148	86.55
4	Reorientation of existing programmes by KVKs to suit the message of Mann Ki Baat program	99	57.85
5	Initiation of New Programs by KVKs on Organic/Natural Farming after Mann Ki Baat Programme	134	78.36
6	Documentation of Success stories by KVKs based on Mann Ki Baat message	75	43.86

*Multiple Response

The follow-up activities are very important to sustain the initiatives. The KVKs and line departments may continue to support the farmers who are willing to adopt the organic / natural farming through adequate technical handholding and facilitating other required support services.

Conclusion

The study clearly indicates that the unique programme "Mann Ki Baat" hosted by tall leader and prominent personality none other than Prime Minister of the country through Radio as mass communication channel attracted farmers, representatives of farmer's collectives, consumers and other stakeholders. The episodes which covered Organic/Natural Farming has created mass awareness and convinced large number of participants about the importance of adoption of Organic/Natural Farming practices among the farmers and need for switching over to organic and natural farming produce among the consumers. The results are very clear in terms of adoption of organic and natural farming practices by most of the participant farmers partially/completely and are satisfied in terms of the soil health, reduction in cost of cultivation and quality of produce. The significant impact may be due to the right message delivered by the Prime Minister at right time along with the various follow-up activities by KVKs and line departments coupled with suitable schemes and programmes to support the farmers to adopt Organic/Natural farming practices. Real time translation and broadcasting in local languages will have better reach.

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Agriculture Sector during COVID Pandemic: Role of Modern Technologies and Digital Platforms for Survival and Sustainability in the Uncertain Situations

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ABSTRACT

The role of modern technologies and digital platform played in ensuring the survival and sustainability of the agriculture sector during the COVID-19 pandemic is significant. This paper examines the impact of the pandemic on the agricultural sector, highlighting the initial difficulties encountered due to lockdown measures, social distancing protocols, and the decline in the workforce. It discusses the adaptation strategies employed by farmers, governments, and other stakeholders, emphasizing the rapid integration of modern technologies and digital platforms to mitigate these challenges. Key agricultural activities such as digitizing production, processing, value addition, marketing, supply chain is discussed along with few relevant successful cases. This article underscores the importance of modern technologies and digital platforms in enabling the agriculture sector to adapt and thrive amidst the uncertainties posed by the COVID-19 pandemic, while offering insights into the future of farming in an increasingly digital and interconnected world.

Keywords: Digital Platforms, COVID 19, Sustainable Agriculture

Introduction

Being a global health crisis, The COVID-19 pandemic made distressing impacts on Indian economy both directly and through essential measures taken to prevent the spread of the pandemic. These impacts are also reflected by in the agriculture and agriprenuership sector. These impacts are damaging for food security, nutrition and the livelihoods of farmers, fishers and others working along the agriculture chain

The COVID-19 pandemic and various restrictions imposed by government has had a sizable impact on agricultural entrepreneurship. The agripreneurs faced various difficulties to carry out activities in the production and marketing processes. It includes production facilities, find labourers, and restrict working

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time. Further, the agripreneurs faced problems related to marketing the products, including in selling agricultural products due to restrictions on mobility between regions and decreased the purchasing power. It caused losses among the agripreneurs due to lower production, value addition and due to unsold agricultural products in the market

The agricultural sector in India has faced so much troubles due to the COVID-19 crisis in spite of many immunities from lockdown, since the agriculture sector provides employment to 55% population and it contributes 17% to GDP, the functioning of the agrarian sector is significant to India (Dhulipala). In addition to that, agriculture is a crucial engine that, like health and education, has the power to propel India to achieve its development goals. The question then is, how can India what are the major problems faced by agriculture sector during pandemic and show such situation and how the agriculture sector can overcome in such situations using technology; learnings and lessons (Edited).

While the Covid-19 poses some challenges for the agriculture system in the short term, it is also an opportunity to accelerate transformations in the agriculture sector to build its resilience in the face of a range of challenges (OECD, 2020). The structure of Indian agriculture has regularly changed as the focus of agricultural development shifted towards acknowledging and accepting the technological developments in the sector, following the vision to improve the situation of the farmers financially. Agriculture has to become market-friendly and flexible by adopting productive efficiency and cost reduction, effective monetization strategies with the help of digital innovation and literacy. The agriculture sector has to cope up with modern technologies and digital platforms to overcome the situations like Covid-19.

Digital Literacy & Modern Technology to Transform Agriculture

Digital transformation, commonly referred as the 'Fourth Industrial Revolution,' has the potential to transform the agriculture sector. Intervention of modern and innovative technologies like AI, IoT, Blockchain, remote sensing, augmented reality, and distributed computing facilitating the access to timely and accurate information on inputs, markets, finance, and the right package of practices adopted for informed decision making. The advanced technologies are making it possible to incorporate farmers into a technology-based agriculture system.

Technological developments in agriculture have transformed severely over the years, from traditional machinery to modern advanced equipment. The indication of technology in various decision-making processes at every farming stage to ensure better crop output has been a noteworthy development in the

overall agricultural landscape. Now, farmers accept technological advancements to increase their potential in any agriculture endeavour. Farming practices are becoming more innovative, less manual, with increased yields with the influx of digitization. At present, digital technology is enabling farmers with precise forecasting, improved production, data-driven decision-making, reducing less human involvement and more. The transformation has optimistically influenced many farmers and ultimately changed agriculture production and agri-entreprenuership system.

Advancement in the technologies is essential for modern agriculture. Digitalization is an unavoidable indication of modern technology. It provides economic growth, crop protection from diseases and pests, increase in yield and income, better access to seeds and inputs, adaptation to climate change, favourable financial services, better crop pricing, etc. Agricultural technology has seen a substantial increase in investment in the last decades. Significant technology advancements have improved the Agriculture Knowledge Graph and enabled critical stakeholders of the Agri value chain with data-driven insights, and sustainably allowed to "improve productivity and effiency" by combining satellite imagery with IoT and field intelligence. Adding to that, enhancement in the industry are indoor vertical farming, robotics and automation, precision agriculture, livestock technology, AI, and blockchain. Digital technology driven by Big Data in agriculture enables practical solutions for resolving complex issues allied to soil health, harvest quality and quantity, fertilization and chemical input, sowing date, seed variety, crop images, pest and disease incidents, irrigation, geotagging, and various agronomic data observation during different crop stages (Kumar, 2021).

The use of digital technology is crucial for enhancing agriculture productivity by delivering customized solutions to farmers based on the crop type, planting date, and variety of seeds, localized weather information, and estimated market prices. Advanced big data analytics are deployed for path-breaking inventions to improve soil quality and access the water stress level, resulting in better crop output, study yields, harvest dates, pests and diseases outbreaks, and pest control methods. The development of internet technology has opened farmers' unparalleled access to vast resources and tools to make farming operations easier. Now, farmers are getting a higher portion of the marketable value of their produce due to democratized market pricing and lesser transaction costs owing to digital literacy. To increase farmer efficiency, big data and mobile phones can increase upstream access to inputs and credit. Market integration and agreed-upon standards, prices, and grades provide targeted solutions for

increasing agricultural productivity.

Agriculture Value Chain: Challenges During COVID

Agriculture value chains from farm to fork are complex webs, due to that alot of stakeholders including producers, consumers, agriculture and fishery inputs, processors, transporters, and more are involved. In a country like India, where over 80% of farmers are smallholders, who is owning less than two acres of land, both the input supply chains that cater to farmers' input needs (seed, fertilizer, agro-chemicals) and the output supply chains that link farmers' produce to consumer demands are highly intermediated. The Agriculture value chains in India has traditionally been constrained for capital and labour. Also, most the agriculture sector is labour intensive, dependent on local labour markets. The COVID restrictions created breaking down of informal labour markets, where farmers are unable to harvest their produce due to labour shortages. The labour shortage is due to the both large-scale returns of migrant agricultural workers to their native villages and the restrictions placed on local workers are reasons for labour disruptions. The advances in digital technologies provided innovative end-to-end solutions across value chains.

Agricultural Extension via Mobile Phones During Covid-19 Pandemic

There are cadres of stakeholders working in agricultural sector, have a significant role in agriculture and agruiprenuership development, who play key roles in technology transfer. These experts are often referred to as field extension workers or agriculture extension officers, and, in most Indian states, they are employed by the Department of Agriculture (Dhulipala). Extension workers are naturally allotted to a group of villages. They are responsible for undertaking workshops, training programs, or field demonstrations on good agriculture practices and technologies (Dhulipala).

The implementation of stringent COVID restrictions and physical distancing measures adversely affected the functioning agriculture extension systems. Extension workers found it is challenging to move across villages and gather farmers for trainings or other capacity building activities. There is a situation raised to identify the alternative methods to continue extension activities in such situations. It is identified that electronic devises and modern digital platforms are one alternative which can enable the extension activities. Agricultural extension work can be done via smart phones, tablets and computers. Latest data on penetration of mobile phone and network coverage is encouraging. While e-Extension has been happening in India for some time, the efforts have been experimental in nature and never positioned as the sole method for transferring

information and conducting trainings. In the present situation, phones and mobile networks might be the only means through which farmers can access meaningful consultancy services (Dhulipala). In 2020, the penetration rate of smartphone in India reached 54 percent with a volume of around 149.7 million and was estimated to reach 96 percent in 2040 (Sun, 2021). The Internet usage in India is estimated in as of 2020, estimated number of Internet users who have accessed Internet in the last one month is around 622 Million. This is shared by the urban population with a 323 million and rural population with 299 million. The number of active internet users are expected to grow and reach 900+ million by 2025. (KANTAR, 2021)

Using Digital Platforms in Agriculture Sector: Learning from Pandemic

Issues related to Pandemic and restrictions are not only affecting the production side of agriculture but logistics and marketing activities also. Because Indian agricultural spot markets usually shows large crowds, particularly during harvest times, governments are designing ad hoc measures to curb large gathering of farmers, traders, and shoppers. For instance, *mandis* in Punjab and Haryana are issuing tokens that indicate a specific time for the farmers to bring produce to market. There is also a cap on the quantity of produce they can sell. Farmers, however, are struggling to find workers to help load, transport, and unload produce at the *mandi,* therefore disrupting the efficiency of the spot markets. These issues have been addressed using modern technology and digital platforms in a crisis like pandemic.

a)Digitizing Input Supply Chains During COVID-19

The agri-input supply chains which provide farmers access to pesticides, fertilizers, chemicals, and seeds etc. could also see a mini digital revolution due to the consequences of COVID-19. Similar to the farm-to-fork supply chains, input supply chains are highly intermediated. There is an urgent need for converting strong informal seed sector to a formal seed gateways using digital & e-commerce platform models, through which farmers access seeds. This potential digital platform will reduce the human interactions and the challenges during COVID like situations. In addition to that, creating whole digital system which provides e-Extension services, other services, utilising e-commerce platforms and integrating with financial institutions to facilitate institutional credit to smallholder farmers will bring a single window opportunity to improve the access of farmers in the different nodes of agriculture value chain. The investments in key logistics must be enhanced to sustain the demand for agricultural commodities.Besides, e-commerce and delivery companies and

start-ups need to be stimulated with appropriate policies and incentives (Peter Carberry, 2021).

b)Digitizing Agriculture Production During COVID-19

New models of digital platforms are coming in the agriculture sector from private ventures. Uber-style models of providing machinery as a service have emerged in a few pockets of the country for the past few years. These platforms are working on digital platforms to aggregate demand and mobilize machinery in order to cost-effectively provide to the needs of farmers. Along with this model, there are also some promising machine based service models using drones to perform tasks like pesticide spraying. This model is not operational in a larger level due to smaller holding nature of Indian agriculture. But farmers might be more tending to discover the Uber-style model to address upcoming challenges of the agrarian sector due to its informal nature. The government has an active role in enabling the functioning of labour market. For example, a digital platform could connect farmers and labour, minimizing the physical contact and crowding and, therefore, reducing the spread of the virus in informal labour markets. Digitalisation can also help to formalise of informal agriculture sector and create a means to implement targeted interventions to protect agriculture sector.

c)Digitizing Value Addition During COVID-19

The shift to digital quality assessment, grading, assaying, and trust in procurement present bigger challenges. Quality examining and grading of agri-produce is largely subjective, and although governments have been investing in assaying labs at *mandis* to gradually reduce human subjectivity and physically inspection of produce. If markets were decentralized to the farm gate, there would also need to be a mechanism in place to remotely grade commodities and reduce the need for physical inspection. There is some promising image recognition technology that is viable for a few commodities, and work is ongoing to address challenges in several other commodities where grades are dependent on the chemical composition of the product. Until a solution is found, blended digital platform models facilitate these activities at the farm gate.

d)Digitizing Procurement of Agri-Produce During Covid-19

The COVID crisis also opens an opportunity to start warehouse-based sales through eNAM (electronic-National Agriculture Market), which is an all-India electronic trading portal. The concept of rural godowns, large warehouses within APMC premises, have been part of many government policies and plans of the National Bank for Agriculture and Rural Development. However, rural

godowns have yet to get momentum. Farmers have to undertake lesser supply to minimize their losses during the pandemic due to the limited number of buyers and traders in the spot markets. The government enabled to store the excess produce in the warehouses with a document of the storage of their assets with electronic negotiable warehouse receipts. This receipt could be pledged by the farmer for immediate liquidity without the need to undertake a distress sale, and the produce sold once market demand returns. Digitally-enabled warehouses would also have boosted governments' ability to procure goods at Minimum Support Price (MSP) and allowed for the transfer of funds directly into farmers' bank accounts.

e)Digitizing Agri-Marketing During Covid-19

There were arguments to amend the APMC Act in the wake of the corona pandemic in favour of digital platforms which could be an effective way to enable decentralized marketing and supply of agriculture produce from the farm gate. For example, digital platforms could be designed to facilitate contract-farming arrangements and remotely monitor and control for quality. Activities like aggregation, packaging, transportation, and delivery could be scheduled in a way that minimizes contact in order to protect workers. These digital platforms could open digital sale opportunities for farmers who typically depend on spot markets to sell.

Successful Digital Apps for Farmers

A huge number of Mobile Apps, other than web portals, particularly useful for farmers were launched and found great success and adoption amongst the farmers. The *'AgriMarket App'* which gives most recent local crop prices is being currently used by more than 33000 farmers across India (Agrimarket App, 2020). in the same way, '*KisanSuvidha App'* which provides weather related information is being used by 371045 farmers (KisanSuvidha, 2020), while *'Pusa Krishi'* which provides farm technology and machinery related information is being used by 34265 agriculturists in India (Pusa Krishi, 2020). *'Crop Info App'* is being used by currently more than 10,000 farmers (Crop Info, 2020), while *'Intelligent Advisory System'* for Farmers of North East India has found usage amongst 6124 farmers of NE States of India mainly Manipur, Meghalaya (Intelligent Advisory System for Farmers, 2020).

Further, *'Bhuvan Hailstorm App'* for capturing crop loss due to hailstorms have been used by 1795 farmers to file loss and recovery payments (Bhuvan Hailstorm App, 2020), while the *'Crop Insurance App,* have been used by 24777 farmers by 2020 (Crop Insurance, 2020) (Dhaliwal, 2021)

In area of poultry and animal husbandry, Apps like '*Application for Poultry*' have been used for filing 7808 applications as per official records (Application for Poultry, 2020), while '*PashuPoshan*' App particularly for information and advice for dairy farmers have been downloaded and used by more than 50,000 dairy owners (PashuPoshan, 2020) (Dhaliwal, 2021).

These adoption number across all three domains of access, adoption and application clearly reflects the increasing digital inclusion of the rural communities because of Digital India but if we focus on the total rural population these number are still quite small (Dhaliwal, 2021). The Digital India Program, launched by Indian government in 2015, the initiatives for Digital inclusion in relation to the schemes and sub-programs and technology apps that have been launched under the Digital India initiative especially catering to agriculture and farmers to bring them into digital mainstream. It further investigates the goal achievement of these initiatives and the hurdles which are there. Lastly, it suggests some solutions which can make this program a success (Dhaliwal, 2021).

COVID-19 offers an opportunity to enhance sustainability of the agriculture sector

In the post COVID-19 period, ensuring that the agricultural system is more sustainable and resilient is now an even more urgent priority. The COVID-19 opens an opportunity to learn more about chokepoints and vulnerabilities in the Agriculture and Agriprenuership system, in order to identify necessary investments and reforms that would further strengthen the resilience of the sector to a range of future shocks and challenges. It will be crucial to engage stakeholders in the process of understanding the full impacts of the pandemic on various population groups and the lessons to be learned. In specific, it will be significant to inspect the current resilience toolkit in the agriculture system, with a view to identifying which policy measures have proven most effective and what new measures may be needed to respond to system-wide shocks. It will be particularly important to understand the factors that enable some food and farming businesses to adapt their business models quickly enough to avoid the most negative consequences. (OECD, 2020)

Teachings from the COVID-19 pandemic will need to be integrated into wider responses to challenges confronting the global agriculture system and integrating with modern technologies and Digital platform. Those challenges include: impact food security by reducing animal and crop production. (OECD, 2020)

Conclusion

The digital infrastructure is very essential facility to accomplish digital equality. Due attention should be given to enhance digital literacy, sustained use over time with substantial benefit. This can be achieved through providing access to services atcommunity level where individual access is costly and difficult, capacity building of farmers and stakeholders, economically benefitting up-to-date content with user customization and so on (Laxmipriya Upadhyaya1, 2019).

Digital tools and technologies pose viable methods for addressing some of the disruptions experienced by the agricultural sector during Covid-19 pandemic. Although agriculture cannot get away with grassroots institutions and human interventions, digital technologies can play an important role in helping the sector overcome specific issues posed by the pandemic. And, faced with the possibility of extended lockdown measures, there couldn't be a more opportune time for stakeholders to explore digital agricultural solutions.

It is crucial to reform existing framework in Indian agriculture so that it becomes more market-oriented while at the same time enhancing a digitally-driven environment. In rural areas, digital connectivity is vital for distributing low-cost data and easy access to farming information. Digital literacy will allow open access to equitable markets that would benefit the farmers to increase their profitability. There is also a growing need for investment in the development of multidisciplinary digital skills and knowledge. Digital platforms and modern technology is the key learning from pandemic, which can be implement in agriculture sector and gradually improve further, which facilitate the sustainability of the agrarian sector in the Covid-like situations.

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Climate Smart Agriculture Interventions: Lessons Learned And Implications for Future

Anupam Anand[1] and Pratiksha Singh[2]

ABSTRACT

Most of the developing countries including India are primarily dependent on agriculture as it provides livelihood to almost two-third of its population. Hence, it is of utmost concern for developing countries to design and implement appropriate Climate Smart Agriculture practices, and then identify factors which have negative impact on agriculture productivity. The review of literature revealed that agriculture is the most vulnerable and sensitive sector affected by climate change because of its dependency on local climate parameters like rainfall, temperature, soil health and so on. The impacts of climate change on crop yields indicate that yield losses may be up to 60 per cent depending on crop, location, and future climate scenario. To alleviate the challenges posed by climate change, agriculture has to become "climate smart". Climate-Smart Agriculture (CSA) is an approach to help agricultural systems worldwide, concurrently focusing on three major challenges: increased adaptation to climate change, mitigation of climate change, and ensuring global food security through innovative policies, practices, and financing. The paper discusses salient CSA innovations and key interventions which will address complex issues of climate change and guide the policy makers and decision makers to priorities investments and programme implementation for maximum impact.

Key words: Climate Change, Climate Smart Agriculture, Climate Smart Villages

Introduction

The Inter-Governmental Panel on Climate Change (IPCC, 2014) defines 'climate' as the "average weather," or more rigorously, as the statistical description in terms of the Mean and Variability (for example by using, statistical tests) of relevant quantities over a period of time ranging from months to thousands or millions of years". Climate change is one of the most potentially serious environmental problems ever confronting the global community (Kumar et al,

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2019). United Nation Framework Convention on Climate Change (UNFCCC, 2010) refers climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". Climate change is emerging as one of the major threats on agriculture, food security and livelihood of millions of people in many places of the world.

In Asia, agricultural crop yield are expected to decline by 5-30 per cent by 2050s due to rising temperature in Himalayas and this decline in agricultural yield will lead to food insecurity, which becomes a serious future problem for human beings (IPCC, 2007). The impacts of climate change on crop yields indicate that yield losses may be up to 60 per cent, depending on crop, location, and future climate scenario (Challinor et al., 2014). Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems (Lipper et al., 2014). To alleviate the challenges posed by climate change, agriculture has to become "climate smart". In response, the concept of Climate Smart Agriculture (CSA) has been developed to address three pillars: food security, adaptation and mitigation (FAO, 2013).

Concept of Climate-Smart Agriculture

Food and Agriculture Organization (FAO, 2014) defines Climate-Smart Agriculture (CSA) as "an approach for transforming and reorienting agricultural development under the new realities of climate change". The term Climate -Smart Agriculture was first used in 2009. The concept of CSA was presented and defined in the first Global Conference on Agriculture, Food Security and Climate Change held at The Hague in 2010, through the paper "Climate-Smart Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation". CSA, an integrated approach to addressing the interlinked challenges of food security and climate change, focuses on three objectives mainly: sustainably increasing food security by increasing agricultural productivity and incomes, building resilience and adapting to climate change, and developing opportunities to reduce greenhouse gas emissions from agriculture (Sala et al., 2016). Enabling CSA at all levels requires a big initiative to implement its policies, capacity building, safety and economic matters from a number of institutions. The adaption of climate-related knowledge, technologies and practices to local conditions, promoting joint learning by farmers, researchers, extension personnel and widely disseminating Climate-Smart Agriculture (CSA) practices, is critical. CSA approach deals with these interlinked challenges in a holistic and effective

manner (Bayala et al., 2016).

Table 1: Key Interventions of Climate-Smart Agriculture.

Sl.No.	Technology	Adaptation/Mitigation Potential
1.	**Water-smart**	Interventions that improve water use efficiency
a)	Rainwater Harvesting (RH)	Collection of rainwater not allowing to run-off and use for agricultural in rainfed/dry areas and other purposes on-site
b)	Drip Irrigation (DI)	Application of water directly to the root zone of crops and minimize water loss
c)	Laser Land Levelling (LL)	Levelling the field ensures uniform distribution of water in the field and reduces water loss (also improves nutrient use efficiency
d)	Furrow Irrigated Bed Planting (FIBP)	This method offers more effective control over irrigation and drainage as well as rainwater management during the monsoon(also improves nutrient use efficiency)
e)	Drainage Management (DM)	Removal of excess water (flood) through water control structure
f)	Cover Crops Method (CCM)	Reduces evaporation loss of soil water (also adds nutrients into the soil)
2.	**Energy-smart**	Interventions that improve energy use efficiency
a)	Zero Tillage	Reduces amount of energy use in land preparation. In long-run, it also improves water infiltration and organic matter retention into the soil
3.	**Nutrient-smart**	Interventions that improve nutrient use efficiency
a)	Site Specific Integrated Nutrient Management (SINM)	Optimum supply of soil nutrients over time and space matching to the requirements of crops with right product, rate, time and place
b)	Green Manuring (GM)	Cultivation of legumes in a cropping system. This practice improves nitrogen supply and soil quality
c)	Leaf Color Chart (LCC)	Quantify the required amount of nitrogen use based on greenness of crops. Mostly used for split dose application in rice but also applicable for maize and wheat crops to detect nitrogen deficiency

d)	Intercropping with Legume (ICL)	Cultivation of legumes with other main crops in alternate rows or mixed. This practice improves nitrogen supply and soil quality
4.	**Carbon-smart**	Interventions that reduce GHG emissions
a)	Agro Forestry (AF)	Promote carbon sequestration including sustainable land use management
b)	Concentrate Feeding for Livestock (CF)	Reduces nutrient losses and livestock requires low amount of feed
c)	Fodder Management (FM)	Promote carbon sequestration including sustainable land use management
d)	Integrated Pest Management (IPM)	Reduces use of chemicals
5.	**Weather-smart**	Interventions that provide services related to income security and weather advisories to farmers
a)	limate Smart Housing for Livestock (CSH)	Protection of livestock from extreme climatic events (e.g. heat/cold stresses)
b)	Weather based Crop Agroadvisory (CA)	Climate information based value added agro-advisories to the farmer
c)	Crop Insurance (CI)	Crop-specific insurance to compensate income loss due vagaries of weather
6.	**Knowledge Smart**	Use of combination of science and local knowledge
a)	Contingent Crop Planning (CC)	Climatic risk management plan to cope with major weather related contingencies like drought, flood, heat/cold stresses during the crop season
b)	Improved Crop Varieties (ICV)	Crop varieties that are tolerant to drought, flood and heat/cold stresses
c)	Seed and Fodder Banks (SFB)	Conservation of seeds of crops and fodders to manage climatic risks
Source: Khatri-Chhetri, et al., 2017.		

Lessons Leaned for Climate-Smart Agriculture (CSA)

The aim of CSA was to distill lessons learned for leveraging and developing

enabling environments for prioritization of CSA options and linking those with opportunities for achieving CSA (Andrieu et al., 2017). There are many areas which need immediate action to increase adoption of CSA practices. These included gender responsive diagnostics and prioritization of climate-smart practices, support to farmer-to-farmer and community wide social learning, prioritization among CSA options and benefits for greater impact, monitoring CSA interventions with a real-time participatory tool etc, through which sustainability can be enhanced by combining and leveraging the strengths of different approaches, promoting local ownership, and providing continued technical support, understanding limiting factors to adoption of CSA and to create enabling environments for the promotion of CSA, in addition to formulating appropriate policies for promotion/ adoption of CSA which need immediate action to increase adoption of CSA practices.

Future Implications for Climate-Smart Agriculture

The key concept of Climate-Smart Agriculture is to provide location specific climate-Smart technologies. Multiple stakeholders i.e. from governments, civil societies, science and private sectors have to be involved in formulating the location-specific technologies like agriculture advisories through Digital Media – from customised advice to shared value with millions of farmers, climate-informed advisories to enhance production and resilience. Use of ICTs should be promoted to deal with climate change, need for a Gender specific approach, public - private partnerships and so on can be encouraged to promote CSA practices. The implementation of CSA would involve changes in the behaviour, strategies and agricultural practices of millions of farmers worldwide. Farmers need support to understand the impacts of climate change and to adopt CSA practices (Raj, S. & Garlapati, S. 2020).

Conclusion

Climate change is more complex and threatening than any other ecological problem. Farming practices are exposed to several, interconnected ecological, economic and social pressures motivated by climate change. Climate change can be eliminate or reduced with the help of Climate-Smart Agriculture practices. So there is need to enhance proper implementation and sound policy framework support. Thus there appears an immediate need to identify and prioritize Climate Smart Agriculture practices. Also a requirement for scientists, government and non-government agents and other stakeholders to focus on awareness creation on climate-smart agriculture interventions so that it may helps to tackle the risk of climate change.

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Financial Independence of Rural Youth through Skill Development – A Case of STRY

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ABSTRACT

Skill development of rural youth has been the focus of Government for creating productive workforce. The Government has introduced various programs to improve skills of rural youth. Skill Training of Rural Youth (STRY) implemented under Sub-Mission on Agricultural Extension (SMAE) is one such program with focus of providing skill based trainings to rural youth in agri-based vocational areas. The present paper analyses the component STRY for its potential to generate income and reach out to other rural youth. The compilation of information on different aspects of implementation of STRY suggests that the strength of the program lies in following an integrated implementation structure involving different agencies operating at national, state and district level. A comprehensive mechanism is followed under the component to identify potential skilling areas by involving district level agencies. The paper also reveals the potential of skill based training programs to generate additional income and ability to reach out to large number of rural youth through youth already trained under the program.

Keywords: Rural Youth, Skill development, Agricultural Skills, STRY, India.

Introduction

Changing demographic profile of the world has thrown a window of opportunities in favour of India. Presently, India has the largest share of youth population in the world and will continue to hold so for next 20 years. The population of youth in India has increased from 16.8 crores in 1971 to 42.2 crores in 2011. The number is estimated to reach 47.94 crore by 2021 (GoI, 2017). Majority of them are coming from rural India as the proportion of rural youth population in India is about 67– 68 per cent of total population of the country (Rajendran and Paul, 2020).

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The challenge, however, is to increase human resource potential and to utilise the same optimally as a driving force for economic development. Understanding the importance of empowering youth of India, the National Youth Policy (NYP – 2014) was launched by the Government in 2014. The NYP has defined the youth as a person in the age group of 15 to 29 years and aims mainly at enabling them to achieve their full potential, and through them enable India to find its rightful place in the community of nations.

NYP-2014 has identified 11 priority areas for development of youth under five categories namely creating a productive workforce, developing a strong and healthy generation, instilling social values and promoting community service, facilitating participation and civic engagement and, supporting youth at risk and create equitable opportunity for all. In order to create a productive workforce, the policy document has laid emphasis on education, entrepreneurship and skill development (NYP, 2014).

Skill development has otherwise also been a focus area of the Government for its ability to improve productivity, better living standard, employability and inclusive growth (NITI, 2015 & ILO, 2008). Accordingly, the Government has introduced a National Policy on Skill Development and Entrepreneurship – 2015. The policy aims at providing the overall framework to all skill related activities carried out within the country in alignment with common standards and link them with demand centres. The national policy speaks about the objectives and expected outcomes along with identifying the institutional framework to facilitate achieving the expected outcomes. The national policy aims to train about 104.62 million people afresh and additional 460 million to be reskilled, up-skilled and skilled by 2022 (NITI, 2015). Skilling become even more vital in agriculture for the development of rural areas as 65 percent of the total population of India live in rural areas (World Bank, 2021). Report on the Taskforce on Elimination of Poverty in India suggests that 80 percent of the Indian poor are in rural areas and their livelihood directly or indirectly depends on the performance of agriculture (GoI, 2016). This further emphasises on the importance of skilling in agriculture for the development of rural areas.

The efforts of the Government to impart right kind of skill and training are also visible from the presence of capacity building component invariably in all the schemes and programs introduced by the different Ministries with focus on production and efficient marketing of output. In compliance with National Policy on Skill Development & Entrepreneurship – 2015, the Ministry of Agriculture & Farmers Welfare, Government of India has also taken the initiative to provide skill based trainings to rural youth on agri-based vocational areas under the skill

development component of Sub-Mission on Agricultural Extension (SAME) of National Mission on Agricultural Extension & Technology (NMAET) namely Skill Training of Rural Youth (STRY).

With this background, the present paper attempts to understand the different aspects of Skill Training of Rural Youth (STRY) covering its implementation structure, skilling areas covered, effectiveness of short duration program in agriculture and its ability to provide financial independence to the rural youth. The paper also throws light on its potential to reach out to large number of rural youth though the youth trained under the skill based training programs organised under the component.

Skill Training of Rural Youth (STRY)

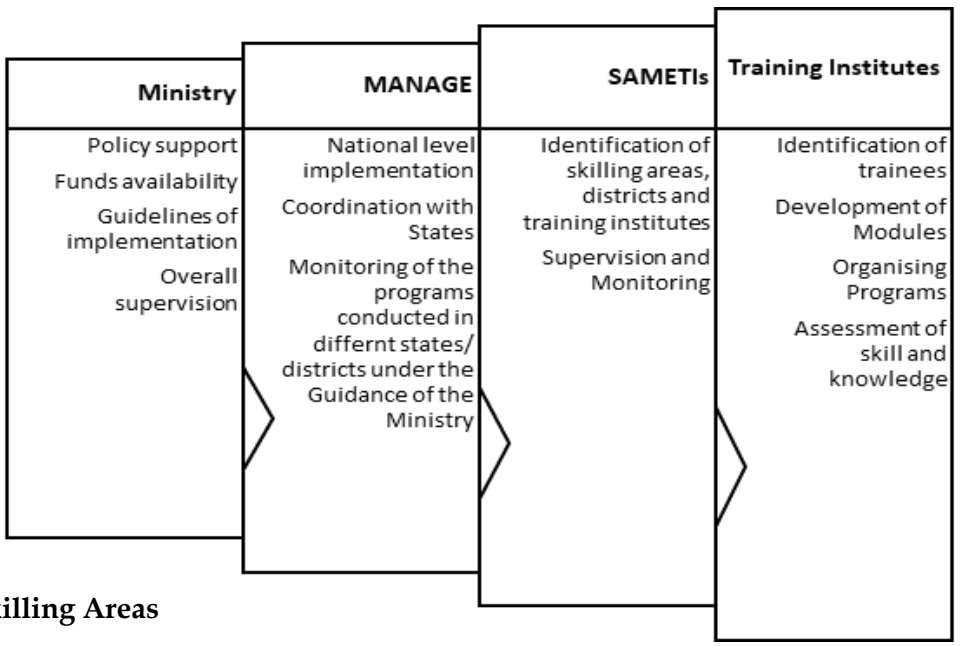
Skill Training of Rural Youth (STRY) is a component implemented under Sub-Mission on Agricultural Extension (SMAE) of National Mission on Agriculture Extension and Technology (NMAET). The component was launched by the Ministry of Agriculture and Farmers Welfare during 2015-16 with the objective to impart skill based training to rural youth on agri-based vocational areas. The National Mission on Agricultural Extension and Technology (NMAET) aims at restructuring and strengthening of agricultural extension through amalgamation of 17 different schemes of the Department of Agriculture and Farmers Welfare implemented to facilitate dissemination of agricultural technology and improved agronomic practices. The National Mission (NMAET), though, consists of 4 Sub Missions namely, (i) Sub Mission on Agricultural Extension (SMAE) (ii) Sub-Mission on Seed and Planting Material (SMSP) (iii) Sub Mission on Agricultural Mechanization (SMAM) (iv) Sub Mission on Plant Protection and Plant Quarantine (SMPP), the common threads running across all four Sub-Missions are Extension and Technology. The Sub-Mission on Agricultural Extension mainly focuses on creating awareness and enhancing the use of appropriate technologies in the agricultural sector and all the allied industries.

Structure of Implementation

The short duration skill based trainings on agricultural vocational areas under Skill Training of Rural Youth (STRY) are implemented at district level following a tree tier structure (Figure-1). The component is implemented in different states by MANAGE in association with State Agricultural Management and Extension Training Institutes (SAMETIs). SAMETIs identiy different institutes based on the suitability as training institutes in association with ATMAs for organising the programs for rural youth at district level. The different categories

of institutes responsible for implementation of programs at national, state and district level will operate in overall supervision and guidance of the Ministry. The comprehensive structure having involvement of SAMETIs, ATMAs and training institutes facilitate not only the smooth implementation but also help in identifying the potential skilling area suitable for a particular district.

Figure 1. The three tier structure for implementation of STRY Programs



Skilling Areas

Skill development can help in making agriculture profitable, attractive and enterprising. In the process, the migration to urban centres will be curtailed by enabling rural youth to choose self-employment in their own village (Bhattacharyya & Mukherjee, 2019). However, it is important to identify the proper skilling area taking into consideration the local needs and potential of the districts. The STRY relies on a robust structure to identify the skilling areas so that rural youth can be trained to perform various farm and non-farm operations more efficiently and to promote employment of rural areas. In order to identify the local need based training areas appropriately the structure suggested under STRY have involvement of SAMETI and ATMA having a better understanding of local needs and potential of different enterprises. However, in order to facilitate the process of identification of skilling area, an indicative list of wide range of areas spanning agriculture, horticulture and animal husbandry, dairying & fisheries has been compiled under the Component (Table-1).

Table 1. An indicative list of skilling areas covered under Skill Training of Rural Youth (STRY) component

Agriculture	Horticulture	Animal Husbandry, Dairying & Fisheries
▪ Agriculture Mechanisation ▪ Soil conservation ▪ Training on oilseed, maize & oil palm development ▪ Soil testing ▪ Organic farming ▪ Seed production ▪ Repair and maintenance of tractors and farm equipment ▪ Setting up of custom hiring agro service centres ▪ Installation and maintenance of food processing machinery ▪ Selection, operation and maintenance of plant protection machinery ▪ Storage and maintenance of foodgrains ▪ Grading of agricultural produce ▪ Management of rural godowns ▪ Integrated pest management in crops ▪ Production of bio-control agents, bio-pesticides and vermicomposting	▪ Mushroom production techniques ▪ Bee-keeping ▪ High-value floriculture ▪ Protected cultivation ▪ Installation and maintenance of micro-irrigation system ▪ Post-harvest processing and packaging of fruits and vegetables ▪ Harvesting, cleaning and grading of fruits and vegetables ▪ Organic production of fruits and vegetables ▪ Transportation and marketing of fruits and vegetables ▪ Nursery management ▪ Orchard management and maintenance ▪ Production of quality planting material through tissue-culture ▪ Production and processing of medicinal and aromatic plants ▪ Planting, execution and maintenance of landscapes ▪ Production and marketing of planting material ▪ Cold chain management ▪ IPM in vegetables and fruit crops	▪ Post-harvest activities on fish handling and processing of fishes ▪ Clean milk production (CMP) ▪ Integrated dairy development ▪ development ▪ Integrated development of small ruminants and rabbits ▪ Feed and fodder management ▪ Rearing of improved breed and rearing of cattle and management ▪ Goat rearing and management ▪ Ornamental fish farming ▪ Duck farming ▪ Piggery rearing and management ▪ Poultry rearing and management ▪ Fish rearing and management

Duration of the Programs

The programs conducted under STRY are of short duration with focus on a

specific agri-based vocational area to be completed in seven days including one day for travel. A total of 24 sessions are to be completed per program each of 90 minutes covering at least 36 hours. The programs are divided into modules of similar nature and relevant to each other to maintain continuity of the subject matter in terms of theory and practical sessions (in the ratio of 30:70). Different skilling areas are demonstrated to the trainees by using different models, audio visual aids and equipment followed by skill based exercises through active participation and involvement of participants. Different skilling areas may require different duration for the coverage of entire relevant content. Accordingly, training institutes have to design the content so that all relevant issues related to the subject can be covered in the time stipulated under the Component. An attempt was also made to record the opinion of the nodal officers and program coordinators associated with the implementation of the programs on suitability of the duration for organising various agriculture related skill based training program for rural youth (Table-2). In most the cases time has been expressed to be sufficient to cover the relevant content except practice oriented skilling areas like rabbit farming and quail rearing. However, in such cases also time was suggested to be sufficient by about two-third of the respondent.

Table 2. Response of nodal officers and program coordinators on suitability of the duration (expressed in percent)

Sr No	Skilling Area	Even Less time would be sufficient	Sufficient to Cover the Content	More time would have been better
1	Beekeeping	13	81	6
2	Fish Rearing	12	76	12
3	Value Addition/Process-ing	15	74	10
4	Piggery Rearing	11	74	15
5	Nursery Management	23	71	6
6	Mushroom Cultivation	18	71	11
7	Poultry Rearing	25	69	6
8	Livestock Production	17	69	14
9	Seed Production	17	66	17
10	Vermicomposting	31	64	5
11	Quail Rearing	23	63	13
12	Rabbit Farming	27	62	12

13	Mechanization	19	61	19
14	Average across skilling areas	19	69	11

Note – The average of the response received from 44 Nodal Officers and Program Coordinators association with the implementation of programs under STRY

Impact of the programs

Rural youth and farmers practicing agriculture have to operate in a very complex and uncertain environment as has been depicted by Kahan David (2012) through an ecosystem covering technology support, finance, commercial services, markets, agents, extension works, competition, government and input suppliers. Practicing agriculture or related enterprise with focus on income enhancement in such an environment will require optimum utilisation of input and technology, understanding of trade dynamics and understanding consumer preferences. In this changed environment, it is important to inculcate business perspective among farmers and rural youth and equip them with requisite skill to facilitate optimum utilisation of the available resources. The same has been reflected by the financial independence as captured through selected success stories experienced under STRY Component. A total of 75 success stories experienced under STRY have been compiled by MANAGE with the help of SAMETIs and training institutes under the guidance of the Ministry as part of Azadi Ka Amrit Mahotsav Celebration. An elementary examination of these success stories suggests that nursery management and vermicomposting are some of the most popular skilling areas accounting for 40 percent of the total cases covered in the compilation (Table-3). Other popular areas are poultry rearing, processing and value addition, mushroom production and livestock production in the same order.

Income Generating Potential

The information compiled from success stories experienced under STRY also reveals the income generating potential of the skill based programs. Various enterprises covered under the document are having different income generation ability which ranges from a lowest of Rs 2000 per month in mushroom production to a highest of Rs 62500 per month in nursery management (Table-3). Most rewarding enterprises in terms of income generation have been nursery management, poultry rearing and beekeeping.

Table 3. Income generation potential of skill based training programs

Sr. No	Sectors	No. of Success Stories	Monthly Income		No. of Persons motivated
			Lowest (Rs)	Highest (Rs)	
1	Nursery Management	15	6500	62500	27
2	Vermicomposting	15	2800	5000	329
3	Poultry Rearing	8	7917	58400	56
4	Value Addition/ Processing	7	4167	20000	235
5	Mushroom Production	7	2000	30000	361
6	Livestock Production	6	6000	25000	260
7	Fishery Rearing	4	4833	30000	12
8	Beekeeping	4	3700	50000	120
9	Piggery Rearing	2	29167	31250	--
10	Others	7	8000	45000	20
	Total	75	2000	62500	1420

Note – Others include soil testing, sericulture, mechanisation, rabbit farming, seed production and quail production, the lowest income of Rs 8000 has been reported in case of soil testing whereas highest income of Rs 45000 has been reported in case of quail rearing. Only a limited number of 20 farmers have been outreached by the youth practicing quail rearing.

Farmer-to-Farmer Extension

The information compiled in Table-3 reveal that a total of 1420 rural youth have been trained or oriented on the respective subjects by the rural youth trained under STRY and thus encouraging farmer-to-farmer extension. In the present time when farmers are relying on various ICT enabled mobile phone based services for their information need, fellow-farmers are still a major source of information for them. About one-fourth of the farmers rely on other farmers for their information need (Mittal et al., 2010). It further emphasises the importance of such programs in reaching out to large number of rural youth and helping them diversify towards new enterprises based on skill improvement.

Conclusion

Changing demographic profile has made it important for the government to focus on development of youth mainly engaged in agricultural sector in rural areas. Skill development has been identified as one of the areas for creating productive workforce. Government has introduced various programs with focus on skill development to improve skills of youth. One such program is Skill Training of Rural Youth (STRY) implemented by the Ministry of Agriculture and Farmers Welfare under Sub-Mission on Agricultural Extension. STRY focuses on imparting skill based trainings to rural youth in agri-based vocational areas. The comprehensive structure followed under STRY to operate at national, state and district level by involving MANAGE, SAMETIs, ATMA and training institutes under the supervision of the Ministry ensures not only the smooth implementation of the programs but also facilitate in identification of need based skilling areas which is vital for creating desired impact. These are short duration programs but the duration is opined broadly sufficient by the nodal officers and program coordinators associated with the implementation of the programs. The programs have also been able to create financial impact as expressed by the income realised by rural youth through different enterprises based on the skill acquired through the programs organised under STRY. The income realisation has been observed to be as high as Rs 62500 per month in case of nursery management. Nursery management and vermicompost production are some of the popular skilling areas. The programs have also emerged as an effective tools to reach out to large number of rural youth though the youth trained under the programs. The short duration skill based programs if implemented appropriately by involving all relevant agencies operating at different level have the potential to improve financial independence of rural youth engaged in agriculture.

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Case Studies on Agri-Startups in India: Inspiration from Mann Ki Baat, Innovations and Impact

Saravanan Raj[1], Yuvaraju Atmakuri[2], Amit R. Kale[3], Praveen H.J[4], Saurabh Kumar[5] and Anju Abraham[6]

ABSTRACT

Innovation is the key to successful startups. Startups are developing technology and innovations supported by improvements in several activities of the agri-food systems. As a major support pillar for the startups, national startup policy, programs and the PM's 'Mann Ki Baat' also had an impact on entrepreneurs to take innovation into action. The study has included 5 startups that are got influenced by the same. The case study on agri-satrtups includes the innovations to farm improvement, the evolving process from the idea to implementation, stakeholder involvement, incubation support and the impact of startups among the farmers and other stakeholders.

Keywords: Mann Ki Baat, Agri Startups, Agricultural Innovations, Agri-Business Incubation, India

Introduction

Agriculture is the largest sector in Indian rural economy. The rural economy contributed nearly half the nation's overall GDP in 2019–2020 and employs 350 million people (68% of the total workforce). After the era of Green revolution, currently India is trying to promote smart farming and natural farming. The overall agriculture ecosystem witnessed revenue growth of approximately 85 percent during FY 2019-20. Howeverr, current state of the agriculture system needs to face different challenges such as backward input market linkage support for farmers to connect with the network, financial accessibility, innovations and technologies and disruptions in the market accessibility and price mechanism and lack of insights on changing consumer needs and these makes gaps in agriculture value chain (Naina, 2022, Sabita, 2014, https://www.downtoearth.org.in). In these complex agriculture scenario, innovation could act as the basic criteria

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for finding the solution for the challenges. Entrepreneurship is all about identifying the opportunities in solution to confront with these challenges.

Startups plays a crucial role in the development of the innovation, especially in the initial phase. Different empirical studies assess the relationship of innovation in the growth of startups (Fiorentino et al., 2020). Across the different segments of the agricultural value chain, startups are coming up with innovations with technological support.

The starting of agri tech startups era in India marked from 2010. A total of 366 agri-based startups have come up from 2013 to 2017 (Anand and Raj, 2019). And Noticeably startups showed exponential growth during the pandemic period (www.pib.gov.in, 18 Oct 2022). That was considered as a need of the hour and ideas such as a consumer-farmer network, input e-commerce platform and agro marketplace were instantly proven, and that boosted investor trust (https://economictimes.indiatimes.com, Sep 24, 2021).

At present, India is home to 4943 agritech startups (www.pib.gov.in, 15 March 2023, www.startupindia.gov.in) . This fast-growing agri startup system resulted as every ninth agri start-up globally is from India (PWC, 2021). This shows the possibility for exceptional transformation in agriculture in India. The sustained and long-term oriented direction from Government also contributed to the rapid growth of startup ecosystem in agriculture. The use of scientific data and technology in farming is constantly being emphasized by the Government and the corporate sector. This expansion of agritech start-ups has a direct impact on the socioeconomic situations of India's rural population by creating jobs and improving farmland.

The government has provided adequate support to agricultural start-ups through policies and programs such as Start-up India, the Atal Innovation Mission, RKVY – RAFTAAR scheme, NIDHI (National Initiative for Developing and Harnessing Innovations), the Venture Capital Finance Assistance (VCA) Scheme promoted by the Small Farmers' Agri-Business Consortium, NewGenIEDC (New Generation Innovation and Entrepreneurship Development Centre) and the ASPIRE scheme. Such programs, in collaboration with well-known accelerators, incubators, and mentors selected for the agritech start-up ecosystem, have been working to provide technical assistance and shorten the gestation period of agri start-ups. The Innovation and Entrepreneurship cell at RKVY-RAFTAAR has made significant steps in establishing the agri startup ecosystem in a much larger scale. So far 3376 agri startups have been incubated with a funding of Rs.119.84 Cr. This could make an benefits to 40.30 lakhs of farmers (Agri-startups innovations 2022, Ministry of Agriculture and Farmers Welfare, Gov. of India).

As a continuation of support, Ministry of Agriculture and Farmers Welfare, GoI has set up Accelerator Programme of Rs. 500 crore for promoting Agri Start-ups. This will help develop a separate division of agriculture start-up to work as a single window agency to facilitate all the stakeholder linkages required for agri Start-ups (www.pib.gov.in, 22nd Oct 2022).

"Mann Ki Baat" – An Inspiration for Agristartups

In the 75th edition of monthly radio program 'Mann Ki Baat, Prime Minister of India pointed out the importance of modernization in agriculture as the need of the hour. He insisted that, technological innovation can reinforce farm diversification. This will create employment opportunities and diversified income sources for farmers. The Government wants to support the improving startup scenario of the country. In the 83rd episode of Mann Ki Baat, the PM mentioned that, ideas, innovation and passion to take risks can-do magic in entrepreneurship to make success stories.

During the 2023 post-budget webinar on 'Agriculture and Cooperatives' the PM highlighted the importance of promotion of agri tech startups for eliminating the challenges of the sector. The Prime Minister pointed out that India is home to more than 3000 agri-startups today compared to next to nothing 9 years ago. He informed about the introduction of Accelerator Funds for agri-tech startups and said that the government is not only creating digital infrastructure but also preparing funding avenues.

In this background, to build a strong ecosystem for nurturing innovation and startups in the agricultural domain, the Government is preparing policies and programs. The regulatory ecosystem governing startups in India and gives an account of complementary schemes under which startups can obtain Government benefits. Through these programmes, the government seeks to delegate start-ups through innovation. Start-up India supports entrepreneurs and those who can innovate by offering various levels of technical and financial support (Singh, 2020). In long term it will boost the startups and contributes to the government's Atma Nirbhar Mission and Make In India vision can be realized, creating more jobs, raising the standard of living for millions of Indians, and strengthening India worldwide.

From 2016 onwards, based on the policies, programs and schemes implemented by the Government, the idea of innovation into reality through startups started to get momentum. The policies, success stories and support highlighted by the PM in 'Mann Ki Baat' has motivated many to take up entrepreneurship as an opportunity.

The support given by the Government has boosted agri-startup scenario. In the

75th Mann Ki Baat, the PM concentrated on diversification and modernisation of agriculture sector. Apart from that, he shared his viewpoints on a variety of topics related to agriculture. The Government of India from the starting promoted the idea of waste utilisation which can be an additional source of income for farmers. On 24th November 2019 the 80th episode on the PM made comments on the 'Waste to Wealth' concept in his Mann Ki Baat. In The Government always put focus on the idea of 'Connect with Nature'. During the Mann Ki Baat of July 2022 episode, the PM mentioned the success of Surath model of natural farming and advised the nation to take up the opportunities in it. The Government has special attention towards Livestock development and welfare. He mentioned the Ladakh farmer Urgain Phuntsog in Mann Ki Baat programme for his diversified farming with livestock. Even though livestock sector is considered as a traditional sector, it provides secured income to farmers. Last but most importantly, the focus was given to the livelihood enhancement of the marginalised community of farmers.

In this context, aspiring entrepreneurs could come up with innovative solutions to the challenges in the agriculture sector. Based on the concept of diversification and modernisation as suggested by Prime Minister, the study has selected five major focus areas which were mentioned in the Mann Ki Baat.

1. Eco- farming
2. Modernisation of agriculture
3. Livestock welfare and development
4. Waste to wealth
5. Farmer livelihood enhancement

Methodology

MANAGE Center for Innovation and Agripreneurship incubated 330 Agri-Startups from 2017-2018 and 134 (41%) of Agri-Startups from the above indicated five areas. From this 134 Startups, five Startups from 4 states have been randomly selected for case study. A structured interview schedule and telephonic interviews were conducted to collect and document the case studies. The authors of the case studies had personal interaction with these selected Startups. As a matter of due diligence policy, the team members of MANAGE Center for Innovation and Agripreneurship regularly visit all the incubated Startups and the Startups also visit MANAGE for mentoring sessions.

Thus, we have selected five early-stage startups from above mentioned focus areas of innovation. The case study documentation included the background of the challenge, innovation to the solution, how the startup made it into reality, stakeholder engagement of the startup and the impact created by the startups.

The five case studies and their areas of innovation and startups are given in the table below:

Case Study No.	Focus area of innovation	Startup	Contact
1	Sustainability in Resource Utilization: Waste to Wealth	Atma leather, Sonarpur, West bengal	Website: https://banofileather.com/ Mobile: +91 9821499797 Email: jinali@atmaleather.com
2	Automation for Water Management in Aquaculture	Bariflo Labs, Bhubaneswar, Odisha	Website: www.bariflolabs.com Mobile: +91-7328021033 Email: bariflolabs@gmail.com
3	Livelihood Enhancement through Collective Marketing and Value Chain Approach	Tribe Grown, Amravati, Maharashtra	Website: www.tribegrown.com Mobile: 08390131411 Email: tribegrown1@gmail.com
4	Animal Welfare, Livestock Management and Marketing	Pashupaala.com, Banglore, Karnataka	Website: www.pashushala.com Mobile: 9910491500 Email: gaurav@pashushala.com
5	Eco-friendly Cultivation and Farm Advisory to Marketing	Eco Agriprenurs, Devanagere, Karnataka	Website: www.ecoagripreneurs.org Mobile: +91-9676598585 Email:ecoagripreneurs@gmail.com

CASE STUDY - 1

Atma Leather: An Environmentally Friendly and Cruelty-Free Material

Environmental degradation and natural resource constraints are demanding sustainable technological advancement in agriculture. Innovative approaches to turning farm waste into ecological and economic assets can contribute to a sustainable way of production. Most crops produce as much or more waste than they do usable products. With this background, the startup Atma Leather introduced the idea of converting banana waste into good-quality leather products. This became a solution for the environmental damage created by the leather industry through the utilization of resources. With educational knowledge and incubation support, the founder, Ms. Jinali Mody could make the innovation into reality. As an environment-friendly product, the startup could create a positive impact not only on sustainability but also on the livelihood of the farmer by providing additional income.

Introduction

India has a rich history of agriculture and with the increasing focus on sustainability and environmental conservation, Agri-startups in farm waste

management have gained importance in recent years. Over the years, the agricultural sector in India has faced a major challenge in managing its farm waste, which has resulted in significant environmental degradation. The COVID-19 pandemic had a significant impact on the agricultural sector, but it also highlighted the need for sustainable agricultural practices. This has led to an increased focus on agri-startups that provide solutions for managing farm waste in a sustainable and efficient manner. The government has also launched several initiatives, such as the Atmanirbhar Bharat Abhiyan, to support the growth of agri-startups and encourage sustainable agricultural practices. Overall, the growth of agri-startups in farm waste management has been encouraging, with several innovative solutions being introduced to tackle this issue.

In the early years of the 21st century, the focus of agri-startups in India was mainly on improving agricultural production and yield. There were very few startups focused on farm waste management during this period. Startups like Carbon Masters India, Blue Tribe, and Roli Roti emerged during this time and introduced innovative solutions such as converting farm waste into biofuels and fertilizers. Government initiatives such as Swachh Bharat Abhiyan also promoted the importance of waste management and provided funding and support for startups in this sector. However, a few startups began to recognize the potential of managing farm waste and started working on solutions to reduce the environmental impact of agricultural practices. And those startups includes, Indian Green Service, Saahas Zero Waste, and Daily Dump.

Areas of Concern

In India, 350 million tonnes of agricultural waste are generated each year. That quantity makes up 35% of the global total of around a billion tonnes of crop waste. Most crops produce as much or more waste than they do usable products. India, for example, is the world's biggest banana producer. During every harvest, 80% of the banana plant ends up wasted - around 120 million tons and the amount of waste generated each year is growing. Less than 10% of banana waste alone is used in some way. Indeed, around 40 percent of the crop gets wasted as a peel. Much of the time, banana waste and other crop waste is simply burnt or left to decompose, yielding pollution and emissions of greenhouse gases like methane and carbon dioxide.

The leather industry is responsible for significant environmental damage and also puts immense pressure on land, food, and water resources. Fruit waste is increasingly being transformed into vegan leather, reducing waste and pollution and helping to create cruelty-free and sustainable materials for the

fashion industry. Looking to the global scenario, in Spain, Persiskin launched a vegan leather made from leftover persimmons, while Pinatex uses pineapple leaves to create a luxury alt leather, a favorite among eco-consumers. Other companies are leveraging fruit waste, using tamarind pods and apples to make shoe collections, watches, bags, and accessories. In Kanpur, India, untreated effluent from tanneries carries heavy metals like chromium into the Ganges River. From there it makes its way into drinking water, crops, and soil, causing congenital defects and debilitating skin diseases. All this effort exploits the natural resources also. A single leather handbag uses up to 18,000 litres of water which could have to meet the daily water needs of over 5,600 people.

The emergence of Atma Leather

Inspired by the above causes of leather making and crop waste in India, the journey of Atma Leather began in early 2022, Ms. Jinali Mody who is the founder of Atma Leather faced difficulty in finding an environmentally friendly leather bag made in India. Also, during the monthly radio address of 'Mann Ki Baat', the Prime Minister emphasized the importance of vocal for locals and adopting new alternatives and innovations in the agriculture sector to increase farmers' income and create employment opportunities, which triggers her to work on the vegan based leather idea.

As someone from India which is considered as the leading exporter country of leather, Ms. Jinali was aware of the environmental impact of this resource-intensive and highly polluting material. She recognized that even synthetic leather, which is advertised as vegan, is derived from petrochemical sources. Given the lack of sustainable alternatives, Ms. Jinali embarked on a quest to replace materials that have a harmful impact on the planet. But to understand in depth how exactly it started from an Idea to Reality, we need to go into the past.

Ms. Jinali leveraged her business experience from McKinsey & Co. and her Master's Degree in Sustainability from the Yale School of Environment to kick-start the venture. In her first year at the Yale School of the Environment, was looking for areas in climate and sustainability where a startup might be able to make a tangible difference. Where Ms. Jinali got $25,000 from Startup Yale's 2022 Sustainable Venture Prize and the necessary equipment for basic R&D and to build a functioning Minimum Viable Product (MVP).

Incubation Support and Journey of Atma Leather

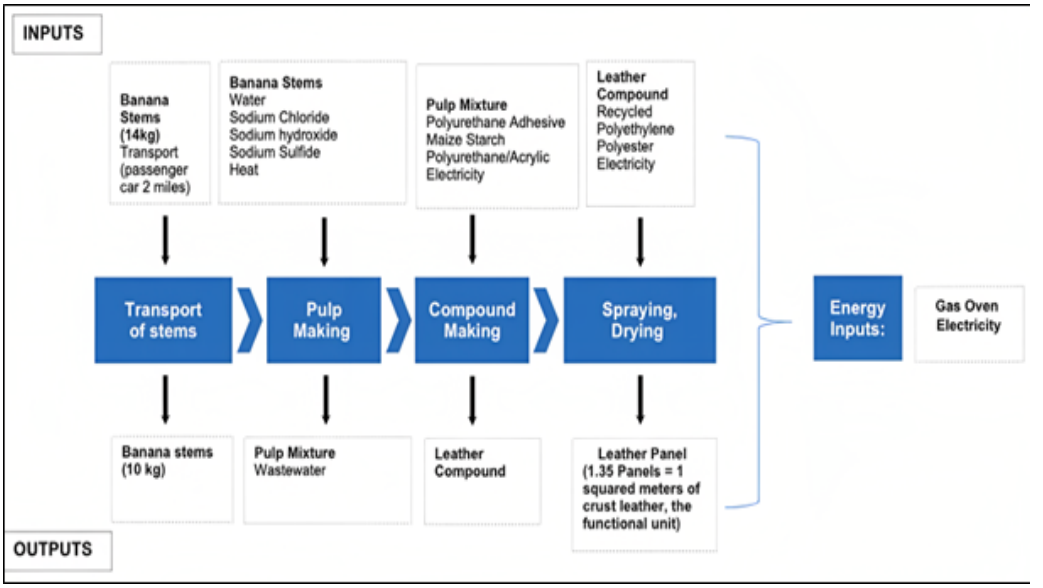
The startup found a niche in a surprising intersection between the problems plaguing leather making and another industry: agriculture. Meanwhile product development and R&D, Ms. Jinali came across the "Rashtriya Krishi Vikas Yojana

- Remunerative Approaches for Agriculture and Allied Sectors Rejuvenation" (RKVY-RAFTAAR) is a flagship scheme of the Ministry of Agriculture and Farmers Welfare (MoA&FW), Government of India is aimed at strengthening infrastructure in Agriculture and Allied sectors by building Agripreneurship & Agri-Business ecosystem in the country, facilitating financial aid to potential Agri-startups and nurturing a system of business incubation. The National Institute of Agricultural Extension Management (MANAGE) supported her startup with the mentoring training program of two months under the RKVY-RAFTAAR program and provided a networking opportunity for connecting with various stakeholders of the startup ecosystem. MANAGE, an autonomous Institute of MoA&FW for agricultural extension, has long been a leader in assisting agricultural entrepreneurs. For the benefit of Agri startups, MANAGE established a Centre of Excellence and Incubation Centre (MANAGE-CIA). The centre's focus is to promote Agri-Startups, which provide better support to their services, products, and technologies in the agriculture value chain. By creating a national agribusiness ecosystem, providing financial support for potential agri-startups, and maintaining a business incubation system, it aims to develop infrastructure in agriculture and related industries.

Armed with funding and a good idea, Ms. Jinali headed back to India to get the company off the ground. The startup journey started with finding Head of R&D, Shashank Srivastava, who was born and brought up in Kanpur and knows the ins and outs of the leather industry and spent the last decade working in the fashion industry. Ms. Jinali met many people along the way who said they knew how to make plant leather, but it is extremely complex and challenging. They opined that 'you have to make a material that lasts very long and you have to do it sustainably and That's not easy'.

"Banofi" is a premium banana leather brand developed by Kolkata-based material innovation firm Atma Leather by upcycling banana crop waste and transforming it into fibres. Atma Leather is using discarded banana crop waste to create plant-based leather, addressing the issues of pollution and animal cruelty in the leather industry and the growing issue of crop waste.

Banofi's make-up is 50 per cent banana stem waste and 30 percent natural additives such as rubber and gum arabic. The remaining 20 per cent is made from primarily recycled polymers required for the leather backing, but Atma is working to innovate and reduce its dependence on polymers. The leather has a significantly lower environmental impact than animal and plastic leather, with 90 per cent less carbon emitted and 90 per cent less water required in the manufacturing process. Atma's process also doesn't create any toxic wastewater and saves animals that would otherwise be slaughtered to produce leather.



Flow chart of manufacturing Leather from Banana stem

Moreover, she began to search for a space and saw more than 50 spaces in Calcutta and found the perfect facility for her startup, as bananas are the primary raw material for banana leather production. Therefore, it's essential to choose a location where bananas are readily available in sufficient quantities and at a reasonable price. Bananas thrive in warm and humid conditions. Therefore, it's essential to select a location with a tropical or subtropical climate, with an average temperature range of 25-30°C and moderate rainfall. While choosing a location for her startup, the availability of skilled workers, transportation options, and infrastructural facilities are the other primary factors are considered.

She searched for the basic machinery that would be needed. As things began to fall into place, they started to find a team. Their procurement specialist, Kaushal, recruited most of their team from the Government College of Engineering and Leather Technology in Calcutta. Shashank leads the design department and has a decade of experience working with export houses that produced leather apparel for popular fast fashion brands like Zara.

The team experimented with mango peels and cores, as well as wheat straw, which are waste products from the pulp industry. However, due to the short seasons for both of these raw materials, sourcing them proved to be challenging. As a result, they turned to the perennial banana crop. Banana fibres extracted from discarded banana pseudostems are ideal for their purposes as they are soft, supple, and breathable. These fibres are also incredibly durable, owing to the thick walls of cell tissue that are bonded with natural gums. The material

composition includes cellulose, hemicellulose, and lignin. Banana fibre possesses the excellent spin ability, fineness, and tensile strength, making it an ideal raw material for vegan leather.

Furthermore, banana fibres have a natural shine that is similar to leather. Most importantly, they are eco-friendly, chemical-free, non-toxic, odour-free, and biodegradable. The startup has conducted extensive comparison tests between its material and animal leather. The results show that their material "Banofi'' (banana-fibre leather) is free from toxic metals and chemicals. Additionally, their material exhibits comparable characteristics to animal leather, including tear strength, flexibility, and overall look and feel. The material is tested by accredited labs across the country such as SGS. This SGS's Eco secure certification supports the global footwear industry by enabling it to verify that components or products have undergone testing and are certified against this global benchmark. Atma Leather has also received a PeTA vegan certification, which indicates a certification for products that do not contain any animal-related materials. However, they are continuously striving to improve the durability, softness, and tensile strength of the material.

The most significant barrier to their enterprise has been the inertia required to move a new product. Leather has existed since ancient times. However, it takes a great deal of time and effort before customers are willing to try their material; to build faith and trust. Atma Leather relentlessly strives to build this faith by providing boutiques with free samples and improved material in return for feedback. To gauge consumer interest in sustainability, they conducted surveys at Yale, which revealed that over 80% of consumers care about sustainability and are willing to pay over 20% more for a more sustainable alternative. They have also engaged with several boutiques to gather on-the-ground customer feedback, with a particular focus on India.

Impact Created by Atma Leather

Atma Leather is a team of individuals with expertise across leather, textiles, design, agriculture, and material science. The startup has generated employment opportunities for women entrepreneurs and rural youth. They possess a diverse range of skills and expertise in leather, textiles, design, agriculture, and material science. The startup is backed by industrial experts and advisors namely Mr. Avinash Goyal, Senior Partner at McKinsey Chemicals & Agriculture Team, Ms. Monica Shah, Co-Founder of Jade, a Luxury Fashion House in India and Mr. Vidit Bhandarkar a Ph.D., Consultant at MIT. Atma Leather continuously striving to improve the durability, softness, and tensile strength of their plant-based leather material.

Atma Leather provides banana farmers with an additional income of Rs. 2/Kg and labour cost to remove the stem, which is the monthly additional income of Rs. 1500 to the individual farmer (on the procurement of ~5000 kg per month – which yields <10% of usable raw material). Atma sources its banana waste from more than 12 smallholder farmers from the area of Rajpur Sonarpur in the state of West Bengal, where this waste is not utilised. These farmers are compensated for their produce, disincentivising harmful crop-burning practices and, by removing the banana waste quickly from farms, reduces water logging in fields and the breeding of mosquitoes and scorpions.

Atma Leather got its first order of 150 leather-bound notebooks for the Yale School of Management and has buyers at small boutiques and major fashion houses alike interested in using Banofi in their products. The startup has just started generating revenue of Rs. 2.00 lakhs of in the previous Financial Year 2022-23 and Atma Leather has team currently consists of 13 members, with 60% being women.

At present, they have established affiliations with more than 20 eco-friendly boutiques situated in India, the United States, and the United Kingdom. Atma Leather partners with brands includes Studio Beej, Pixie Mood, Coral by Seema, Mondarro Shoes, Lo and Sons, Amare Antwerp, Misfit Panda, Crimzon, Sylven New York, Luxtra London, Nisolo, and Santos By Monica, among others and working hard to position her startup in the international market. These partnerships were established by diligently approaching brands already involved in sustainable practices. As a result, they have received requests from brands interested in launching a range of products made with their material. Moreover, they have a contractual agreement with one brand granting them exclusivity until their summer launch.

Ms. Jinali looking forward to the Agricultural Accelerator Fund introduced by the Government of India, which seeks "creative and cheap solutions to the difficulties faced by farmers'' and current technology to be efficient and successful, it inspired her to scale up her venture. She travels in Europe and the United States to scale up her startup, but she envisions Atma remaining based in India, where it benefits from proximity to both the farmers it works with and the manufacturers it hopes to sell to.

CASE STUDY - 2

Bariflo Labs – On Mission to Provide Quality Water for Aquaculture

Founded in 2018 by Mr Mrityunjaya Sahu, Bariflo-labs is a startup working in the aquaculture sector. They have developed an Intelligent and automated aquaculture management system comprising sediment aeration, water column and sediment mobile monitoring and mobile nutrient control module. The primary application of their system is in Shrimp Aquaculture with the major market segment being B2B i.e, Shrimp aquaculture farmers. They are also offering total water management solutions for water bodies.

Mrityunjaya Sahu founded Bariflo Labs with a vision of providing the best water quality needed for aquaculture. The level of dissolved oxygen at the sediments is not optimal as per the requirement and Bariflo Labs came up with an AI-IoT Robotic aeration device called LOTUS for aqua-pond. Their IoT-based aeration system is a wave-based diffused aeration that operates at the sediment, where the aeration works by the guidance of mobile monitoring system. They also have a mobile AI-IoT floating robot that gathers water-quality parameters at different strata of the water body on a real-time basis and provides a complete three-dimensional picture of the water body. The data helps in the early detection of shrimp disease and facilitate timely action.

The device was found to be quite useful for both Aquaculture and urban water management bodies with a total of 12 Cr litres of water managed by the 19 devices installed by the company.

Introduction

In India, approximately 16 million farmers are involved in aquaculture as an occupation among them sizeable population are involved in shrimp farming. Based on yield, shrimp farming can be segmented to three segments. Intensive farmers, semi-intensive farmers and rest are low-income traditional farmers. In all the segments, it is observed that farming is unorganized. Bariflo Labs, a technology-based aquaculture startup is planning to capture organized the market by making farmers its adopting sustainable green technology and management practice will enhance yield by at least two times leading to creating bigger market. In addition, acceptance of aquaculture as an organized market can be established, quality and quantity of exports also can be improved. The business and tech model is very much scalable as segments are well explored as well as the requirement to scale the model doesn't require not more than 2-3 crore in India. Further, as the issue is so ubiquitous that the tech and

business model can be replicated to other geography and other issues such as lake cleaning, and reservoir health management as well. In India, as in many countries across the world, groundwater levels have been depleting rapidly and at unsustainable levels for the future. What has happened down the line is that a huge amount of water is being drained, the soil moisture is eroding faster leading to desertification. All major cities across the globe are water-stressed, as well as in the villages, where all the farmers are pumping water from the ground. The challenge is finding a way to show value in the water. This is how he ended up building a venture in the aquaculture sector to create dependency on water reserves.

Startup Founder's Introduction

To address the issue water quality management, Mr Mrutyunjaya Sahu from Titlagarh, Bolangir, Odisha founded Bariflo Labs. Mr Mrutyunjaya is an Environmental studies academician with specialization in water management. His interest has always been in water resources. He spent much of his early career in academia and had been studying the water sector since his undergraduate years. He has pursued his PhD from the University of Canterbury. Previously, he did his MS and B. Tech from NIT Rourkela in Civil Engineering. He has published highly cited publications on the application of Artificial Intelligence in water resources management. He has also filed product design patents for water quality improvement of water bodies. One of the main verticals of his innovation is Aquaculture, primarily pond based/brackish water aquaculture.

Birth of Bariflo Labs- Aquaculture Startup

Technology: Bariflo Labs has developed an innovative water body management system by leveraging fluid dynamics, IoT (Internet of Things), robotics, and AI (Artificial Intelligence) for aqua-farm management. Its intelligent and automated aquaculture management system comprises of sediment aeration, water column and sediment mobile monitoring and mobile nutrient control module.

He left an enriching life after his Ph.D., in Australia and came back to India to pursue his venture. He entirely bootstrapped his venture Bariflo Labs and built a team to create a prototype for the proof of concept. He leveraged upon his knowledge on water resource rejuvenation and fluid dynamics and gathered knowledge on AI-IoT and robotics, collaborating with several research institutions and academics. Bariflo Labs has worked closely with ICAR-CIBA (ICAR- Central Institute of Brackishwater Aquaculture) for validating the proposed technology such as diffused bubble aeration, Intelligent hypolimnetic

aeration and the results and the results were promising. ICAR-CIBA provided the ground and facility for the testing and validation of the technologies which helped in the POC of the device. Subsequently Bariflo Labs developed several patented devices for the field of aquaculture such as the ISAS (integrated sediment aeration system) and IMS (intelligent monitoring system). Patents were filed based on the study such as "**Intelligent Maneuvering Hypolimnetic Aeration System"** with patent number 201831031000.

Bariflo Labs is an industry 4.0 compliant startup that has developed a water body management system by leveraging technologies such as AI-IoT, machine learning, LORA transmission. The company offers intelligent solutions for aquafarmers, co-operatives, villages, communities, cities and industries at a variety of scales. In different fields the devices are deployed for specific requirements for example in case of aquafarmers the prime objective of the devices are to monitor and maintain the DO level at a higher value for cultivating high population of fish in a smaller area, where as in case of cities the main objective is to remove the surface dirt of the waterbodies, remove Phosphorus and Nitrogen to suppress the bad odour and algal bloom etc. Same devices could serve for different requirements at different fields using the sensors and analyzing the final deliverables.

Intelligent Solutions for Aquaculture Management

Bariflo Labs has developed an innovative water body management system by leveraging fluid dynamics, IoT (Internet of Things), robotics, and AI (Artificial Intelligence) for aqua-farm management. Its intelligent and automated aquaculture management system comprises sediment aeration, water column and sediment mobile monitoring and a mobile nutrient control module. Fluid dynamics and robotics mainly helps in the aeration maneuverability and efficiency for water quality and suitable oxygen transfer mechanism in the water. AI and IoT are used for the monitoring of the aeration and data integration to the overall mechanism. A data driven aeration method could be implemented. In the majority of the shrimp ponds, lack of consistent electricity and connectivity is observed where the devices can be life savers for the farmers. Monitoring can be homogeneously done across a pond by sediment mobile monitoring and mobile nutrient control module is useful to provide nutrition to the livestock in the pond uniformly.

Startup Incubation Support, Funding and Inspiration

The project was initially bootstrapped by the founder; his prototype was subsequently supported by the Vellore Institute of Technology Incubation fund

where Bariflo Labs raised its first external funding. Later the company was selected for multiple grants including secured SEED FUND under Biotechnology Industry Research Assistance Council (BIRAC), grant in aid under Innovation and Agri Entrepreneurship program under RKVY-RAFTAAR.

In one of the "Mann ki Baat" sessions the Hon'ble PM of India Shri. Narendra Modi expressed the intent of "Amrit Sarovar" plan which initiated the establishment of 75 ponds in each district in India with the proper management system for the ponds and promote livelihood for the community. This was a great opportunity and hope for Bariflo Labs to leverage its technology to serve the purpose.

As the company grew and the prototype developed towards MVP, several other grants were awarded recognizing the gravity of the problem addressed by the startup. The initial prototype was costing a lot and was unaffordable by the target customers. Besides, there is a distinct difference between a theoretical concept and field application, so there were many instances where the prototype failed to perform as desired in an extreme or unpredictable conditions. So it was a long way to stabilize the product to work efficiently in all conditions and also to be cost-effective.

Startup came up with the flagship products of Bariflo Labs are ISAS (Integrated Sediment Aeration System) and IMS (Intelligent Monitoring System). The ISAS is responsible for the sediment aeration of water bodies and thereby improving the water quality for better productivity in aquaculture and cleanliness for urban water bodies. It increases the DO (dissolved oxygen) and manages the BOD/COD, pH and ORP. The IMS has the purpose to acquire the water data, analyze it and implement a data-driven aeration for the ponds and subsequently use the data for predictive modelling of outcomes. Aqua farmers in Odisha, Tamil Nadu, Telangana and Andhra Pradesh have used the devices and shown impressive results in their productivity and maintenance. The devices could be installed in the ponds of the farmers and they work in automation. The farmers could monitor their operation through web/smartphone dashboards. Several parameters such as DO, ORP, pH, BOD/COD, TDS/TSS, TOC and TAN can be monitored.

Impact

- 19 devices deployed across three states
- 12 Cr Litres of water quality improved
- Up to 25% of productivity enhancement for the aqua based farmers
- Saving 50% of the energy cost through innovative solutions

The devices have been proven to be more effective than the traditional paddle wheel and jet aeration system. Farmers from different regions have secured more profit and managed their ponds in a much more structural way. Nineteen devices deployed across three states with 12 Cr Litres of water quality improved. There is an Up to 25% of productivity enhancement for the aqua based farmers and saving 50% of the energy cost through innovative solutions.

Awards and recognition

Bariflo Labs have won several accolades on its journey from multiple Government agencies. The Ministry of Housing and Urban Affairs has recognized Bariflo Labs for its exceptional contribution to the field of rejuvenating ponds and creating livelihood through aqua farming. It has also won the 'Fisheries grand challenge' from the Department of Fisheries.

Revenue Generated

Year	Income/Turnover(In Lakhs)
2019-20	3
2020-21	12.5
2021-22	48
2022-23	100

Vision for the Startup and Services

Bariflo Lab's Vision is to rejuvenate and create livelihood around the waterbody of PAN India and expand to North America, Australia and Europe. With its technology, biodiversity can be revitalized and GHG emissions can be tackled easily which would be a game changer. In the next 10 years, Bariflo Labs aims to expand to all major cities across the globe where these small and medium-sized lakes are eutrophic and not being managed properly because of a lack of monetization opportunities and ignorance about the problem.

As one of the biggest dreams, startup want to create a platform for aquafarmers to be connected with the real-time monitoring and maintenance of their ponds and livestock. Along with this, the farmers would be able to interact with experts for consultation 24x7 by creating a profitable online business model for the aquaculture consultants. Subsequently Bariflo Labs has the aim to expand these services all over India for both pond based and brackish water aquaculture targeting a minimum of 30000 farmers and create direct and indirect employments by creating a sustainable supply chain of high quality aqua products all over India and creating awareness about the philosophy of innovating new technology in this field.

CASE STUDY - 3

Tribe Grown - Serving Pure

Social entrepreneurship can contribute to the economic empowerment of tribal and marginalized communities of society. The startup collaborated with local tribes by creating a supply chain for the products such as wild honey, Desi ghee cow and turmeric powder. And this has given the uniqueness of the product by giving flavor of nature and tradition without any modernization. Apart from the product The startup has given training to 1500+ farmers and tribals from the states of Maharashtra and Madhya Pradesh for long-term skill advancement.Ultimately it could provide financial independence to the marginalized community by improving their income by 30 percent.

Introduction

Tribe Grown, one of the startups incubated and supported by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad, is training tribal farmers to produce high-quality natural products in the state of Maharashtra and Madhya Pradesh, making them available to urban consumers at an affordable price. The startup has been selected for financial assistance in the form of a Grant-in-aid from MANAGE through the RKVY-RAFTAAR scheme of the Ministry of Agriculture & Farmers Welfare, Government of India.

Wild honey, turmeric powder, and Desi Cow Ghee are among their products. All items are supplied by tribal and marginalized farmers in Maharashtra and Madhya Pradesh's wilds. The items are specifically sourced without losing their tradition and originality.

Bhavesh Ravindra Wankhade, Founder of Tribe Grown has done his master's in social Entrepreneurship from the Tata Institute of Social Science (TISS, Mumbai). As he grew up, he was exposed to the alarming issue of farmers' suicides in Vidarbha and Central India. His father used to discuss the pain points with him, and he felt a strong urge to find solutions to the problem which piqued his interest in the farming sector, and he realized that he wanted to work towards improving the lives of farmers and their families. According to him, the motivation behind his startup was driven by several factors, including his father's heart attack, the importance of healthy food, the need to bridge the gap between tribals and the market, and the growing demand for safe and healthy food. Earlier the founder visited many companies to understand their operations which provided him with valuable insights into the market and helped him further in refining their business strategy.

Partnership with Tribal Farmers

> "In the 75th episode of Mann Ki Baat, Honourable PM Modi said that farmers should embrace new alternatives while doing traditional farming and urged farmers to diversify the agricultural income. While listening to Mann Ki Baat, I felt like a new energy to go deep to the problem and now PM himself is suggesting the diversification of the farmers and tribal farmers' income. It was kind of an approval I got for my model and with all my confidence and resource. I have started working on the ground with the tribal farmers"- Bhavesh Ravindra Wankhade, Startup Founder, Tribe Grown.

Startup partnered with the local tribes and work together to prepare the product for the market. They have established a supply chain for the product and designed appropriate packaging and send their samples to customers for feedback, both in bulk and retail, and then launch the product. The startup prioritize cost-effectiveness, adaptability, and accessibility to make our products available to farmers and customers sustainably and efficiently. Startups also promoted sustainable farming practices among tribal communities and connect them with consumers looking for safe and healthy food options.

Startup products are also in demand in the US, Singapore, Australia, and Dubai. Founder says that he has no problem with the customers, but the production is not that much due to limited resources, and they are constantly looking for investors who share their vision of creating a sustainable and equitable food system. They are also planning to launch seven new products, which will be sourced directly from tribal farmers using sustainable and organic farming practices. Startup aims to expand their product line and increase the income of tribal farmers while promoting sustainable and healthy food options for consumers. The tribal communities in the country are still far away from mainstream society. They have been farming in the same way for centuries. As such, it was quite challenging to bring about change there.

Their products include Wild Honey, Turmeric Powder, and Desi Cow Ghee. All products are sourced from tribal and marginalized farmers from various wilds of Maharashtra and Madhya Pradesh. First, they select the tribal region where they want to work and the product they want to launch. Then they collaborate with the local tribes and work together to prepare the product for the market. They also establish a supply chain for the product and design appropriate packaging.

The products come from remote lands, untouched by modernization. The forests are blessed with a vast diversity of flora and fauna, and they are mainly focused

on wild honey from the Melaghat tiger reserve in Maharashtra and Madhya Pradesh. The bees source their nectar from plants such as the Sheesham, Neem, Jamun, Mahuaa, Amaltas, and thousands more, making the honey a rich source of vital nutrients. The lands are so fertile, that turmeric can be grown with no pesticides or chemicals. The tribal cows are healthy and are forest grazed, making their milk abundant in nutrients. Furthermore, the milk is removed only after the calf has had its due. All of these factors contribute to the products being natural, high-quality, and flavourful. Moreover, zero to minimum processing is used for the products, making them chemical and preservative-free.

Digital Marketing and Organic Stores

The Company sells its products through social media platforms like Facebook and Instagram by posting its products and all the required information with the help of social media marketing. Apart from this, their goods are also available in more than 120 organic stores in the country in states like Madhya Pradesh and Maharashtra with the help of sustainable agriculture promotors.

Best Practice in Bee-Keeping

Tribe Grown changed its process. The earlier tribal community used to cut the entire beehive for honey. Due to this hundreds of bees used to die in one hive. Then, the startup guided them that a beehive is like a house, with the young living separately and the adults living separately. Earlier they used to wrap cloth on the face, smoke it and cut the honeycomb. They taught them how to use shoots and how even by cutting just 10-15 percent of the hive, the entire honey can be extracted. They also helped the farmers in learning about the method of beekeeping. In this process, the whole hive was not wasted, and honey could be extracted from it again in 10-15 days. Earlier the tribals were extracting the honey by smoking it for centuries. That's why it was not easy for them to adopt a new method. Startups adopted strict ways to show the right direction to the tribals. They stopped buying honey from farmers who don't wear suits and cut the entire hive to show them the right path. This made them (farmers) to realize that if they are selling honey on the roadside, they may get only Rs.100 per kg, but Startup was buying from them for Rs.300 per kg. In this way, in the desire for more profit, they were motivated to change themselves. Earlier tribal farmers could hardly get four to five kilos of honey from a hive and moreover, beehives were destroyed but now they get 10-15 kg of honey easily through extensive research and training programs conducted by the startup to educate the tribals on the importance of bees in the wilds and sustainable ways to harvest honey without destroying the beehives. Startup team also taught tribal farmers the right time to harvest honey to get the best quality. Startup is currently associated

with 1200 farmers from tribal communities like Korku, Gond, Bhil, and Bhelwa, of which 500 work directly with him.

Startup Activities

Tribe Grown Startup had a significant impact on the lives of tribal farmers in Maharashtra and Madhya Pradesh. In addition to creating employment opportunities, Startup team members are also working towards empowering women entrepreneurs, rural youth, and self-help groups (SHGs) and by providing training, resources, and support to these groups, they can help them to build their skills, create their own enterprises, and become active participants in their local economy. Startup believe that by investing in people and communities, it can create a more equitable and sustainable world for all.

Impact

Founder himself along with other team members have trained more than 1500 farmers in over 30 villages and has seen a 33% increase in their monthly income, benefiting at least 300 + farmers. Out of 1500 trained, 1200+ have been employed and are working with them to produce high-quality sustainable products. Their efforts have not only raised the income levels of these farmers but also equipped them with the necessary knowledge and skills to adopt sustainable and organic farming practices.

Revenue Generated

Year	Income/Turnover (In Lakhs)
2020-21	7.00
2021-22	45.00
2022-23:	200.50

Innovation/USP

- Better Livelihood in own area
- Creating Micro-Entrepreneurs
- SHG & FPO Formation
- Value addition, processing, and packaging practices
- Tribal (Gondi) language Agri Literature Videos
- Research & Revive Desi Seeds
- Land & Soil Specific Training
- Forest to Fork Supply Chains

Network of Farmers as Entrepreneurs

By connecting with these farmers, they have created a network of rural entrepreneurs, helping them to grow their businesses and contribute to their local communities. Startup has also hired members from the tribal community to procure and transport the products to our warehouse. This not only creates employment opportunities for the community but also helps us to build a strong network of individuals who are invested in the success of our business. Through their team building and employment generation efforts, they aim to not only create a successful business but also to make a positive impact on the lives of those they work with.

Startup's innovation and adaptation in product development and supply chain management have resulted in a positive impact on the environment and the economy and have contributed to the sustainable development of rural areas. Mainly farmer connectivity is the backbone of their business model as work closely with tribal farmers to educate them about sustainable and organic farming practices and provide them with market linkages and fair prices for their produce.

CASE STUDY - 4

Pashushala.com – Comprehensive Online Solutions for Cattle trading: A Case Study of Inspiration to Implementation

Pashushala.com is an online marketplace for livestock aimed at reducing the dependencies on middlemen and to further strengthening the Livestock Economy of the country. It intends to help farmers with a wide variety of choices and better prices.

It was founded in 2018 in by Mr Gaurav Choudhary and a team of technology management professionals, has first-hand experience with the livelihood of farmers. The startup understood the need for "Bharath" and Pashushala.com is the solution that connects "Bharath to India". Mr Gaurav is inspired by the talks of the Honourable Prime Minister – Mann ki Baat, where he emphasized Indian Products for Indian Consumers and a Self-reliant and resilient Nation (Aatma Nirbhar Bharat), and the idea of Pashushala born.

Pashushala has supported over 30000 farmers through animal husband and dairy. They have enhanced their livelihood and social status while making them self-dependent (Aatma Nirbhar). They have generated revenue of Rs 5 crores as of March 2023 and have shown the model is self-sustainable and can go a long way in supporting the farmers.

Introduction

Technology is playing a major role in the last decade in solving the problems faced by the agriculture sector. Many innovations are being introduced by the Agri-startups. Agri- startups play a crucial role in the sector through various technology-led interventions. India is the world's largest dairy producer as well as has the world's largest livestock population but in terms of livestock productivity, it's lagging. There exists great scope for improvement that can create huge economic value. The allied sector is an integral part of the Indian agricultural ecosystem with India being the largest producer of milk and buffalo meat, second in terms of production of goat meat and eggs. The sector contributes to nearly 30% of agricultural products in terms of value. This has allowed multiple startups to venture into the sector. Number of livestock technology-based startups are there in India solving very critical problems in the sector.

Currently, the availability of quality livestock is only in certain geographical regions, such as quality Gir Cow are available in Gujarat, Sahiwal in Haryana, and Rajasthan, Murrah buffalo in Haryana and HF in Karnataka and Punjab. This resulted in a distributed market, absence of any organised player in the domain has left the industry highly unstructured, besides, a lack of quality breeds and access to best practices, and veterinary services results in loss of income and also a limited income opportunity for a farmer. This lack of organized players in the livestock industry was identified as an opportunity by Mr Gaurav Choudhary, and he launched Pashushala.com, an integrated online marketplace for livestock and livestock-related products, services to digitalise and organise the Industry as a whole. The solution is an innovation in animal husbandry and dairy space that's transforming the way livestock have been traded and has supported over 30000 farmers to date.

The company was founded in Sept'2018 in Bangalore by Mr Gaurav Choudhary, a technology management professional with over a decade of experience across multiple sectors. Promoters come from a humble background and have closely seen the livelihood of farmers. Mr Gaurav is inspired by the Talks of the Honourable Prime Minister – Mann ki Baat, where he emphasized Indian Products for Indian Consumers and a Self-reliant and resilient Nation (Aatma Nirbhar Bharat) and the Idea of Pashushala born.

It offers livestock (Cow, Buffalo, Goat, Sheep), and livestock-related products and services like livestock insurance, transportation, veterinary services, feed/ fodder, cattle accessories, plant equipment etc. through an Android application and web portal. Here, the customers can choose from a vast pool of curated

livestock, compare prices in real-time, and make decisions based on factors such as produce, distance, price, and age of the animal. They are providing multiple solutions in the livestock trading space by collaborating with various stakeholders of the livestock industry. The company work with several transporters, insurance providers, feed/fodder manufacturers, plant equipment manufacturers, veterinary doctors etc to offer its services seamlessly across geography. Pashushala is all set to disrupt the market with its game-changing offering. Founders themselves have experience in the dairy sector. They wanted to create a solution that can unleash the income potential from livestock while enhancing their health and productivity, their solution is now well-received in the industry and has benefited several farmers across India.

Motivation to take up the Startup

Opportunity to create a company that can create sustainable Impact at scale and keep on adding value to the lives of farmers.

Primary and Secondary research was the key to hypothesis and solution modelling, they undertook structured question-based interviews and free flow connection with approximately 2000 dairy farms across the country. They also conducted focus group discussions with experts to understand the gaps in Animal Husbandry and Dairy Industry and create solutions to bridge them. The key gaps identified and a solution created:

Key Decision Criterion	Classical Sales Findings	PS Sales
Geographic reach	100 KM	Over 1500 KM
Average time to purchase 6 livestock	4 -5 Months	15 Days
Selection/Price/Quality	Traditional/Bargain/Luck	Scientific/ Guaranteed
Accessibility of livestock	Haat/Fair/Referrals	24/7, Online
Insurance, Transportation and Vet Services	Unknown	Upto 100%

First investment: The first investment was from the founder followed by friends and family round. Pashushala.com is incubated at MANAGE as part of the Agripreneurship Orientation Program under RKVY-RAFTAAR program of the Ministry of Agriculture and Farmers Welfare, Govt. of India and incubated and supported with a pre-seed grants of Rs 5 lakh.

The startup also got good visibility and recognition by participating in various

MANAGE led Saturday Webinar Series on Agri startups, and E launch for Agri-startups. The founder was invited to multiple training programs like Pre Incubation Mentoring Program, Digital Marketing for Agri startups where he shared his experiences that inspired aspiring entrepreneurs.

Startup Journey

The journey from prototype to Minimum Viable Product (MVP) was the result of a constant endeavour the cyclic effort of learning, improving and implementing. Some examples are as follows:

Sl. No.	Parameters/ Assumption	Learning	Improvement
1	Android application will start giving results as soon as it gets launched	You need to support technology with manual experts and string processes.	Set up an expert team of animal husbandry and dairy experts to guide farmers.
2	Online payment will be easily adopted	Farmers are sceptical about online payments. It may take time to bring the change	Training, early adopters and local influencers were employed.
3	Processes will enable trade	Trust enables trade	Set marketing campaigns and field activities to establish trust.
4	Digital marketing was nominal driver	Digital marketing (Facebook, Instagram, You Tube) is very extensively used by farmers.	Have a strong digital presence with key focus on target segment.

Initially, they started by working closely with a closed group of livestock breeders and buyers and based on the learning they created the proper tech model, business model, revenue model etc. They are operating in 12 Indian States namely Uttar Pradesh, Rajasthan, Haryana, Punjab, Gujarat, Maharashtra, Karnataka, Tamil Nadu, Bihar, Jharkhand and Madhya Pradesh. The solution is offered via a cognitive Android application and a web portal. The platform is available in 13 Indian vernacular languages and is easy to use by the end users (farmers).

The market is highly unstructured and the target segment is very new to the use of technology (mobile) hence tapping the market was not a straightforward one. But they believed that the impact this idea can create for the ecosystem and

every day is a new day and has its perks and its share of challenges. They readied themselves to solve the issues be it an operational issue of onboarding sellers or giving guarantees to buyers of the livestock. Or be it guiding the technology team to make the product more user-friendly or be it reaching out to investors to excite them for the idea every aspect is challenging. But the solution to all is, trust, as they are working towards building a disruptive innovative channel of livestock sales that gives confidence among all the livestock stakeholders.

Team: Founding members are the most critical factor that a startup need to figure and they have assembled a good mix of management professionals from IIM, IT experts from the top colleges in India, people from animal husbandry and veterinary background, and access to industry veterans as advisors and mentors product/services provided by startup & the farmer connect. They also work with the rural population, train them to be "Pashumitras" and "Pashusakhis" and get social and economic recognition. So far they have a team of 18 full-time employees and over 100 on-demand Feet on Street, Vet and Expert teams. They have transformed over 2000 farmers into Pashumitras and Pashusakhis supporting animal husband and dairy in 10 states of the country. these Pashumitras and Pashusakhis promote trade through the pahsushala.com platform and in the process gets an opportunity to help fellow farmers while generating income for themselves.

Cost-effectiveness, adaptability and accessibility: Quality cattle are not available to cross all geographic locations which is a pertinent problem. Pashushala.com not only solve the problem related to discovery but its processes impart trust and promote inter-state and intra-state trade. The startup provides a trustworthy, convenient and cost-effective solution with end-to-end support. Farmers can avail the services through their Android Application (https://play.google.com/store/apps/details?id=com.pashushala&hl=en_IN&gl=US), Web Portal (www.pashushala.com) or just by giving a call to the centre. Access to the portal and Android application is free of cost, a user can come on the platform and learn/select from a vast pool of livestock options available on the platform. Only for carrying out transaction company is entitled to fee/service charges.

Impact

So far Pashushala has supported over 30000 farmers through animal husband and dairy. They have enhanced their livelihood and social status while making them self-dependent (Atma Nirbhar). Some of the best moments in the startup Journey include:

- International excellence award for best social impact start-up of the year

(2022-23).

- Most promising company for nation-building by Indian Achievers Forum (2022-23)
- Appreciation from Jharkhand Govt. and Ram Krishan Mission
- Top 30 startups to invest in by TimesNext
- Promoted Women empowerment & micro-entrepreneurship for marginal farmers

The startup has access to over 1 Lakh dairy farmers that take support from their platform to improve their dairy and animal husbandry practices. They have provided support to over 3000 dairy farmers directly by enhancing their farm standards and market connectivity.

It is Working with 30,000 farmers across India in 12 states. Generated employment for 118 people with 18 directly and 100 indirectly. Generated revenue of Rs 5 Cr appox as on date.

Revenue Generated

Year	Income/Turnover (In Lakhs)
2019-20	2
2020-21	52
2021-22	108
2022-23	335

Future Plans for the Start-up and Services

Pashushala.com is a disruptive online channel of sales, that brings various stakeholders of the livestock economy together in a managed environment to instil trust and promote trade. The initial few years were dedicated to spreading awareness, establishing processes that farmers can trust, prove that the structured tech-based solution will optimise the livestock trade market. Convincing farmers to change their habits took a lot of effort and eventually they manage to establish Pashushala.com as a trusted channel of sales in the industry that provide 24/7 market access to farmers to buy or sell anything related to the livestock industry.

As they move ahead towards their journey of structuring the livestock market, service expansion geography-wise / vertical expansion domain-wise is on the card. Pashushala wants to expand to 15 states of the country by end of this year 2023. They target to onboard more dairy farmers and animal husbandry

owners across the country so that they can benefit and grow from pashushala. com. They are launching an IoT Solution to track various cattle and farm-related parameters to improve livestock health and optimize farmer income. They have kept themselves a target to support over 10 lakh farmers and create over 10000 women entrepreneurs in the next 3 years.

CASE STUDY - 5

Eco Agripreneurs Pvt Ltd – An Innovation Towards the Sustainability

Residue farming is a key to ensuring nutritional security and environmental sustainability. But shifting from conventional farming to nature residue farming requires proper advisory services, input access and market connection. The startup Eco Agripreneurs Pvt Ltd took this challenge into an opportunity for entrepreneurship and developed a holistic framework for the same. Their ideas of "Eco Rice", the residue-free paddy, Agri pharmacy for quality tested inputs, market connect mechanism, and advisory services to farmers of different crops could make a positive impact on crop production as well as livelihood development of farmers.

Introduction

India is predominantly agrarian; 80 percent of the population is directly or indirectly dependent on agriculture. India is the world's second-largest producer cum largest exporter of rice in the world. India accounts for 21 percent of the world's total rice production. Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. The Rice provides instant energy as its most important component is carbohydrate (starch). Surprisingly, rice was found to contain high pesticides and trace elements. India has tremendous potential to become a major exporter of organic rice and residue free rice in the international market. Residue-farming adopts a much wider scope in comparison to natural farming. Environment-friendly sustainable agriculture practices are the need of the hour for ensuring food and nutritional security.

"Honourable Prime Minister's Mann Ki Baat has influenced me in many ways. His ideas for building the nation are truly inspiring. The examples of success stories and inspiring personalities has motivated me to do more for the country. I could understand several initiatives taken up by the Govt through Mann Ki Baat program. He is the first person to seek suggestions from common people"- Nagana Gouda Malkaji, Founder, Eco-Agripreneurs.

Eco Agripreneurs

The Company was founded in the year 2017 by Mr. Nagana Gouda Malkaji who has 20+ years of experience in the promotion of sustainable agriculture. Lack of scientific knowledge among farmers, lack of access to right agro-inputs, pollution of the ecosystem by the harmful pesticides and pesticide residues in the food chain made him to start Eco Agripreneurs Pvt Ltd. He did his Masters in Agronomy from the University of Agricultural Sciences, Dharwad. He is a Master trainer on Sustainable Agriculture/ IPM/FFS. He is helping farmers to produce residue free foods to conserve the ecosystem, protecting the health of farmers, farm workers and consumers. He is an expert consultant for a project "Green Innovation Centre" supported by GIZ, Germany and also a professional consultant for many horticultural crops. He was involved in training GIZ staff and lead farmers on Good Agricultural Practices in Potato and Tomato. His startup Eco Agripreneurs Pvt Ltd is helping these eco-farmers to grow rice responsibly without harming the ecosystem

He has conducted several trainings programs for NGO staff and other extension workers on Sustainable Agriculture Practices, Farmers Field School (FFS) methodology and IPM. He has also coordinated cotton research trials across India and station trials of paddy for reduced pesticide uses. They have farmers growing paddy for the past 6 years (12 crops) without using any pesticides. They trying to promote specific package of practices. They could increase the farmer base from 'zero' during 2017 to 5000 at present. He was quite instrumental in training the research and production team on technical aspects. It was his passion for farming and cultivation that made him quit his job as a Research Agronomist at Seedworks International Private Limited to pursue Agripreneurship.

Mr. Nagana says, "Producing safe food, sustaining the environment and improving agricultural productivity is the key for the future generations". His envisions creating a better life for every farming family by providing support through a holistic approach to crop management that integrates multiple agricultural components such as crop production and soil management, providing technical guidance before selling Agro-inputs, nurturing seed growers and creating a market for pesticide residue free 'Eco Rice'. Eco Agripreneurs procures the residue free paddy by paying a premium of Rs 100/quintal. Paddy will be supplied to exporters after residue testing. Rice is sold in the brand name of Eco Rice to consumers and retailers.

Focus

Agriculture consultancy: They follow a holistic approach to crop management. Often farmers are interested in only pest management but they are educating them

about other aspects of farming, especially plant nutrition through training and awareness activities. Regarding pest and disease management, they consciously focus on building capacities of farmers on growing residue free food, even if it is for the domestic market. They are currently providing technical guidance to about 100 Pomegranate farmers, 200 Paddy farmers, 20 Papaya farmers, 200 Vegetable growers, and about 600 seed growers. These are the farmers who consulted Eco Agripreneurs for farm advisory services and who attended the awareness programs and agreed to try the methods recommended by Mr. Naganagouda. They proudly call themselves as "Eco Farmers"', as they follow ecological principles in farming. This refers to ensuring healthy farming and healthy food for today and tomorrow, by protecting soil, water and climate. The current focus on paddy: Avoidance / reducing pesticides to produce pesticides residue free rice.

Agri pharmacy: They are into marketing of quality agro inputs. Their products are tested and certified by competent authorities. They have gained trust from farmers in a very short period of time. They don't sell inputs without providing technical knowledge. This includes the composition, measurement and frequency of application. This is their Unique Selling Point (USP) and they don't have much competition here. They buy products from quality-conscious, result oriented companies. Regular field visits are made to see the effectiveness of inputs supplied. Field trials are conducted before introducing any new input.

Developing SeedPreneurs: They are into contract farming for hybrid seed production. They have trained farmers on seed production and managerial skills. They are into HSP for about 10 crops. Village meetings were conducted to brief about seed production opportunities. Whoever shown interest will be selected for growing seeds of different crops through contract farming. A typical agreement contains details such as crop, variety, expected yield, minimum assured price, payment terms, seed quality standards, etc. They have a network of a large number of professional seed growers who have been into seed production for several years. They coordinated multilocation research trials across India to choose the best-performing hybrids. They Organized different agronomic trials to decide on the hybrid specific package of practices, data management. They are organizing seed production in various crops like Cotton, Tomato, Okra, Bitter Gourd, Marigold, Chilli, Sunflower, etc. Seed distribution is done through an established network of retailers. Farmers will get genuine seed.

Linking Farmers to Markets: They have begun to link their consulting farmers to markets. There is a huge scope to be expanded, especially for pomegranate.

They are exploring possibilities for pomegranate processing and they see huge potential to connect to niche markets and export. Residue free paddy was procured by them by paying a premium of Rs 100/quintal. Paddy was supplied to exporters after residue testing. Rice was sold in the brand name of Eco Rice to consumers and retailers. They have developed a mobile application AgBiz related to market linkage.

Present focus

- Testing of paddy for residue levels, procurement of residue-free paddy, processing of paddy and marketing of residue-free rice.
- Crop advisory services: Covering 8000 acres of different crops
- Carbon farming: In collaboration with Bayer they are implementing a project in paddy covering 5492 acres in 33 villages of Davanagere, Haveri and Vijayanagar districts. The Focus of the project are Alternate Wetting and Drying (AWD), reducing methane nitrous oxide emissions, balanced nutrition and integrated pest and disease management. They have employed 9 staff members exclusively for implementing this project.
- Manufacturing of micronutrients: We have started manufacturing mixed micronutrients meant for soil application.

Impact

Sl No.	Farmers' impact	
1	Farmers Reach	Direct Reach – About 5000, Indirect Reach – About 20,000
2	Area Coverage	2900 cumulative acres
3	Training	957 farmers
4	Field Days	1313 farmers
5	Krishi Mela	600 farmers
6	Field Visits	450 farmers
	Employment Created: 9 Persons	

Revenue Generated

Year	Income/Turnover (In Lakhs)
2019-20	3,76.07
2020-21	5,95.80
2021-22	6,33.97
2022-23	7,16.15

Collaborations

Mr. Naganagouda Malkaji, in his career span of 20 years have built strong relationship with many research organizations, Agri Universities, KVKs and companies who are into Agri business. To mention few, below are the collaborations of Eco Agripreneurs Pvt Ltd

- Department of Agriculture – Organised Farmers Trainings and Field Days jointly
- University of Agricultural and Horticultural Sciences, Shivamogga: Grown Eco Rice in their farm at Kattalagere successfully.
- University of Agricultural Sciences, Dharwad: Oriented final year Agri graduates at graduates at Dharwad and Hanumanamatti on residue free on residue free rice production
- KAPPEC, Bengaluru: Provided space for exhibiting Eco Rice during Gulffood
- KVK: Jointly organized trainings and field days

Conclusion

India is predominantly an agrarian economy. Hence, the agriculture sector also needs to be technologically advanced as other domains. With the complexity in the sector, the challenges need to be faced with appropriate solutions that are feasible in sustainability also. Hence, innovation needs to be put forth in this scenario to fill these gaps. Startups are considered as the pathway to implementing creativity and innovation in agriculture. With the support of technology and ideas, modernization can be included in to it. The Government's national-level policies and schemes for the promotion of the startup ecosystem with all the stakeholders and this has boosted the entrepreneurs to take up startups. During different episodes of Mann Ki Baat, PM has expressed his interest in the promotion of agri startups for the improvement of various domains of agriculture.

With inspiration from PM's Mann Ki Baat, the startups were focused on some selected activities of nature-friendly practices to livestock development. The case studies indicate how the startups choose the challenges, the selection of choice of innovative solutions, the advancement of the technology implementation and the impact created by the startup to the farming community. These startups indicate that technological advancement can reduce resource utilisation for farming, adoption of AI or automation in could impact the positive utilisation of natural resources. The startup focusing on residue free farming has implemented the idea of residual-free rice production with end-to-end advisory support.

The idea of farm waste utilisation could benefit the farmers with an additional income and which is environmentally friendly. The opportunity of social entrepreneurship has been chosen by the startup for the livelihood enhancement of the marginalized groups of farmers and tribes. They improvised their market connection through a collective organization. With the idea of ensuring livestock welfare, the startup could benefit the farmers for stable income.

Sustained support from the Government has motivated aspiring entrepreneurs to take the agriculture challenges as a startup opportunity. The success stories that are documented in the study could be a model to showcase how the farming challenges and Government initiatives are coming in the same nexus to find solutions through startups.

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Response of Pigeonpea to Zinc Sulphate and Potassium under rainfed Conditions in Western Mandals of Chittoor District

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ABSTRACT

On-Farm Trials on Yield enhancement in redgram through basal application of Potassium and Zinc sulphate were conducted in sandy loam soils under rainfed condition in western mandals of Chittoor district in Andhra Pradesh during 2017-18 to 2019-20 in 5 farmers fields in 2.0 ha during each year. Treatments comprised of basal application of Nitrogen @ 20 kg/ha, Phosphorus @ 50kg/ha, Potash @ 60 kg/ha and Zinc sulphate @ 25 kg/ha were applied to Redgram. In check plot FYM @ 20 q/ac was applied. Yield attributes viz. number of pods/plant (223), 100 seed weight (11.1 g), yield (4.2 q/ha) and B: C ratio (1.1) were significantly higher in case of treatment plot compared to check plot with number of pods/plant (194.3), 100 seed weight (9.2 g), yield (3.3 q/ha) and B: C ratio (1.0).

Keywords: Redgram, Pigeonpea, Potassium, Zinc sulphate, yield and Economics

Introduction

Pigeonpea (Cajanus cajan L.) is one of the important protein rich pulses in the tropics and subtropics and is the second most important pulse crops of India after chickpea (Sahaja et al., 2019). Globally, arhar is grown in an area of 56.16 lakh hectares with a production of 44.25 lakh tonnes and productivity of 788.1 kg/ha (FAO STAT, 2019). India ranks first in redgram production globally with 38.8 lakh tonnes cultivated under 48.24 lakh hectares with productivity of 804 kg/hectare in 2020-21 (agricoop.nic.in). In India, Redgram takes second position in total pulse production

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after Bengalgram. Andhra Pradesh produced1.16 lakh tonnes in an area of 2.33 lakh hectares with 496 kg/hectare productivity in 2020-21. (http://indiastat.com). In Chittoor district of Andhra Pradesh, Redgram was grown in an area of 7501 ha during 2020-21 (O/o JDA, Chittoor). Pigeonpea is rich source of proteins. Heavy incidence of Pests and diseases during flowering and pod formation leads to reduction in productivity. Availability of Potassium and Zinc to crop will improve yields of Redgram along with nitrogen and phosphorus as these are essential nutrients for redgram. The function of potassium in plant metabolism is different from that of other major nutrients. The later become part of the plant structure, whereas potassium largely remains as an ion in the cells and sap and helps to control the water intake and metabolism of the plant. Some of the specific effects of potassium are to increase root growth and improve drought resistance. (Ranade, 2011). Zinc is one of the seventh plant micronutrients, involved in many enzymatic activities of the plant. It functions generally as a metal activator of enzymes. It is reported that, zinc improves crop productivity almost as much as major nutrients. Besides increasing crop yield, it increases the crude protein content, amino acids, energy value and total lipid in chickpea, soybean, black gram etc (Chalak et al.,2018). Soils in Chittoor district are in general deficit in micro nutrients. Moreover redgram is being cultivated in sandy loams recording low yields. Research results at RARS, Tirupati showed that application of zinc sulphate and potassium as basal dose will increase yield of Redgram by about 23%.

Materials and Methods

On-Farm Trials on Yield enhancement in redgram through basal application of Potassium and Zinc sulphate were conducted in sandy loam soils under rainfed condition in western mandals of Chittoor district during 2017-18 to 2019-20 in 5 farmers fields in 2.0 ha during each year. Sowings were done with seed drill with spacing of 180 cm between rows and intercropped with redgram. In TO1 Nitrogen @ 20 kg/ha, Phosphorus @ 50kg/ha, Potash @ 60 kg/ha and Zinc sulphate @ 25 kg/ha were applied to Redgram. In TO2, (Farmers practice) FYM @ 20 q/ac was applied. No irrigations were given as it is grown under rainfed conditions. Five plants were selected in each field and data was recorded on number of pods/plant, number of seeds/pod and 100 seed weight which were statistically analyzed. Yield was recorded in 5 sq.m in five locations after threshing of the produce.

Economics was calculated as shown below:

Cost of cultivation (Rs. ha^{-1})

Cost of cultivation (₹ ha^{-1}) was calculated considering the prevailing charges of agricultural operations and market price of inputs involved.

Gross returns (Rs. ha^{-1})

Gross returns were obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies.

Gross return (₹ ha^{-1}) = (Seed yield x price)

Net returns (Rs.ha^{-1})

Net returns were obtained by deducting cost of cultivation from gross return.

Net returns (₹ ha^{-1}) = Gross return (₹ ha^{-1}) - Cost of cultivation (₹ ha^{-1})

Cost: Benefit ratio

The benefit: cost ratio was calculated by dividing gross returns by cost of cultivation.

$$\text{Cost: benefit ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Table 1: Technological Options

Technology Option	Particulars	Source of technology
TO1	Basal application of Zinc sulphate (25 kg/ha) + MOP (60 kg/ha) + Nitrogen (20 kg/ha), Phosphorus (50 kg/ha)	RARS, Tirupati
TO2 (Farmers practice)	Basal application of FYM @ 20 q/ac	-

Results and Discussions

Table 2: Yield Attributes of Treatment and Check Plots of Redgram

Year	No. of pods/plant		No. of seeds/pod		100 seed weight (g)	
	TO1	TO2	TO1	TO2	TO1	TO2
2017-18	254	213	4.0	4.0	11.3	9.5
2018-19	205	190	4.0	4.0	11.1	9.2
2019-20	210	180	4.0	4.0	11.0	9.0
Mean	223.0	194.3	4.0	4.0	11.1	9.2

Yield Attributes: On an average no. of pods/plant in treatment and check plots were 223 and 194.3, respectively. 100 seed weight of treatment and check plots were 47.8 and 38.8, respectively (Table 2). The highest 100 seed weight was due to application of potassium and zinc sulphate. Similar results were also reported by Chalak et al., (2018). It has been concluded that there is significant difference between treatment and check plot with regard to number of pods/plant and 100 seed weight (Table 4)

Table 3: Yield and Economics of Treatment and Check Plots of Redgram

Year	Yield (q ha^{-1})		% increase in yield over check	Gross returns (Rs ha^{-1})		Net returns (Rs ha^{-1})		B: C ratio	
	TO1	TO2		TO1	TO2	TO1	TO2	TO1	TO2
2017-18	5.0	3.75	33	20000	15000	1000	-1000	1.05	0.94
2018-19	3.7	3.15	17.5	20350	17325	1850	825	1.10	1.05
2019-20	3.9	2.95	8.5	21450	16225	2950	-275	1.16	0.98
Mean	4.2	3.3	19.7	20600.0	16183	1933	-150.0	1.1	1.0

*Yields are low as farmers are growing local varieties which are very low yielders and also proper management practices are not followed.

Table 4: Summary of t-test in comparing no. of pods/plant, 100 seed weight, yield and net returns in treatment and farmers practice for three years

	Treatments	N	Mean	Std.Deviation	t-value	p-value
No. of pods/ plant	TO1	5	223.0	0.38	2.36*	0.003
	TO2	5	194.3	0.25	2.36*	0.003
100 seed weight	TO1	5	11.1	0.12	2.31*	0.004
	TO2	5	9.2	0.10	2.31*	0.004
Yield	TO1	5	4.2	0.16	2.31*	0.002
	TO2	5	3.3	0.16	2.31*	0.002
Net returns	TO1	5	1933	1.6	2.36*	0.004
	TO2	5	-150	1.0	2.36*	0.004

*Significant at 5% level

Yield and Economics

Perusal of the data presented in the table 3 and 4 and fig.1and 2 revealed that in demo plot, yield and net returns were found to be significantly higher than in control (farmers practice) during all the years (2017-18 to 2019-20). In treatment plot mean yield of 4.2 q/ha was recorded. Whereas, in control plot 3.3 q/ha yield was recorded. Net returns of treatment and check plot were 1933 and -150 Rs/ha, respectively. Mean B: C ratio of treatment and check plots were 1.1 and 1.0, respectively (Table 3). The higher yield resulted due to more number of pods per plant and 100 seed weight as it is one of the important yields attributing character. The seed yield of pigeon pea further increased with the soil application of zinc sulphate. The positive effect of K on crop yield might also be due to its requirement in carbohydrate synthesis and translocation of photosynthesis and also may be due to improved yield attributing characters, shoot growth and nodulation (Chalak et al., 2018). Similar results are in compliance with the findings of Jat et al. (2013), Mukundgowda et al. (2015), Patil and Dhonde (2009), and Ali et al. (2007), Buriro et al. (2015).

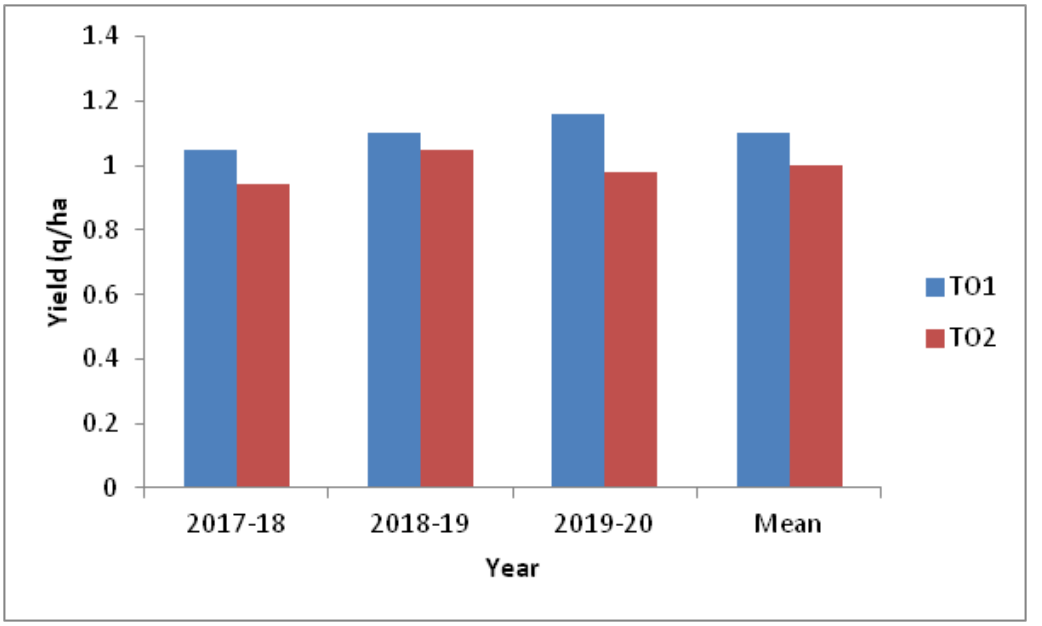

Fig 1. Comparison of Treatment and Check plots in terms of yield

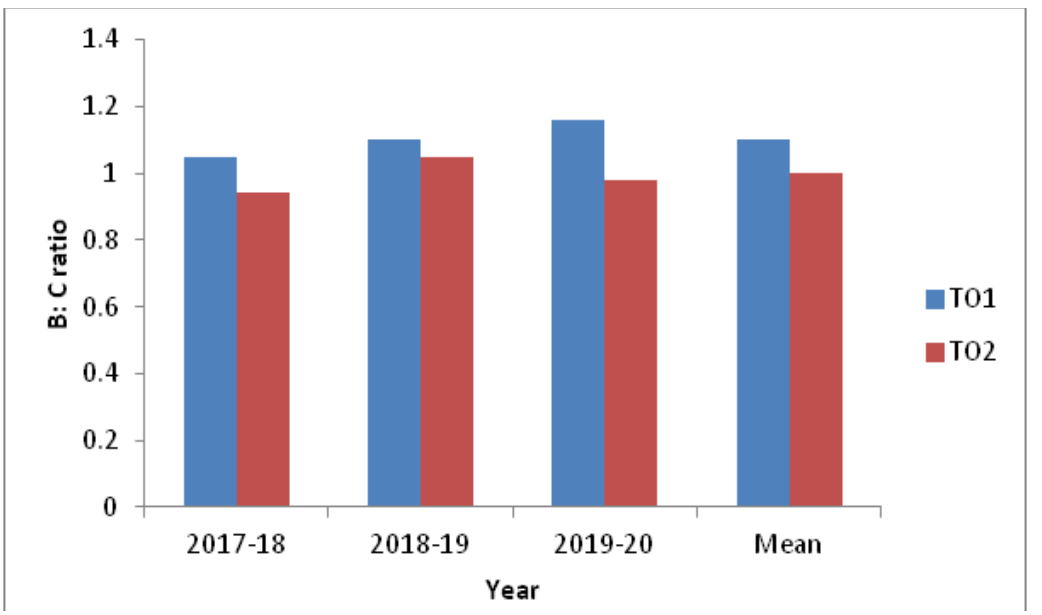

Fig 2. Comparison of Treatment and Check plots in terms of B: C ratio

Conclusion

Basal application of Nitrogen Phosphorus, Potash supplying fertilizers and zinc sulphate proved best in terms of increasing pods/plant, test weight and giving higher yields compared to check plot where only FYM was applied. It was due to fulfilling of nutrient requirement to the crop. Hence application of required fertilizers is beneficial in giving higher yields and net returns.

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Effectiveness of Mobile Application-based Agromet Advisory Service: Case Study in Telangana, India

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ABSTRACT

In India, climatic factors changing very rapidly and climate-induced extreme events are increased during the period of the last two decades. Consequently, India is facing a double challenge of sustaining rapid economic growth while combating the threat of climate change, especially regarding its impacts on land, water, and agriculture. To adapt farmers to the changes, the government and other external agencies are providing several kinds of support like crop insurance, subsidies, loan free of interest/lowest rate, agro-advisories but yet the adaptability is not that high. It means, there exists considerable knowledge gaps in understanding climate vulnerability, socio-economic impacts, and suitable ways to build resilience. Therefore the study is planned to assess the effectiveness and to improve weather-based location and crop-specific climate-resilient advisories through farmers' feedback. Advisories were disseminated via mobile application (FarmPrecise app) for Kharif and Rabi seasons of the year 2020-21 for the paddy crop of the Narayanpet district of Telangana. Results indicate that weather-based Climate Resilient Agriculture (CRA) advisories help to build the resilience of the farming community to climate change and mobile application (FarmPrecise app) is an effective way of their dissemination. Farmers are able to reduce the input cost and increase the net profit for the crops. However, farmers' feedback revealed that community-level capacity building is required to increase the adoption of weather-based CRA advisories and communicating advisories in colloquial language will have a greater uptake.

Keywords: Climate Change, Climate Resilient Agriculture (CRA) , Mobile Application, e-Extension, Agricultural Extension

Introduction:

In the last 30 years, the damage caused by climate change in India has doubled and is increasing day by day. The damage to agriculture is the

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biggest and its adverse effects need to be considered very seriously (ACT, 2018; Jogesh and Paul, 2020). Additionally, with the advent of the green revolution, Indian farming has become more and more dependent on external inputs, most of which are synthetic and chemical products. Excessive use of synthetic fertilizers and agrochemicals for plant nutrition and protection measures not only increases the cost of cultivation but also degrades the natural resource base of soil and water (Singh et. al., 2019).

Given the multidimensional impacts of climate change and climate variability, and faulty agricultural practices, there exist considerable knowledge gaps in understanding climate vulnerability, sustainable agriculture practices, socio-economic impacts, and suitable ways to build resilience (Birkmann et al., 2012). This view is strongly underscored by both the IPCC and India's Second National Communication to United Nations Framework Convention on Climate Change (UNFCCC) which recommended integrated research on operational strategies and approaches for adaptation of region and sector-specific policy interventions that build resilience and adaptive capacities of communities (Raghunandan, 2020).

Reducing the impacts of changing climate on agriculture will require efforts in generating granular climate data, integrating those in informing farming decisions, improving quality of inputs, enhancing knowledge on better cultivation practices, and adopting better management practices for resource conservation (ISC, 2021). In this view, farmers need a dynamic decision support system that is tailored to their specific farms and provides them weather-responsive advisories across key aspects of agricultural operations. This will help them mitigate weather-induced risks, reduce losses and costs of production, increase productivity and improve incomes (Lobo et al., 2017).

In this regard, Watershed Organisation Trust (WOTR) has developed "FarmPrecise"- an android based mobile application (app) that provides location and crop-specific weather-based climate resilient agriculture (CRA) advisories on up-to-date farming techniques, fertilizer and nutrient management, integrated pest, and disease management, irrigation water management, and market prices of different crops in nearby markets at a local scale (Bhagat and Gholkar, 2021). As of now, the FarmPrecise app is available for free and can be downloaded from the "Google Play Store" which provides advisories to farmers in English, Hindi, Marathi, and Telugu languages, and soon it will be available in other Indian languages. Presently more than 50000 farmers have downloaded this app (WOTR, 2022). The farmer's feedback has shown that the FarmPrecise app is a boon for profitable farming (Joshi, 2020). But still, there is a

great need to develop policy interventions/strategies to improve weather-based CRA advisories into actionable information for farmers to build resilience and adaptive capacities.

In this view, to assess the effectiveness and ground feedback on weather-based CRA advisories, there is a need to study the status of the adoption of advisories, their usefulness, improvements needed in advisories, and any modification required in the design of the media of dissemination (FarmPrecise app). Therefore a study was planned to improve CRA through farmers' feedback into agromet advisories disseminated through the FarmPrecise app.

Objective

To assess the farmers feedback to understand the adoption and appropriateness of agromet advisories disseminated through the app (FarmPrecise)

Material and Methods

Study Area:

Telangana state is emerging as a key rice-producing state in the country. Also, Telangana called the rice bowl of South India which grows rice in about 44 lakh acres, has seen its share to the national rice production improve considerably from 29 lakh tonnes recorded in 2015-16 increased by four times to 1.3 crore tonnes in 2019-20 (RBI, 2021). Narayanpet is one of the major rice-producing districts of Telangana state (Sharma and Raju, 2016) and WOTR is being actively engaged in the Narayanpet district through its various project activities. Therefore, for the study, 100 farmers of five villages of Narayanpet block of Telangana state were selected who have been using the FarmPrecise App for paddy. Both qualitative and quantitative data are collected for both the seasons (Kharif and Rabi) of the year 2020-21. The location map of the study district is shown in Figure 1.

Study Design: Experimental Design, Sampling and Data Collection

The study design is depicyed in Figure 2 which the farmers feedback to understand the adoption and appropriateness of agromet advisories disseminated through the app (FarmPrecise). The unit of analysis is an individual farmer. The major crop/most grown crop was preferred for the data collection in the selected villages of the Narayanpet district of Telangana. A questionnaire-based tool was designed in Telugu and English languages to collect the data and then converted it into Open Data Kit (ODK) format so that it can be assessed online and digital data collection is possible using a mobile or a tab. The sample size

was determined at a 95% confidence level and 10% confidence interval. So, a total of 100 farmers and equally divided into study villages who are recipients of FarmPrecise advisories were interviewed to collect the feedback on the e-agromet advisory service. The survey team was trained for the data collection using the ODK application before the data was collected. The process of data collection was divided into three stages during the cropping cycle- the early stage, mid-stage, and end/harvesting stage of the crop. The survey team was closely monitored during the data collection process and required inputs and clarification were given to them to avoid gaps and errors in the data.

Figure 1. Study Area- Narayanpet district on the map of Telangana

Village Sample Selection	**Study Site: Telangana** District: Narayanpet Villages: Laxmipur, Ammireddypalle, Perapalla, Appireddypalle, and Lingampalli	**Jan-May 2020**
	Sampling frame of Villages: All 05 villages have been receiving agromet advisories disseminated through the FarmPrecise app	
	A sampling of Villages: Simple random sampling, 05 villages (20 farmers/village/ season) have been using agromet advisories for paddy	
Data Collection	**Face to face interviews: Kharif Season 2020-21** The first round of face to face interviews Interviewed 100 farmers and collected data for paddy (Kharif)	**June-December 2020**
	Face to face interviews: Rabi Season 2020-21 The second round of face to face interviews Interviewed 100 farmers and collected data for paddy (Rabi)	**October-May 2021**
Analysis	**Data Analysis:** Status of adoption, Farmer's feedbacks on agromet advisories for paddy	**June-October 2021**

Figure 2. Study Design

Results and Discussion

Present Status of Farmers Adoption of Weather-based CRA Advisories

Table 1 revealed the status of farmers' adoption (%) of weather-based CRA advisories disseminated through the FarmPrecise app for paddy during the Kharif and Rabi season of the year 2020-21. The average farmer's adoption of advisories of cultural practices is highest (about 85%) followed by advisories of daily weather information and weather alerts (about 83%) and lowest for crop-specific advisories (about 25%). Also, the average farmer's adoption of advisories of Integrated Nutrient Management (INM) is about 63%, and for Integrated Pest Management (IPM) is about 40%.

Table 1 Status of farmer's adoption of weather-based CRA advisories

Weather-based location and crop-specific climate-resilient advisories		Adoption (%)
Advisories of Cultural Practices:	Advisory of puddling	92
	Advisory of crop geometry	91
	Advisory of weeding	72
	Gap filling required in the field	6
	Re-sowing required in the field	4

Advisories of Integrated Nutrient Management:	Advisory to apply organic manures (FYM/ Vermicompost/ Compost) and green manuring	61
	Advisory of Amrutpani and Jeevamruit application	79
	Advisory of vermiwash spraying	22
	Advisory of the recommended dose of chemical fertilizer	90
	Advisory of split-dose application	62
	Used fertilizer calculator tool of FarmPrecise app	32
	Saved cost on fertilisers by using fertilizer calculator	18
Advisories on Integrated Pest Management:	Advisory of seed treatment	98
	Advisory of trap crop	11
	Advisory of pheromone trap	59
	Advisory of the light trap	13
	Advisory of bio-pesticides (Dashparni ark/NSKE/ Neemark)	12
	Advisory of chemical pesticides to control the pest/ disease infestation	45
Advisories of Daily Weather, and Weather Alerts:	Weather alerts (Heavy rainfall/hail storm/pest-disease attacks) are appropriate for your region and agricultural activities in the field	80
	Fallow weather alerts (Heavy rainfall/ hail storm/ pest-disease attacks) for agricultural activities in the field to save the crops	85
Crop Specific Advisories:	Advisory of nursery preparation	83
	Advisory of Azolla application	3
	Advisory of application of buried green leaves of Gliricidia @ 3 tones/ha during puddling	1
	Advisory of Paddy transplanting at 20 x 20 cm or 25 x 25 cm	91
	Advisory of application of Urea: DAP briquettes	21
	Advisory of silicon spray @ 1-2 gram or 1-3 ml/liter of water	10
	Advisory of a spray of 00:52:34 @70 G, Multi Micro-Nutrients @50 G and Silicon @15 ml in 15 liters of water at Panicle Emergence Stage	22

Impact of Weather-based CRA Advisories

Table 2 revealed that overall about more than 90% of farmers benefited atleast by an increase in crop yield or reduction in the cost of field inputs or reduction in the cost of cultivation and labor cost or saving of irrigation water.

Crop Yield: 43% of farmers observed that crop yield is increased by 25% and more by following agromet advisory while 57% observed no change concerning the average historical crop yield.

Field Inputs: 91% of farmers observed that the cost of field inputs (like fertilizers, pesticides, insecticides) is decreased by 25% and more by following agromet advisory while 5% observed not much difference with average historical input cost.

Cost of Cultivation and Labor: 90% of farmers observed that the cost of cultivation and labor cost is decreased by 25% and more by following agromet advisory while 7% observed that the cost of cultivation and labor is not decreased much, but it is approximately equal to the average historical cost.

Water Saved: 93% of farmers observed that irrigation water saved is up to 25% by following agromet advisory while 6% observed that irrigation water is not saved much, but it is approximately equal to average historical water applied.

Table 2 Impact of weather-based CRA advisories on crop yield, cost of field inputs, cost of cultivation and labour cost, and application of irrigation water of Paddy crop

Crop yield increased by following advisories	Yes (Increased by 25 % and more)	Yes, but crop yield near about equal to average historical yield	No
	43	57	0
Cost of field inputs (like fertilizers/ Pesticides/ Insecticides) decreased by following advisories	Yes (Decreased by 25 % and more)	Yes, but the cost of field inputs near about equal to the average historical cost	No
	91	5	4

Cost of cultivation and labour cost decreased by following advisories	Yes (Decreased by 25 % and more)	Yes, but the cost of cultivation and labour cost near about equal to the average historical cost	No
	90	7	3
Irrigation water saved by following advisories	Yes (Decreased up to 25 % and more)	Yes, but irrigation water applied near about equal to the average historical amount	No
	93	6	1

Usefulness (Farmers Rating) of Weather-based CRA Advisories:

Figure 3 revealed that the usefulness of advisories disseminated through the FarmPrecise app was rated by farmers in the spectrum of Very Low, Low, Average, Good, and Very Good. About 70-73% of farmers rated the overall usefulness of advisories are good to very good, and 27% of farmers rated as average.

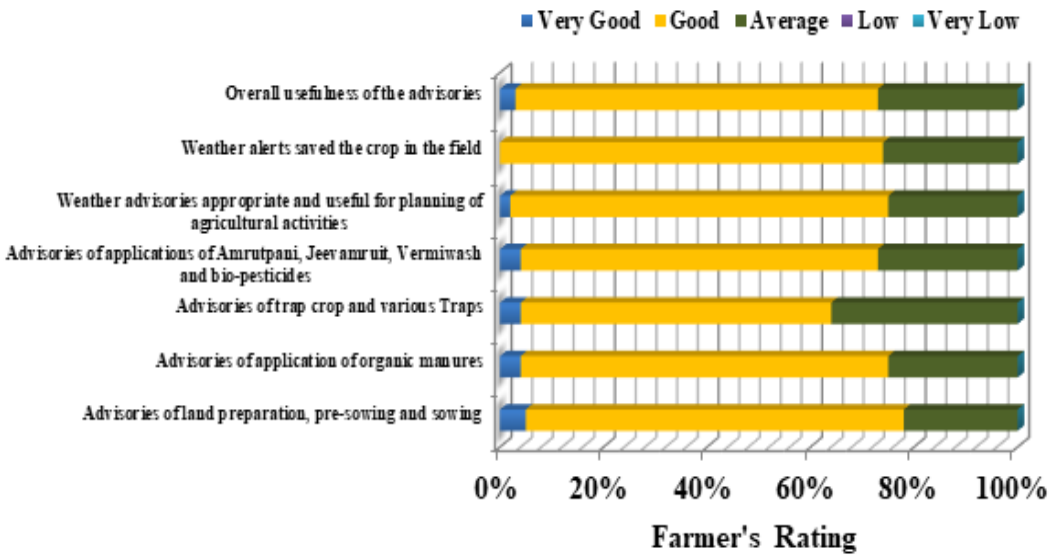

Figure 3 Status of the overall usefulness of advisories for paddy crop

Farmers Feedback on the Adoption of Weather-based CRA Advisories and Possible Actions:

Farmers' feedback on the adoption of advisories, and possible actions to increase the adaptability through improving advisories and media of dissemination (FarmPrecise app) are discussed below.

Advisory	Adoption	Remark	Action
Advisory of land preparation (Puddling or ploughing and harrowing).	Adoption is about 90%.	Farmers are interested to know and use of new implements and modern tools and technologies to save both energy and time at the field level.	Advisories need to be updated with information on new mechanization techniques (e.g. modern machines /implements /tools for sowing / transplanting /harvesting etc.).
Advisory to incorporate organic manures (FYM, Vermicompost, compost, and green manuring) while land preparation.	Adoption is about 60%, lower due to the insufficient quantity of manures that were available and was not ready to apply at the household level. Also, 30-35% of farmers are willing to purchase organic manures but are not available locally.	Opportunity to produce the organic manures commercially else farmers have to develop their capacity to produce a sufficient amount of organic manure.	Green manuring is one of the better options to address the shortage of organic manure.
Advisory of seed treatment.	Adoption is about 98%.	Field demonstration is required to increase the accuracy of proper seed treatment.	Scope to spread the technology at scale with proper use ingredients of seed treatment.

Advisory of crop geometry.	Adoption is about 90%.	Farmers are facing the issues of the availability of machines during the period of sowing or transplanting.	Opportunity to strengthen custom hiring centres (CHC) or group of people can purchase the machines with their contribution or commercially make availability of the machines.
Advisory of trap crop.	Adoption is about 15%.	Farmers are not aware of the technique and selection of trap crops.	Advisories need to be updated with the selection of appropriate trap crops. Capacity building of farming community through field training and technology demonstration.
Advisory of pheromone trap.	Adoption is about 60%.	20-40% of farmers are not aware of the techniques, 30% of the farmers observed that timely none availability of lures and traps in the local market, 15-20% of the farmers observed that it is easy to use chemical spraying trap.	Needs to develop a network with the agriculture service centre (ASC) for smooth supply of traps and lures in the local market.
Advisory of the light trap.	Adoption is about 13%.	30-70% of farmers don't have an idea of technology, installation, and features of instruments. 15-55% farmers willing follow advisory but material/ instrument have not available locally.	Need to train the farmers for the proper installation of traps and make them aware of their features through field training and technology demonstration.

Advisory of application of Amrutpani and Jeevamruit.	Adoption is about 85%.	The raw material was not available to prepare it	The opportunity of commercial production of biological formulations locally. Raw material (plant leaves) can be available by growing the required plants on field borders. Needs to demonstrate technologies by field training.
Advisory of spraying of Vermiwash.	Adoption is about 9-35%.	Farmers don't have an idea about the technique. Didn't make provision to collect Vermiwash from the Vermi-bed.	
Advisory of application of Bio-pesticides (Dashparniark/ NSKE/ Neemark).	Adoption is about 5-15%.	60-70% of farmers are not aware of technology, the raw material was not available to prepare it for 10-50% farmers, 34% are interested to purchase from the market but not available in the market.	
Advisories of application of a recommended dose of chemical fertilizer.	Adoption is about 90%.	62% of farmers are following the technique of split-dose application. 32% of farmers use the fertiliser calculator tool in the app (FarmPrecise).	Needs to develop the user-friendly interface of fertilizer calculator. In-house training is required to train farmers.
Advisories of application of chemical pesticides/ insecticides.	Adoption is about 40%.	Application of bio-pesticides reduced the use of chemical pesticides/ insecticides.	Advisories of the application of pesticides/ insecticides need to be updated with information on their latest trade names available in markets.
Advisories of daily weather and weather alerts.	Adoption is about 85-100.	Farmers got benefited by saving their crops to a different extent.	Scope to increase the accuracy of advisories at the local/ micro level.

***CRA advisories need to be updated with their exact purpose and benefits including short videos of best practices, preparation of biological formulations, installation traps, etc.**

Conclusion:

It may be concluded from the above findings that, at the present level of farmers adoption of weather-based CRA advisories, there is a need for additional support and efforts by the government and other agencies beyond the existing strategies. The adoption of weather-based CRA advisories is a broad issue like adaptation to climate change. Therefore, it needs to be undertaken at a strong collaborative level between farmers, research institutions, funding agencies, governments, non-government organisations, and private sectors. There is a need to develope strong institutional mechanisms to fine-tune CRA-related knowledge gaps, and essential agromet advisories for successful implementation of region-specific agriculture action plans. However, weather-based CRA advisories disseminated through the mobile app (FarmPrecise) helped farmers to increase their knowledge about sustainable farming practices including modern technologies and nature-friendly solutions. Farmers are able to reduce the input cost and increase the net profit for the paddy. Also, the mobile app (FarmPrecise) is an effective way to disseminate agromet advisories and build the resilience of the farming community to climate change. To enable farmers to adapt to weather-based CRA advisories, continuous community-level capacity building, dissemination of small videos on the good practices and communicating the advisories in colloquial language will have a greater uptake.

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Internal Displacement of Farmers and Food Losses in Benue State, Nigeria

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ABSTRACT

The study investigated the quantity of food losses from 2016 to 2020 as a result of internal displacement of farmers in Benue State This study employed social survey design. A combination of Cluster sampling, random sampling and purposive sampling was used in selecting 429 respondents for the study and data collected with the use of a well semi-structured questionnaire. The result shows that most of the internally displaced farmers 142 (39.4%) were within the age bracket of 56 – 65 years with 225(62.5%) of the female and that a simple majority of the respondents 139(38.6%) had only primary education. majority of the IDPs 112(31.1) are farmers with farming experience of 16 – 20 years. 131(36.4%) and 99(27.5%) of the respondents had farm sizes ranging from 1-2 hectres and 3-4 hectres of land respectively with majority of them having been displaced for over 12months. The results on quantity of food lost indicated a level of decrease in quantity of crop production which is evident that violence and internal displacement have negatively influenced agricultural productivity and investment in the study area. The study recommended a process of peace building which is multi-faceted, involving re-establishing security and law and order; reconstruction and economic rehabilitation; reconciliation and social rehabilitation; and political transition to creating a more accountable governance structures and institutions.

Key Words: Farmers Displacement, Food Losses, Cassava, Yam, Benue State, Nigeria

INTRODUCTION

Internal displacement has become the norm in far too many countries, often in places with some of the lowest development indicators and the highest levels of violence exist. In many places it is fueled and perpetuated by unresolved inter-ethnic, religious or political tensions. Displacement affects food security, also

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provides fertile ground for human rights abuses including torture, rape, killings, as well as forced evictions, forced migration and loss of heritage (Nwalie,2017).

Worldwide, the rate of internal displacement has been on the increase, the Internal Displacement Monitoring Center (IDMC) accounted that in 1982, only 1.2 million people were IDPs in 11 countries; however, by 1995, there were 20 to 25 million in more than 40 countries, almost twice as many as refugees. At the end of 2008, there were 26 million people worldwide who had been internally displaced by conflict, general violence or violation of human rights. This figure rose to 27.1 million at the end of 2009 and 27.5 million at the end of 2010 (IDMC, 2013). The estimated figure at the end of 2012 was 28.8 million indicating that additional 6.5 million people were newly displaced, nearly twice as many as the 3.5 million during 2011 (IDMC, 2013). IDPs suffer emotional problems which are characterized by memory of fearful events and nightmare (Durosaro and Ajiboye, 2011), loss of livelihoods, frustrations, abuses, threats of assaults among others (Mazo, 2011). The misery of displaced persons has in recent years become a formidable problem of global significance and implications (Ladan, 2001).

In recent times, Nigeria has been plunged into series of clashes springing flashes of armed attacks and silent killings at different locations in the forms of Boko Haram in the North eastern part of the country, farmers/headers crises in many states of the federation, Agitations for the Emancipation of the Republic of Biafra in the South East, Militants in the Niger Delta Area among several others. These crises have impeded the basic right of freedom of movement of people within the area. Unsuspecting villagers are attacked on their way to farm, isolated houses are besieged and burn to ashes living the people homeless and displaced.

The Boko Haram insurgency has led to extensive displacement of housholds which in turn has become a major factor affecting food security in the northeast of Nigeria. Already poor and vulnerable host communities have absorbed large numbers of people fleeing violence, which has placed considerable pressure on fragile agricultural and pastoral livelihoods, while the insecurity has severely disrupted markets and food availability. In July 2016, the Nigerian Minister of Health declared a "nutrition emergency" in Borno State. Critical levels of food insecurity and malnutrition have been reported in the worst-hit and least accessible areas. Millions of people face severe food insecurity with some areas having seen no food production in the last three years, poor access to markets, high prices of staple foods, low incomes, depleted household food stocks, and the adoption of extreme coping strategies. Some 4.5 million people are now severely food insecure in the three northeastern states of Adamawa,Borno and Yobe. Of these, more than 65000 people are classified in phase 5 (Famine),

while the number of those in phase 4 (Emergency) has tripled since March 2016, reaching over 1 million.

In recent times, the issue of violent clashes and instability between farmers and nomadic herdsmen across the regions in Nigeria has become a major focus to the Nigerian Government, International and National or indigenous development organizations. This to a large extent, if not nipped in the bud, may affect the achievement of Sustainable Development Goal 2 which aims at ending hunger, achieving food security and improving nutrition and promoting sustainable agriculture by 2030. The clashes, instead of abating have been on the increase exponentially to the dismay of helpless Nigerians. However, in spite of the spate of violent clashes between nomadic herdsmen and farmers in Nigeria, and other causative factors of internal displacement of rural farmers, adequate social research attention has not been given to the implications as its effects on household food production and food security generally. With the tremendous population increase in Nigeria, this has constituted a threat to food security as farmers are displaced from their farmlands.

Agricultural production in any country requires an enabling environment to reach its maximum potential, sustainable development in agriculture among other things demands a peaceful co-existence between the producer communities. But despite Nigeria's great potential to increase agricultural productivity and food production particularly in northern regions, serious crises of conflicts in these areas have worsened the already existing challenges to production, such as climate change, poor soils and lack of access to credit and extension services.

Internal displacement is a formidable challenge to economic development, threat to food security and sustainable livelihood of the agrarian communities (Ukamaka, Danjuma, Mbolle, Achonam & Mbadiwe, 2017). The implication of the conflicts resulted to the insecurity, displacement, disability and death, poor food production, widespread hunger and malnutrition in the North-Central geo-political zone of Nigeria.

Not only has the displacement of rural farmers limited food production and increased food losses, it also has the propensity to deny people access to food and availability of food supply. Prices of food remain extremely high around the country and are expected to continue increasing due to current inflation and recession. Conflict affected households thus face additional strain in accessing stable food due to their reduced purchasing power.

Several efforts have been made internationally and locally to curtail the rate of

internal displacement yet the menace is still on the increase. Though several studies have been conducted to ascertain the effects of displacement, not much has been done on rural farmer displacement and its impact on food security. Most of the studies on displacement centre on displacement from Natural sources or disasters like drought, flood, and landslides and so on. It is in view of the above that the study investigated the quantity of food losses from 2016 to 2020 in Benue State

The invasion of north-central states by herdsmen have forced farmers to abandon their fertile farmlands, rendering several communities deserted and reduced farmers to tenants in internally displaced persons (IDPs) camps. Nweze (2005) noted that many farmers and herders have lost their lives and herds, while others have experienced declining productivity in their herds. This according to Olobatoke & Omowunmi (2017) implies food insecurity in Nigeria.

In addition, Abughdyer (2016) stated that a total of 664.4 hectares (56.4%) of farmland were destroyed in Benue state between 2010-2014 in three local government areas, namely,Agatu, Guma and Logo as a result of farmers and herdsmen crises. This development indicates a great danger for food production in Nigeria since the state is the hub of the nation's food security.

Also four famers interviewed for this paper were located in Benue and Nasarawa states. They reported large drops in their average production of yam, maize, millet, rice and sorghum, from before the conflict in the period 2004-2008 to the period during the conflict; 2009-2013. This reduction in the output of crops is due to a combination of factors. First, there has been reduction in the availability of labour due to the threat of attacks on farmers on their way to their fields. Both farmers and farm labourers are afraid of attacks on the farms or on the roads to farms. The lack of labour has caused inadequate and improperly timed weeding and harvesting. Second, the four farmers interviewed have experienced a situation where they were forced to abandon their farmland leaving them to be overgrown by weeds. This resulted to low productivity.

Similarly, the Assessment Capacity Projects (ACAPS) thematic report (2017) opined that approximately 132,818 are said to be facing IPC Phase 3 (Crisis) levels of food insecurity in Benue; 167.561 in plateau; and 212,348 in Kaduna states as at December 2016, with 12,063 in Phase 4 in Plateau state. 46,000 were projected to face Crisis of food security conditions in Benue, Kaduna, and Plateau states from June to August 2017. The report further goes to state that prices of food remain extremely high around the country and are expected

to continue increasing due to current inflation and recession. Conflict affected households thus face additional strain in accessing stable food due to their reduced purchasing power. Any food assistance has been inadequate and irregular. Members of the Goska district in Southern Kaduna made up of about 156 households, report receiving food assistance once, and enough for only 30 families.

According to Okereke (2012) and Bello (2013), the conflicts in most part of Nigeria especially the Fulani herdsmen and farmers clash are largely uncalled for. Farmers can no longer farm peacefully because of Fulani herdsmen. Recent studies conducted by Okereke (2012) and Kasarachi (2016) have shown that, serious conflict erupt between Fulani herdsmen and farmers leading to loss of lives, valuable properties and destruction of vast expanse of arable agricultural farmlands thereby posing serious threat to food security since farmers for fear of attack could no longer go to farm and harvest their farm produce.

Tersoo (2016) assessed the impact of Farmers/Herders conflict on food security in Benue State, Nigeria. The paper examined how the conflict has impacted on food security in Benue State. The result showed that so many human lives were lost; farm lands, residences and schools were destroyed, leading to a decline in farm output (causing food insecurity)and human capital loss. The study therefore recommended a strong government policy on the localization of the pastoralists in line with the world best practices to avoid further conflicts.

Materials and Methods

This study employed social survey design. According to Osuola (2005), survey design relies on the techniques of sampling a large number of subjects by interviewing and or the use of questionnaire. The study was carried out in Benue State. Benue is a State in the North central region of Nigeria, it has a population of about 5,741,800 (National Bureau of statistics, 2016); its total land area is 34,059km^2 and it is the 11th largest land mass in the country. Benue State has its capital at Makurdi. The name Benue is named after the River Benue and the state was formed from Benue Plateau on the 3rd of February 1976 along with Igala and some parts of Kwara State which were carved out to become part of the present Kogi State. Some popular towns in this state include Vandeikya, Gboko, Ogbadibo Katsina-ala, Okpokwu, Obi, and Makurdi which is the state capital of Benue.

Benue State falls within longitude 7^047^1, 10^00E and latitude 6^025^1, 8^08^1N, the State shares boundaries with five other states in Nigeria. It share boundary

with Nasarawa State to the North, Taraba State to the East, Cross River State to the South, Enugu State to the South-West and also with Kogi State to the west, hence it shares International boundary with the Republic of Cameroon to the South-East.

Figure 1: Map of Benue State Showing Distribution of Local Government Areas by Zones

Source, Bureau for Lands and Survey Makurdi, 20015

There are 23 local government areas in Benue State namely Ado, Katsina-Ala, Oju, Agatu, Konshisha, Okpokwu, Apa, Kwande, Oturkpo, Buruku, Logo, Tarka, Gboko, Makurdi, Ukum, Guma, Obi, Ushongo, Gwer-West, Ogbadibo, Vandeikya, Gwer, Ohimini. However, the dominant dwellers in Benue State are the Tiv, Idoma, Igede, Etulo, Abakpa, jukun, NyIfon, Akweya . The Tiv are the major dominant ethnic group, they occupied about 14 local government areas with the Etulo and Jukun, however, Idoma, IgedeAkweya ,Nyifon occupy the remaining nine local government areas, while other migrants like the Igbo, Hausa , Yoruba and some other minor other tribes in Nigeria leave among them.

A combination of Cluster sampling, random sampling and purposive sampling was used in selecting the respondents for the study and data collected with the use of a well semi-structured questionnaire. Benue State is divided into three senatorial districts, namely, North East senatorial district (Zone A) North West Senatorial District (Zone B) and Benue South Senatorial district Zone (C). These three Senatorial Districts make up the three clusters selected for this study

One (1) L.G.A was purposively selected from each of the three senatorial districts. These are L.G.As that has the greater number of displaced persons. Logo local government area was selected from Zone A. Makurdi Local government area was selected from zone B. Agatu local government area was selected from zone C. Furthermore, two (2) internally displaced persons (IDPs) camps and two (2) communities were randomly selected from Logo and Makurdi L.G.As while only two communities were randomly selected from Agatu L.G.A. This is because there is no IDP camp in zone C, as displaced persons are living within the host community.

The total number of registered displaced households in the six (6) selected communities (11,353) and four (4) IDP Camps (4,886) is sixteen thousand, two hundred and thirty nine (16,239). This figure therefore represents the sample frame (Benue State Emergency Management Agency 2018).

Table 1: Sampling Frame of the Study Areas

ZONES	LGAs	IDP CAMP	HHS	COMMUNITIES	HHS
A	LOGO	Abeda CAMP Ayiin Camp	422 1271	Abeda community Ugba community	3546 1431
B	MAKURDI	Abagena Camp Agan Camp	1990 1203	Abagena Community Ichwa community	1165 1650
C	AGATU			Usha-Agatu Engila-Agatu	2214 1347

The sample size for each zone was determined by a mathematical formula given by Miller and Brewer (2003) as;

$$n = \frac{N}{1+N(\alpha)^2} \quad \text{..... (1)}$$

Where: N is the sample frame for the twelve communities,
n is the sample size and
α is the margin of error (fixed at 5%).

$$n = \frac{16239}{1+16239(0.05)^2} = 390$$

In addition, ten percent (10%) of the number of intended respondent was added to take care of unavailable, unreachable or unwilling respondents. This will make room for missing cases or responses. This will enable us the opportunity to ensure that responses do not fall below 390. That brings the total number to 429 respondents. Data for the study was analyzed using descriptive statistics such as frequencies and mean

Table 2 captures the details of the sample frame and the sample size for the selected local government areas in all the zones in the study area.

Table 2: Sample Size Selection Plan

Zones	LGAs	Camps	Sample frame	Sample size	Communi-ties	Sample frame	Sample size
A	LOGO	Abeda Camp Ayiin Camp	22 271	11 33	Abeda community Ugba community	3546 1431	93 37
B	MAK-URDI	Abagena Camp Agan Camp	990 203	52 37	Abagena Community Ichwa community	1165 1650	30 43
C	AGATU				Engila-Agatu Usha-Agatu	2214 1347	58 35
Sub total			4886	133		11353	296
Grand total		16,239			429		

Results and Discussions

Table 3a shows that most of the internally displaced farmers 142 (39.4%) were within the age bracket of 56 – 65 years. This was followed by young people mostly children and teens who were Less than 30years 88(24.4%). The least displaced were able bodied young farmers within the age range of 31-55. From the result, old and week farmers from the ages of 56 and above 206(57.4%) were displaced more than any other age bracket. This implies that older persons form a significant proportion of IDP and refugee groups. This result is in consonance

with the assertions of F0A (2020) that older persons form a significant proportion of groups of IDPs and refugees, as 35-65 per cent of them may be over 60 years.

The sex shows that 225(62.5%) of the internally displaced farmers were female while 135(37.5%) were male. This emphasizes that female farmers were displaced more than their male counterparts. 163 (45.2%) of the IDPs were married, 74621.1%) were single while 122 (33.8%) of the displaced persons have lost either their husbands or wives.

Table 3a below also revealed that most of the respondents constituting 139(38.6%) of the respondents had only primary education closely followed by those with no formal education 122(33.9%). 89(24.7) had secondary education and only 10(2.8%) of the IDPs had tertiary Education. Similar results were reported by Oyekanmi & Okeleye (2007) and Olaniyi, Adetumbi & Adereti (2013) in southwest Nigeria. The result implies that internal displacement can interrupt education of the populace, harm their wellbeing and hinder their development. It can reduce their future livelihood opportunities, creating a poverty trap that endures even after displacement. Education plays a central role in the lives of displaced youth. Being able to access quality education is a key factor for integration, protection and for ensuring better conditions for their lives. Displacement poses many challenges to accessing quality education. Schools in poorer communities are seldom sufficient for displaced youth or those in host communities, teachers and educational personnel are often unavailable, there may be shortages of teaching materials, and insecurity may limit students' ability to attend classes(Ferris and Winthrop 2010) School dropout is often related to insufficient family resources. Leaving school to work and help support the family is the main reason that displaced boys in Afghanistan are out of school (UNESCO 2011). It is also a key educational issue in Iraq (Ferris and Winthrop 2010) . Dropping out of school can have long-term repercussions on future livelihoods as well as food security

Table 3a also revealed that most of the respondents 297 (82.5%) were Christian, 47(13.0%) were Muslims while 16(4.4%) of the displaced persons were traditional worshiper.

Table 3a: Socioeconomic Characteristics of Displaced Farmers in the Area.

Variable	Frequency	Percentage
Age		
Less than 30years	88	24.4
31 – 45	22	6.0

46 – 55	44	12.2
56 – 65	142	39.4
Above 65	64	18.0
Total	**360**	**100**
Male	135	37.5
Female	225	62.5
Total	**360**	**100**
Married	163	45.2
Single	76	21.1
Widowed	122	33.8
Total	**360**	**100**
Educational Qualification		
No formal education	122	33.9
Primary Education	139	38.6
Secondary Education	89	24.7
Tertiary Education	10	2.8
Total	**360**	**100**
Religion		
Christianity	297	82.5
Islam	47	13.0
Traditional	16	4.4
Total	**360**	**100**

Source: Field Survey, 2021

Table 3b reveals that majority of the IDPs 112(31.1) are farmers with farming experience of 16 – 20 years followed by 98(27.2) with farming experience of 11-15 years. 72(20%) of the IDPs had farming experience 6-10 years while about 56(15.6%) of the IDPs had farming experience of above 21 years. Majority of the displaced farmers 131(36.4%) had farm sizes ranging from 1-2 hectres of land, 99(27.5%) had farm size of 3-4 hectres of land. In all, 71(20%) had between 7 hectres and above. 111(30.8%) of the IDPs had income ranging from 501,000-750,000 naira annually, 98(27.2%) of them had 251,000 – 500,000 as annual income while 81(22.5%) had 1,000000 and above annually from agricultural activities. The result indicates that the all of the displaced persons are majorly farmers and by implication food production is expected to reduce and therefore, they cannot be said to be food secured. Most of the farmers 223(61.6%) have been displaced for about 1-6 months, 66(18.2%) have been displaced for about 13-18 months,

45(12.5%) have been displaced for 19-24 months while about 21(5.9%) of the IDPs affirmed that they have been displaced for over 25 months.

Table 3b: Socioeconomic characteristics of Internally Displaced Farmers in Benue State

Variable	Frequency	Percentage
Years of farming experience		
1 – 5	22	6.1
6 – 10	72	20
11 – 15	98	27.2
16 – 20	112	31.1
21 and Above	56	15.6
Total	**360**	**100**
Farm size before displacement		
	0	0
Less than 1 hectares	131	36.4
1-2 hectares	99	27.5
3-4 hectares	59	16.4
5-6 hectares	23	6.4
7-8 hectares	22	6.2
9-10 hectares	26	7.4
11 hectares above		
Total	**360**	**100**
Estimate of annual income from farm prior to displacement		
Less than 100,000	17	4.7
100,000 – 250,000	53	14.7
251,000 - 500,000	98	27.2
501,000 - 750,000	111	30.8
1,000,000 and above	81	22.5
Total	**360**	**100**

Number of years displaced		
1-6 months	223	61.8
7 – 12 months	5	1.5
13 – 18 months	66	18.2
19 – 24 months	45	12.5
25months and above	21	5.9
Total	360	100

Source: Field Survey, 2021

Quantity of Food Lost As A Result of Internal Displacement of Farmers in Benue State from 2016 To 2020

From the result in table 4, cassava and yam were the major food crops produced by the respondents. Others include rice, cowpea, groundnuts and oranges among other.

Cassava

The result reviled that in 2016, 108(30%) of the respondents lost between 6001-8000kg (6-8 tons) of cassava while about 147(41%) of the IDPs lost estimated quantity of cassava from 2001kg to 6000kg (2-6 tons). However, 89(25%) of the IDPs lost bigger quantities which were estimated to be from 8001kg and above. In 2017, majority 188(52%) lost about 2001kg to 6000kg (2-6tons) of cassava in the farm. 99(28%) lost from 6001 to 8000kg of cassava while only 52(14%) lost 8001 and above. This implies that the losses of 2016 reduced the productive capacity of the IDPs in 2017, thus only a few were able to produce beyond 800kg. In 2018, 199(55%) lost from 2001kg to 6000kg. the result implies that as the year go, the production capacity of the farmers reduces. Only 44(13%) of the respondents were able to produce 8001kg and above. In 2019, 188(52%) lost from 100kg of cassava to 4000kg while 172(43%) lost from 4001kg to 8000kg. the result implied that farmer could not plant more. This could be for the fear of attack and destruction as the case may be While in 2020, about 186(52%) lost from 4001kg to 8000kg of cassava.

Yam

The result revealed that in 2016, 147(41%) of the respondents lost between 100kg-4000kg (1-4tons tons) of yam while about 202(56%) of the IDPs lost about 4001kg to 10000kg (4-10 tons). However, 11(3%) of the IDPs lost bigger quantities which were estimated to be from 10001kg and above. In 2017, majority 132(37%) lost

about 100kg to 4000kg of yam in the farm. 141(39%) lost from 4000 to 8000kg of yam while about 87(24%) lost 10000kg and above and above. In 2018, 73(20%) lost from 8000kg and above. 70(19%) lost about 8000kg in 2019 while 63(18%) lost about 8000kg in 2020

The results above indicated a level of decrease in quantity of crop production which is an evidence that violence and internal displacement have negatively influenced agricultural productivity and investment. This could be linked to disruption of the supply and distribution of inputs and outputs, price shocks and massive displacement of labor. These compounding challenges make agricultural investments difficult to maintain in politically volatile environments which according to the assertions of Yigza and Abitew (2019) is an indication that Internal displacement denies innocent persons access to food, shelter, and medicine and exposes them to all manner of violence. The result implies that in the course of displacement, brain and labour are drained out of the affected areas (rural-urban migration), with the resultant effect of scarcity of labour, skills and knowledge needed for rural agricultural production which has a direct consequence on food security status, economic status and even health status of the populace. The findings agrees with the assertions of Abbas, (1998) that productivity of smallholder farmers has been on the decline for some years now and at the same time the rate of rural-urban migration has been on the rise. Those moving from rural to urban areas constitute certain classes, categories and strata of the society that are basically plagued with certain social and economic problems in which poverty ranks highest and most fundamental.

Table 4: estimated quantity of food lost as a result of internal displacement of farmers in Benue State from 2016 to 2020

Quantity lost	2016	2017	2018	2019	2020
Cassava					
100kg-2000kg	16(4)	22(6)	52(14)	77(21)	75(21)
2001kg-4000kg	79(22)	78(22)	101(28)	111(31)	89(24)
4001kg-6000kg	68(19)	109(30)	98(27)	98(27)	69(19)
6001-8000kg	108(30)	99(28)	65(18)	74(21)	117(33)
8001-10000kg	56(16)	34(9)	21(6)	-	10(3)
10001 and above	33(9)	18(5)	23(7)	-	-
Yam					
Quty lost	2016	2017	2018	2019	2020
100kg-2000kg	64(18)	78(22)	93(26)	-	

2001kg-4000kg	83(23)	54(15)	31(9)	121(34)	123(34)
4001kg-6000kg	66(18)	43(12)	101(28)	98(27)	76(21)
6001-8000kg	48(13)	98(27)	62(17)	71(20)	98(27)
8001-10000kg	88(25)	67(18)	57(16)	70(19)	63(18)
10001 and above	11(3)	20(6)	16(4)	-	-

Conclusion

Conflicts have constituted severe threats to the means of survival and livelihoods of both the internally displaced farmers and the entire communities in Benue State. These conflicts have demonstrated high potential to exacerbate insecurity and food crisis particularly in rural communities where most of the conflicts are localized, with reverberating consequences nationwide. Conflict in Nigeria has persisted and stands out a threat to national food security, livestock production and eradication of poverty with farmers often regarded as the most vulnerable. It is a formidable challenge to economic development, threat to food security and sustainable livelihood of the agrarian communities. The outcome of conflicts always results in the insecurity, displacement, disability and death, poor food production, widespread hunger and malnutrition of people and communities. The study recommended a process of peace building which is multi-faceted, involving re-establishing security and law and order; reconstruction and economic rehabilitation; reconciliation and social rehabilitation; and political transition to creating more accountable governance structures and institutions

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Review on Wheat Straw as Agricultural Waste to Wealth: A Way of Sustainable Micro Entrepreneurship

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ABSTRACT

Wheat is one of the major cereal crops of India. The higher production of wheat also produces its residue also in higher amounts. Approximately 110, Mt. of wheat residue is produced every year, which is less than rice residue but higher than all other types of residue production. Crop residue is mainly burnt in the field, which released harmful smoke and creates many drastic situations. The wheat residue is mainly used as fodder for animals and the marketing value of this is not so high. During COVID- 19 pandemic, the wheat residue was also burnt because of the mechanical harvesting method. The present study reviewed the problems because of the burning residue and focused on the solutions in which wheat straw can be used as raw material and it can help produce different economical aspects by which farmers can take initiative not to burn fields and can support in making a healthy environment. Raw material and rural women may start their micro-entrepreneurship by using innovative techniques. Different types of handicraft items can be developed by using wheat straws. There are lots of opportunities for making sustainable eco-friendly products. The products made by using various types of weaving styles and which fulfill various purposes can open the opportunity for starting a micro-enterprise. Rural youth can also start their time in the growth of their family income by making eco-friendly papers with paddy and wheat residue. Today, eco-friendly paper making has wider scope in the international market. Various art forms of wheat residue are in use in modern times. So, it can be said that the eco-friendly market of wheat residue is one of the sustainable resources for a wealthy start-up from waste.

Keywords: Wheat Straw, Micro Entrepreneurship, Rural Development, Handicraft, Papermaking

Introduction

Agriculture is the major contributor to the total economy of India. Various varieties of crops are produced in different regions of the country. The majority

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is for food grain crops like rice, wheat and maize, which also produce a large portion of crop residue (Devi et al., 2017). The leftover parts from the plants after harvesting like leaves, stems, husks and roots are called crop residue. Govt. of India (2016) and The National Policy for Management of Crop Residue in 2019 revealed from the report of the Indian Ministry of New and Renewable Energy (MNRE) that approximately 500 Mt of crop residue is generated per year in India, in which approximately 110 Mt is of wheat residue Devi et al (2017). A large amount of wheat straw is mainly used for animal feed, fodder, soil mulching, bio-manure and fuel (Grover et al., 2015). but still, these are not proper sustainable management practices. Presently, about 92 Mt wheat crop residue is burned annually, which is the cause of environmental problems, health issues and contributes to global warming as well (Bhuvaneshwari et al., 2019). Burning of residue will release toxic gases like CO2, PM10, PM2.5, CO, NO2 and other global warming gases, which are responsible for respiratory and cardiovascular diseases (Bimbraw, 2019).

According to the various news reports like Hindustan Times, Indian Express, and Times of India, (2021) retrieved that the drastic situation of burning wheat residue becomes more critical during the period of COVID- 19. Because of the lockdown, farmers did not hire labour and burnt the fields; and the smoke generated was more dangerous for the patients, who were already suffering from COVID- 19. Micro-entrepreneurship is the key point to motivating farmers not to burn residue and properly manage this residue. Modern technologies in the field of development made it possible to use different crop residues for biogas generation and five million small biogas plants were constructed in rural areas by MNRE (Bhuvaneshwari et al., 2019). This paper helps to know many more sustainable strategies of wheat straw by which farmers can earn money and also different aged people can involve in different activities and can start their small enterprise. It will help in the development of the rural areas and also will contribute to reducing the wheat residue burning. The objective of this study is to find the solutions to use wheat residue in sustainable micro-enterprises.

Methodology

A combinatory review of the literature was carried out before December 2021. The relevant studies were found by using six different academic electronic databases such as Science Direct, PubMed, Springer, Scopus, Google Scholar, Sage Journals and some other websites for relevant recent data. National and international studies were included in this paper. The papers were used after being reviewed and screened completely.

Inclusion/ Exclusion Criteria:

Originally observed studies, valuable reviewed papers and news reports were included for the latest update. Publications are used only in the English language. Referred publications were taken, which were fulfilling the need of the present study. On other hand, non-referred publications were excluded and other articles presented in conferences as abstracts and papers, editorials, and unofficial reports were excluded.

Results and Discussion

The burning of wheat residue creates serious issues for the atmosphere and the living creatures. After reviewing the selected papers, the researcher found major results, which can help in the use of wheat residue towards a sustainable move and for the economic growth by utilising residue in a more efficient way.

The Burning Status of Wheat Residue During COVID- 19

Previous studies show that farmers have lack of awareness about the benefits of wheat residue, so they did not use residue properly for economic purposes and burnt residue in the field. During the period of COVID-19, this situation becomes more drastic. In a few newspaper articles, the status of wheat residue burning was given during the COVID pandemic situation. Majorly, the problem was in districts of Punjab like Malwa district, Sangrur, Patiala, Bathinda, Ferozpur, Barnala, Moga, and Mansa (Hindustan Times, Indian Express, Times of India, 2021).

Impact of Residue Burning on Human Life

Burning residue created a very crucial situation during the pandemic for the patients who were suffering from respiratory diseases because the smoke affects the throat and lungs (Indian Express, 2021). Wheat straws release particulate matter and Green House Gases after burning. Many other gases are also released by burning and it contributes to forming black clouds (Chandramauli, (2020)and Ravindra et al.,(2019). Pollution is responsible for respiratory problems, heart and lungs problems, eye irritation, skin irritation, blood problems, etc. (P. Kumar & Singh, 2021). Burning of residues also affects soil fertility, loss of nutrients, reduces worms and microbes, etc.

Wheat Straw for Handicraft Products

Wheat straws are lustrous, shiny, smooth, flexible and yellowish in colour (Liu et al., 2013; Rani & Brar, 2020), this can be moved in a cylindrical shape; and these straws have woven kinds of abilities, so that different products can be developed (Liu et.al, 2013). This idea can help in a start-up of a micro-enterprise for rural women as the local solution (S. Kumar et al., 2019). Innovative and

environmental-friendly products can be developed with wheat residuem which will have much economic value and is comfortable to use in each type of weather (Yan et al., 2020).

Wheat Straws for Making Paintings

The shiny and smooth texture of wheat straw is proved to be an advantageous, because the straws can be used in making paintings by cut and pasting method. Attractive paintings can be developed and also all the ages of people can involve in this craft activity (Liu, 2016). So, it can be proved as a beautiful and innovative micro-enterprise for all types of aged people (Liu et al., 2013).

Wheat Straws Convert into the Papermaking

It is possible to prepare wheat straw pulp after using various processes. The bleached wheat straw pulp can be characterized by good strength properties, reasonable brightness, good printability, etc (Fang & Shen, 2018). After proper pulping, cleaning and screening, pulps from it can be used for manufacturing various writing and printing papers, such as light-weighted printing paper, letterpress printing paper, typing paper, writing paper, tissue and sanitary papers, and almost all grades of paper and paperboard grades (Pandita et al., 2015). Wheat straw pulp furnishes must be mixed with some portion of bleached wood pulps or bamboo pulps occasionally (Fang & Shen, 2018). Rural youth can involve in this type of activity, so that income can be generated and residue can be used in an eco-friendly way (Devi et al., 2018; Verma, 2014).

Sell Wheat Residue

Wheat residue gives lots of benefits and opportunities to everyone for income generation. This residue gives a chance to start own micro-enterprise basis on the interest. So, farmers also have an opportunity to deal with these entrepreneurs directly to sell wheat residue in the form of raw material. They need some awareness, knowledge and patience to crack a good deal. Threshing the entire crop is not the right way in direction of selling crop residue. Chopped residue can not be used in all the activities, so farmers must know all the benefits which can be reaped by wheat residue.

Conclusion

All studies have shown that there is no need to burn residue, and it can be a potential source of a sustainable micro-enterprise. Awareness of farmers regarding the modern solutions, technologies, and production by residue can be an outstanding response. Burning of wheat straws is the easiest method to save labour costs and prepare the field for the next crop in a short period. This

burning practice by farmers creates many serious health issues and environment problems. The review of studies suggests some major environmental-friendly solutions, which can help in reducing the environmental issues that are created because of residue burning. The government of India and people in every sector like social, agricultural, environmental, etc. should work on this area. Straws can be used for different purposes by utilising various processes. Research has suggested that creatively all types of aged rural people can involve in these activities by which rural development can be possible. To provide knowledge and awareness about the benefits of residue, extension education should be involved for the farmers and other rural people, who can participate in these activities. Extension workers can easily teach in the rural areas by involving Gram Panchayat through various methodologies like speeches, group discussions, presentations, demonstrations, etc.

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Promoting Women Entrepreneurship in India: Challenges, Initiatives and Strategies

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ABSTRACT

Women entrepreneurship plays a key role in the economic growth of the country. Women in India need to be strengthened economically, socially and culturally to pave their way towards entrepreneurship. Providing opportunities and an enabling environment can enable women in emerging as entrepreneurs for their development. This paper reviews the challenges faced by women entrepreneurs and initiatives that have been taken up by public and private organisations for providing enabling environment to them. An attempt has been made to highlight specific strategies such as getting access to financial and digital literacy, integrated policy framework, enabling ecosystem and gender specific initiatives for encouragement of entrepreneurship. There is a dire need for promoting public private partnerships to benefit larger section of women for bringing change and development in the status of women entrepreneurship.

Keywords: Women Entrepreneurship, Agripreneurship, Agri Startups, Rural Women

Introduction: The role of women in Indian society has changed drastically in the past few decades and for the betterment. Now, women are occupying the corporate positions previously regarded as masculine and are outpacing their male counterparts in some areas. The gender stereotypes which were more prevalent in the society decades ago are breaking slowly. But there is still a long way to go. Women constitute around half the total (48%) Indian population but their participation in the economic activities is only 25%. According to Forbes India, women comprise about 30 percent of senior corporate management positions in India, which is notably higher than the global average (24%). But, when it comes to the gender gap in overall workforce, India is far behind several countries in the world — 113th out of 135 (Darshan, 2017).

The Government of India has defined Women Entrepreneurs as "an enterprise

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owned and controlled by women having a minimum financial interest of 51% of the capital and giving at least 51% of the employment generated in the enterprise to women" (Goyal and Prakash, 2011; Sharma, 2013).

Out of 633.88 lakh MSMEs, 608.41 lakh (95.98%) MSMEs were proprietary enterprises. The predominance of male owners has been overwhelming in the proprietary MSMEs. Thus, for proprietary MSMEs as a whole, male owned 79.63% of enterprises as compared to 20.37% owned by female. There was no significant deviation in this pattern in urban and rural areas, although the dominance of male owned enterprises was slightly more pronounced in urban areas as compared to rural areas (81.58% compared to 77.76%).

Table 1: Percentage Distribution of Enterprises in rural and urban areas.

Sector	Male	Female
Rural	77.76	22.24
Urban	81.58	18.42
All	79.63	20.37

(Source: MSME Annual Report 2018-2019)

Table 2: Percentage distribution of Enterprises by Male/Female Owners.

Category	Male	Female
Micro	79.56	20.44
Small	94.74	5.26
Medium	97.33	2.67
All	79.63	20.37

(Source: MSME Annual Report 2018-2019)

Further male dominance in ownership has been more pronounced for Small and Medium Enterprises with 95% or more enterprises being owned by them, as compared to Micro Enterprises where 80% were owned by males (MSME Annual Report 2018-2019).

According to Cabrera and Mauricio (2017), economic growth of the nation would be lop-sided without the involvement of women in entrepreneurial activities, as women constitute approximately half of the population and the domain of entrepreneurship is not confined to any particular gender. Women entrepreneurship directly affects income, employment and capital formation while indirectly benefitting household-level resource allocation. Supporting women entrepreneurs not only improves their livelihood but also creates jobs.

But the development of women entrepreneurship largely depends on internal as well as external factors such as personal attributes of the entrepreneurs, family affairs, government and other supportive organizational involvements (Parvin et al., 2012). In a developing country like India, there is need to establish an enabling environment for women entrepreneurs to prosper through overcoming their challenges. Also formulating strategies for promoting women entrepreneurship in both urban and rural communities should be given utmost importance.

Challenges faced by the Women Entrepreneurs in India

The hurdles faced by women who have embraced entrepreneurship are vast and often very different from those experienced by their male counterparts. The challenges which constrain women entrepreneurs are enlisted as follows:

The traditional structure of gender bias in the society, severely constrains women's productivity by the fragmentation of their time, their dual and triple responsibilities, and their lack of access to essential inputs including knowledge i.e. lack of education, and social barriers (Garg and Agarwal, 2017).

1. **Lack of access and awareness about the financial assistance:** The loans to medium and small women entrepreneurs only satisfy a fraction of their financial needs (Barhate and Patgaonkar, 2012; Mwobobia, 2012). This is consistent with the anecdotal evidence of the problems faced by women entrepreneurs in accessing finance. Lack of property as collateral limits the women entrepreneur's access to finance (Mwobobia, 2012). The bankers also don't have trust in providing the loans to women. This gender gap in access to finance has been examined by a large number of studies providing evidence that women face "higher hurdles" in financing their businesses (Brush et al., 2014). Many women in the rural areas are unaware of the government schemes and subsidies available.
2. **Socio cultural factors and status of women:** Barhate and Patgaonkar (2012) posit that the dual role of women, male domination, patriarchal society, lack of economic freedom and absence of family encouragement are major social impediments faced by women entrepreneurs. All these forms a barrier to and adversely affect entrepreneurial activities.
3. **Individual factors like low self-esteem or confidence:** Achievement motivation of the women folk found less compared to male members. The low level of education and confidence leads to low level achievement and advancement motivation among women folk to engage in business operations and running a business concern.

4. **Lack of Social mobility:** Social mobility levels in terms of going for customer meetings or travelling extensively to be in the marketplace is a challenge for women across rural and urban settings levels in terms of going for customer meetings or travelling extensively to be in the marketplace is a challenge for women across rural and urban settings
5. **Lack of managerial,** marketing, organizational and entrepreneurial skills limits the potential of the women entrepreneurs.
6. **Lack of entrepreneurial training:** Large number of women has no proper and sufficient technical and professional training to set-up a new venture. All women entrepreneurs are given the same training through EDPs. Second-generation women entrepreneurs don't need such training as they already have the previous exposure to business (Vijayakumar and Jayachitra, 2013).
7. **Lack of proper linkages and networking:** Women are less integrated with formal and informal networks which constrains their ability to access business opportunities, mentors and informal knowledge. Networking is key to better funding outcomes for female entrepreneurs (Bendall, 2018).
8. **Incomplete entrepreneurial life cycle:** Women face challenges in raising capital as investors have observed women not completing the entrepreneurial life cycle due to family constraints

Apart from the mentioned constraints, there are other problems such as improper infrastructural facilities, high cost of production, attitude of people of society towards the women modern business outlook etc. Women also tend to start business much later than men and being a mompreneur is also challenging to pave their way towards entrepreneurship.

Facilitators of Women Entrepreneurship:

- Better access to education /knowledge
- Better access to finance
- Better resources
- Increasing social acceptance
- Completing the cycle of building an enterprise
- Rise of role models (Deloitte, 2019)

To provide the opportunity for a large number of women to turnout into successful entrepreneurs through overcoming their both the public and private entities have launched a wide range of initiatives. These interventions seek to address gender-specific financing challenges, providing skills training, building

market linkages, financial and mentorship access.

Efforts by Public and Private Organizations towards Promoting the Women Entrepreneurship

Government of India along with the nationalized banks has initiated many schemes to empower women. The launch of various schemes and measures have definitely helped women greatly to spark their talent and build their identity. There are some MSME schemes offered by banks to women entrepreneurs like the Mahila Udyam Nidhi Scheme (offered by Small Industries Development Bank of India -SIDBI), Annapurna Scheme, Cent Kalyani Scheme, Stree Shakti Package for Women Entrepreneurs, Bhartiya Mahila Business Bank Loan, Dena Shakti Scheme, Udyogini Scheme, Orient Mahila Vikas Yojana Scheme:

Table. 3. Different Schemes and Initiatives for Promoting the Women Entrepreneurship

Sl. No.	Name of the Scheme	Description
	Government	
1	Mudra (Micro Units Development & Refinance Agency Limited) Yojana Scheme (www.mudra.org.in)	This scheme is applicable to women who want to start up with smaller units of enterprises (including start-ups) either individually or as a group. Loans from Rs 50,000 onwards and up to Rs 50 lakh are sanctioned under this scheme. Collateral and guarantors are required only if the loan amount exceeds Rs 10 lakh.
2	Rashtriya Mahila Kosh (RMK) under the Ministry of Women and Child Development https://rmk.nic.in/	Offers multiple loans under various schemes to encourage women to create wealth and assets. One of their schemes is specifically focused on providing loans to new and smaller organizations with an experience of at least six months in thrift and credit. The organization can avail a maximum loan up to Rs 10 lakhs under this scheme to start-up.

3	Trade Related Entrepreneurship Assistance and Development (TREAD) under the Ministry of Micro, Small, and Medium Enterprises http://www.dcmsme.gov.in/schemes/treadwomen.htm	A MSME scheme for empowering women entrepreneurs. It aims to empower women by providing credit to projects, conducting specific training and counselling, and eliciting information on related needs.
4	Capital Subsidy Scheme (CSS) under the Ministry of Micro, Small, and Medium Enterprises http://www.dcmsme.gov.in/schemes/credit_link_scheme.htm	A MSME scheme provides 15% subsidy prioritizing any investment by women led enterprise.
5	SFURTI (Scheme of Fund for Regeneration of Traditional Industries) under the Ministry of Micro, Small, and Medium Enterprises https://msme.gov.in/scheme-fund-regeneration-traditional-industries	It is encouraging rural women with traditional and KVIC (The Khadi and Village Industries Commission) industries in rural areas.
6	Udyam Sakhi Project ambitious towards entrepreneurship. http://www.udyamsakhi.org/	It gives the right information to go for self-employment on one single portal comfortably for women
7	WE Hub (platform for every women) wehub.telangana.gov.in	Telangana also promotes women owned enterprises and start-ups. It is the first state led incubator for women entrepreneurs. WE Hub is also taking efforts to attract women in rural areas. It has collaborated with German Development Agency to run a seven-month incubation and acceleration programme for women led and women owned enterprises in rural areas.
8	The Kutumbashree	Kerala state government encourages the women communities, gender programmes, sthreesakthi portal to promote women entrepreneurship.

	Private	
1	Women Entrepreneurship Platform (WEP)	Federation of Indian Chambers of Commerce and Industry (FICCI) and NITI Aayog formed the WEP for development of women entrepreneurs.
2	Indian Women Network (IWN)	The CII (Confederation of Indian Industry) has launched IWN, a network of women, for the women and by the women provides opportunities for women professionals/ students to grow personally and professionally through entrepreneurship opportunities.
3	Women Entrepreneurship and Empowerment (WEE)	A social national initiative by IIT Delhi to strengthen women eco system. It offers entrepreneurship training for every six months at free of cost across the country.
4	COWE India (Confederation of Women Entrepreneurs of India)	It is one of the leading Women Business Associations in Andhra and Telangana which works towards enhancing the spirit of Women Entrepreneurship and incubating the women led start-ups. It focuses on promoting entrepreneurial skills among rural women.
5	Atal Incubation Centre, ALEAP Women Entrepreneurs Hub (AIC ALEAP We-Hub)	It is an effort towards creating innovative start-up ecosystem to translate the dreams of young women into sustainable entrepreneurship. With the support of ATAL Innovation Mission (AIM) NITI Aayog, Government of India, WE hub have now scaled up existing facility to the state-of-the-art incubation centre with an objective to support a number of innovative start-ups by women (http://aicaleapwehub.in/).
6	International Centre for Entrepreneurship and Career Development (ICECD), Association of Women Entrepreneurs of Karnataka, (AWAKE), Manndesi Foundation	These NGOs are making efforts to support the empowerment of women by providing entrepreneurial skills, mentoring, encouraging women to pursue further education and build communities that value gender equality and inclusion.

Box-1: Farm Women Entrepreneurship Development through Finger Millet Processing and Value Addition: Initiative of KVK

A group of 20 farm women of Talagawara village, Chintamani taluk were extensively trained on processing, preparation of value-added products, packing, branding and various avenues for market linkages of finger millets by Krishi Vigyan Kendra (KVK), Chikkaballapura. After getting acquainted with these aspects, the women under the leadership of Mrs. Roopa Rajendra with technical guidance of KVK established a small-scale processing and value addition unit and registration was done for marketing of finger millet value added products. They are involved in preparation and marketing of value-added finger millet products viz., Malt, Laddu, Chakkuli and Hurihittu under a brand name of "CHIRAYUSH" food products and marketing in and around Chikkaballapura district and Bangalore. The monthly production of the products is 550 to 600 kg with a turnover of Rs. 60,000- 70,000/-. The efforts made by the KVK to establish village level enterprise on processing and value addition of finger millet with the objective to provide additional employment and income generation for the farming family sets as an example for a new way of self-reliance practice. This initiative by the KVK also played a strategic role in increasing the self confidence among the farm women (Yankanchi and Majula, 2016).

Box-2: National Entrepreneurship Awards for encouraging Women Entrepreneurs

The Ministry of Skill Development and Entrepreneurship (MSDE) has instituted the National Entrepreneurship Awards (NEA) to the outstanding efforts of young Entrepreneurs. The NEA has dedicated the special category awards for women. A few women entrepreneurs have also won the awards for their efforts in the field of agriculture.

- Petarbar grahmin poultry cooperative society won NEA award in 2018: A Jharkhand based poultry cooperative society by tribal women. Initially start as a small business it was later expanded to other villages on larger scale sale of boiler chickens.
- Green Biotech Eco solutions: It is a research-based farming input biotech manufactures and marketing enterprise based in Manipur, India founded and managed by women. Provides innovative solutions to farmer's problems through their products and improves the quali**ty of farming. They are also into manufacturing of healthy foods and won NEA award in 2019.**

- Early foods (Freshness first): Early Foods by Shalini Santhosh is on a mission to provide "organic, fresh and chemical and preservative free food to children" won NEA award in 2019. Their product portfolio includes porridge mixes, health drinks, cookies and rusks for young children using nutritious cereals and millets as key ingredients with 2000 orders in a month and turnover of about 3 crores (https://yourstory.com/2018/03/shalini-santhosh-healthy-babies-food).

Women's increasing role in family farming could be an opportunity for enhancing their economic and social empowerment as producers, traders, workers and entrepreneurs. If women have the same access as men to extension services, technologies and loans, they can contribute to improving the agricultural productivity of family farms, engage in processing and marketing activities, and increase their voice in household decisions (World Bank, Food and Agricultural Organization, and International Fund for Agricultural Development, 2009).

MANAGE Role in Promoting Women Entrepreneurship in Agriculture and Rural Areas:

MANAGE is focused towards promoting entrepreneurship in farming sector through its initiatives across the country.

1. Agri-Clinics and Agribusiness Centres (AC&ABC) scheme: The Ministry of Agriculture and Farmers Welfare, Government of India, MANAGE as an implementing agency and in association with NABARD has launched this AC&ABC scheme to promote private extension and to promote entrepreneurship development in the field of agriculture across the country by professionally mentoring the agricultural and science graduates. A 45 days residential training is provided to the graduates and diploma holders in agriculture and allied subjects to start up their own Agri-ventures after the successful completion of the training. Many women agricultural graduates and diploma holders are encouraged through this scheme (44% subsidy for maximum of Rs. 20-25 lakh bank loan for AC&ABC trained women) to turnout into successful agripreneurs (www.agriclinics.net).

The progress made through this scheme in promoting women agripreneurship from its inception (2002) to till now (April, 2023):

- The total women trained under this scheme is only around 7,401 (8.72%) of the total candidates (84,783) trained.
- The total women who established ventures after successful completion of the training are only around 2,540 (6.77%) of the total ventures (37,491) established. Maharashtra, Tamil Nadu, Telangana, Andhra Pradesh and

Bihar are the top five states having higher trained women and ventures established.

With the assistance of this scheme, 6.77% women out of the total trained 8.72% were able to establish their own venture which highlights its significance towards promoting women in Agriculture and allied sector entrepreneurship also.

2. Promotion of Agri Startups through RKVY- RAFTAAR: Under the RKVY-RAFTAAR program, MANAGE-Centre for Innovation and Agripreneurship (CIA) has Incubated and mentored more than 331 startups across India overall from the 8 cohorts since 2017-2018 and out of 331 Agri-startups, 77 Startups led by women (23%) and 12 (11%) women's received grant in aid under RKVY-RAFTAAR program of Ministry of Agriculture and Farmers Welfare. GoI.

MANAGE also conducts several training programs and Saturday webinars for the awareness, capacity building and entrepreneurship development such as Pre-Incubation, Digital marketing, and Agri-Eureka-Innovation challenge program. In all these programs put together around 5692 women participated during last three academic years 2020-23 (https://www.manage.gov.in/managecia/).

3. Promoting the Rural Women Entrepreneurship through partnering with UNDP and NGOs like Access Livelihoods India for initiating a six-month micro MBA training programme for transforming the rural communities and working at promoting entrepreneurship at grassroots level. One hundred rural women have successfully completed the training and are certified by MANAGE. These 100 rural women are intended to train 150 women each, thus reaching a total target of 15,000 rural women.

MANAGE is also offering partnerships with other like-minded organizations for enhanced efforts towards achieving the goal of promoting women entrepreneurship.

All National, State and non-governmental organizations objectives are same for promoting entrepreneurial development in every level of their activities and make them economically independent and creating many employment opportunities through them and make them successful contributors for the economic development of the country (Uma and Ramesh, 2018).

Box-3: Gender Inclusion in Agri-Entrepreneurship -Recommendations by Syngenta Foundation India

Syngenta foundation India has launched Agri Entrepreneurs (AE) Programme in 2014 and has trained 278 women across 6 project locations i.e Bihar, Jharkhand, Maharashtra, Odisha and Andhra Pradesh.

Based upon the study conducted by the foundation few immediate steps are put forth for the successful Agripreneurship among the women:

- Women centric financial products to promote initial investments
- Business training for decision makers (spouses)
- Training centres to have child care support facilities
- Exclusive women AE forums to be created
- Training on confidence and business simulations
- Women mentors and trainees should be hired to lead the change
- Focused campaigning
- Promote women to take technology adoption decision (Chowdhary, 2019)

Suggestions for Promoting Women Entrepreneurship:

Unlocking entrepreneurship amongst women in India is a complex effort, but it provides an unprecedented opportunity to change the economic and social trajectory of India and its women for generations to come. A few specific suggestions for promoting women entrepreneurs is as follows:

- There is a need for an integrated policy framework for accelerating entrepreneurship among women including the semi urban and rural India.
- Launching a dedicated national and state level mission for women entrepreneurship to lead and /or catalyse transformational interventions across India.
- The banking ecosystem needs to create transparent and simple access to banking instruments and policy intervention to define accountability and tracking.
- The government, NGOs and various supporting organizations should emphasize on development programs that focus on the development of competencies of women entrepreneurs.
- Need for the dedicated funds to companies owned or led by women agripreneurs.
- Women focused pitch days for Agri-startups and celebration of women role models.
- Setting up sector specific incubators and accelerators to drive targeted networking and mentorship for women.
- Planning for sector specific online classes and training platforms for women.

Training and certificate courses to drive participation in women friendly and growing sectors.

- Digital enablement and access to women networks for ideas, insights and connects.
- Enabling the public-private partnerships to provide access to technical and business counselling and mentoring to reach the women in rural areas.
- Encouragement of entrepreneurship in gender balanced ways through showcasing role models, women entrepreneurship champians, case studies, guest lectures etc.

Conclusion

For the development of women entrepreneurs, the attitudes of women should be channelized towards innovative, scientific and economic thinking. Their dormant entrepreneurial qualities and their deficiencies are to be brought to the limelight through capacity building and handholding support.

In a diversified society like India, social factors are much dominant in determining even the economic well-being of the people. So any full-fledged women empowerment programmes must be multi-dimensional in nature which should encompass social as well as economic criteria.

With the growth of entrepreneurial awareness in the country, the women entrepreneurs have emerged into existence in rural and urban areas. But, unfortunately, the public-private entrepreneurship development activities have benefited only a small group of women. The majority of women have not benefited from the entrepreneurship development initiatives. Hence, the governments and developmental institutions have to analyse the current status and potential role of women in the process of entrepreneurship development with a view to bring positive change which would result in sharing responsibilities and benefits by all the stakeholders in the entrepreneurship ecosystem.

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